East Fork Kaskaskia River and Farina Lake Watershed Total Maximum Daily Load

Stage 3 Report for Public Review

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Acronyms and Abbreviations

AWQMN	Ambient Water Quality Monitoring Network
BMP	best management practice
CAFO	concentrated animal feeding operation
CSA	critical source area
CWA	Clean Water Act
IAH	Illinois Agronomy Handbook
ICBMP	Illinois Council on Best Management Practices
IDOA	Illinois Department of Agriculture
IEPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
LA	load allocation
LDC	load duration curve
MOS	margin of safety
NLRS	Nutrient Loss Reduction Strategy
NPDES	National Pollutant Discharge Elimination System
RC	reserve capacity
STP	sewage treatment plant
TMDL	total maximum daily load
USDA	United States Department of Agriculture
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WLA	wasteload allocation

Units of Measure

lbs.	pounds
µg/L	micrograms per liter

Executive Summary

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 in waters that are not currently meeting them.

This TMDL study addresses approximately 207 square miles in the East Fork Kaskaskia River and Farina Lake watershed located in central Illinois. One stream segment within the project is receiving TMDLs. A segment of North Fork Kaskaskia River received TMDLs for atrazine and terbufos. The sources of pollutants in the watershed include National Pollutant Discharge Elimination System 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 water quality standards 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 (WLA) to point sources. The required pollutant reductions vary between 54 and 93 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 in waters that are not currently meeting them. This TMDL study addresses the approximately 207 square mile East Fork Kaskaskia River and Farina Lake watershed located in central Illinois (Figure 1).

Several waters in the East Fork Kaskaskia River and Farina Lake watershed have been placed on the State of Illinois 303(d) list and require the development of a TMDL. This project addresses one impaired segment along the North Fork Kaskaskia River. Concurrent with this TMDL study in the East Fork Kaskaskia and Farina Lake watershed, TMDL studies are being conducted in the Middle and Lower Kaskaskia watersheds, Upper Kaskaskia and Lake Fork watershed, and Crooked Creek/Lost Creek watershed.

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 water quality standards. 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 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 an initial 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 atrazine and terbufos 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. 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 water quality standards. It should be noted that the controls for nonpoint sources (e.g., agriculture) will be strictly voluntary.

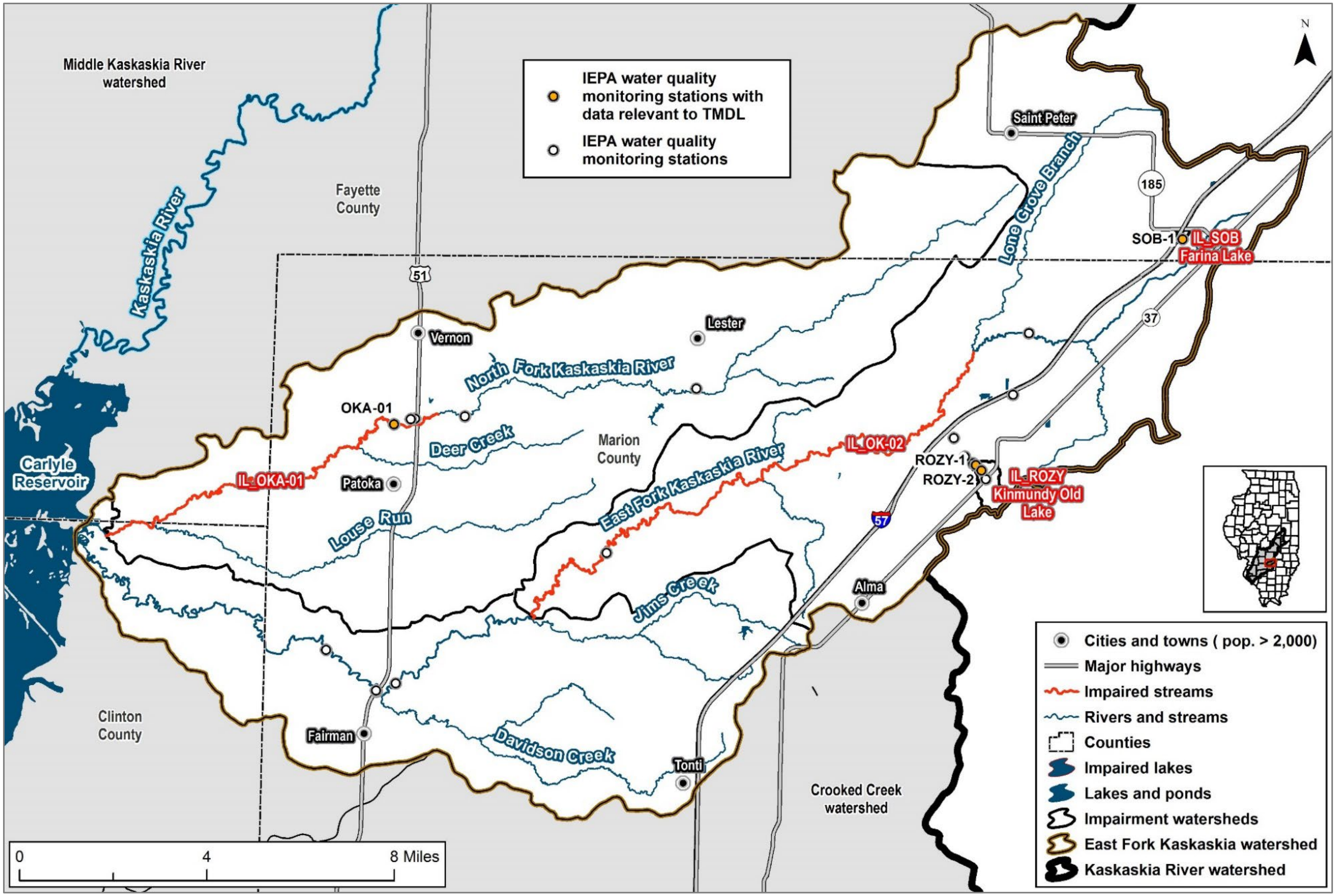

Figure 1. East Fork Kaskaskia River and Farina Lake watershed TMDL project area.

Note: IL_OK-02, IL_ROZY, and IL_SOB are not addressed in this TMDL document. See Appendix C for more information.

1.2 Water Quality Impairments

Two TMDLs were developed to address one segment of the North Fork Kaskaskia River (Table 1 and Figure 1). One impairment is recommended for delisting; see Appendix C for the justification. Other impaired waters in the East Fork Kaskaskia River and Farina Lake watershed are not addressed in this TMDL report.

Table 1. Impairments in the East Fork Kaskaskia River and Farina Lake watershed addressed in this TMDL report

Name	Segment ID	Impaired Designated Uses	Cause(s)	Action
East Fork Kaskaskia River	IL_OK-02	Aquatic Life	Dissolved oxygen	Recommend delisting
North Fork Kaskaskia River	IL_OKA-01	Aquatic Life	**Atrazine**	**TMDL (atrazine)**
			Terbufos	**TMDL (terbufos)**

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

1.3 Prior TMDL Development in the Watershed

Three TMDL reports were previously developed for subwatersheds within the East Fork Kaskaskia and Farina Lake watershed:

- *East Fork Kaskaskia River TMDL Report* (MWH 2003)
  https://www2.illinois.gov/epa/Documents/epa.state.il.us/water/tmdl/report/kaskaskia/kaskaskia.pdf
  A single concentration based TMDL was developed for total suspended solids for the East Fork Kaskaskia River. EPA approved this TMDL in 2003.

- *North Fork Kaskaskia River Watershed Final Approved TMDL* (Limno-Tech 2006)
  https://www2.illinois.gov/epa/Documents/epa.state.il.us/water/tmdl/report/kaskaskia/north-fork/north-fork-kaskaskia.pdf
  Load duration curve TMDLs were developed for fecal coliform, iron, and manganese. These TMDLs were approved in 2006. pH TMDLs were calculated empirically using the water quality standard; the two pH TMDLs were also approved in 2006. Two biochemical oxygen demand TMDLs were also developed using QUAL2E modeling, but the two TMDLs were not approved by EPA since lack of flow (a non-pollutant) was the cause of dissolved oxygen impairment.

- *East Fork Kaskaskia Watershed TMDL Report* (Baetis Environmental Services, Inc. 2007)
  https://www2.illinois.gov/epa/Documents/epa.state.il.us/water/tmdl/report/kaskaskia/east-fork/east-fork-kaskaskia.pdf
  A single load duration curve TMDL was developed for fecal coliform for the East Fork Kaskaskia River. Four TMDLs were developed for manganese for four lakes. EPA approved these five TMDLs in 2006. Two biochemical oxygen demand TMDLs were also developed using QUAL2E modeling, but the two TMDLs were not approved by EPA since lack of flow (a non-pollutant) was the cause of dissolved oxygen impairment.

- *East Fork Kaskaskia River / Farina Lake Watershed Simazine Total Maximum Daily Load (TMDL)* (IEPA 2015)
  https://www2.illinois.gov/epa/Documents/iepa/water-quality/watershed-management/tmdls/reports/kaskaskia/kaskaskia-approved-tmdl.pdf
  A single TMDL was developed for simazine for Farina Lake using a simple, volume-based calculation. This TMDL also addressed a simazine-impaired segment of the East Fork Kaskaskia

River; water is pumped from the East Fork Kaskaskia River into Farina Lake. EPA approved the TMDL in 2016.

A summary of TMDLs is presented in Table 2.

Table 2. 2003, 2006, and 2007 TMDL studies impaired waters

Name	Segment ID	Size [a]	Designated Uses	TMDL Parameters	TMDL Approval
East Fork Kaskaskia River	IL_OK-01	20.06 miles	Aquatic Life	BOD	-- [b]
				TSS	2003
			Primary Contact Recreation	Fecal coliform	2006
	IL_OK-02	18.72 miles	Aquatic Life	BOD [c]	-- [b]
	IL_OK-03	8.76 miles	Aquatic Life	Simazine [d]	2016
Farina Lake	SOB	4 acres	Aquatic Life	Simazine	2016
			PFPWS	Manganese	2006
Kinmundy Borrow Pit	SOG	5 acres	PFPWS	Manganese	2006
New Kinmundy Lake	SOF	107 acres	PFPWS	Manganese	2006
North Fork Kaskaskia River	IL_OKA-01	11.83 miles	Aquatic Life	BOD [c]	-- [b]
				Iron	2006
				Manganese	2006
				pH	2006
			Primary Contact Recreation	Fecal coliform	2006
	IL_OKA-02	18.56 miles	Aquatic Life	BOD [c]	-- [b]
				Iron	2006
				Manganese	2006
				pH	2006
Old Kinmundy Lake	ROZY	20 acres	PFPWS	Manganese	2006

BOD – biochemical oxygen demand
n/a – not available
PFPWS – public and food preparation water supply
TMDL – total maximum daily load
TSS – total suspended solids
[a] These sizes are from Illinois's 2020/2022 Integrated Report and differ slightly from the sizes reported in the TMDL studies.
[b] U.S. EPA did not approve the BOD TMDLs that would have addressed dissolved oxygen impairments because the cause of impairments was lack of flow, which is a non-pollutant.
[c] Wasteload allocations were developed for ammonia (as nitrogen) and carbonaceous biochemical oxygen demand.
[d] The simazine-impaired segment IL_OK-03 of the East Fork Kaskaskia River is addressed through the Farina Lake (SOB) simazine TMDL.

2. Water Quality Standards and TMDL Endpoints

This section presents information on the water quality standards that are used for TMDL endpoints. Water quality standards are designed to protect beneficial uses. The authority to designate beneficial uses and adopt water quality standards 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 water quality standards are designated under Section 302. Designated uses and water quality standards 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 East Fork Kaskaskia River and Farina Lake 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.

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 302 contains water quality standards promulgated by the IPCB. This section presents the standards applicable to impairments in the study area. Water quality standards are the endpoints to be used for TMDL development in the East Fork Kaskaskia River and Farina Lake project area (Table 3).

Table 3. Summary of water quality standards for the East Fork Kaskaskia River and Farina Lake watershed

Parameter	Units	General Use Water Quality Standard
Atrazine	µg/L	If fewer than 10 samples, not to exceed the chronic 9 µg/L nor acute 82 µg/L standard. If greater than 10 samples, not to exceed the chronic standard and fewer than two observations exceed the acute standard.
Terbufos	µg/L	If fewer than 10 samples, not to exceed the chronic 0.002 µg/L nor acute 0.024 µg/L standards. If greater than 10 samples, not to exceed the chronic standard and fewer than two observations exceed the acute standard.

Note: µg/L = microgram per liter

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 (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 https://www.epa.gov/wqc). 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 standards (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 Illinois Administrative Code 303, Subpart C) or adjusted standards (published in the IPCB's Environmental Register at https://pcb.illinois.gov/Resources/EnvironmentalRegister).

2.3 TMDL Endpoints

One atrazine and one terbufos TMDL were developed for the impaired segment of North Fork Kaskaskia River (IL_OKA-01). The TMDLs were set to the general use standards. The atrazine targets were 9 µg/L for the chronic standard and 82 µg/L for the acute standard. The terbufos target was 0.024 µg/L for the acute standard. As is discussed in Section 6, the terbufos chronic standard is for advisory purposes only.

3. Watershed Characterization

The East Fork Kaskaskia River and Farina Lake watershed is in central Illinois (Figure 1). The headwaters begin in Fayette and Marion counties. East Fork Kaskaskia flows west until its confluence with the Kaskaskia River at Carlyle Lake. The Kaskaskia River eventually joins the Mississippi River south of St. Louis, Missouri. Much of the information presented in previous TMDL reports (Limno-Tech 2006, Baetis Environmental Services, Inc. 2007) is applicable to the East Fork Kaskaskia River and Farina Lake project area. There have been no known changes in the project area; therefore, the two previous TMDLs provide much of the basis for the watershed characterization and source assessment for the East Fork Kaskaskia River and Farina Lake watershed TMDL.

Both approved TMDL reports are published online:

- *North Fork Kaskaskia River Watershed Final Approved TMDL* (Limno-Tech 2006) at https://www2.illinois.gov/epa/Documents/epa.state.il.us/water/tmdl/report/kaskaskia/north-fork/north-fork-kaskaskia.pdf
- *East Fork Kaskaskia Watershed TMDL Report* (Baetis Environmental Services, Inc. 2007) at https://www2.illinois.gov/epa/Documents/epa.state.il.us/water/tmdl/report/kaskaskia/east-fork/east-fork-kaskaskia.pdf

3.1 Jurisdictions and Population

Relevant information on jurisdictions and population can be found in the *North Fork Kaskaskia River Watershed Final Approved TMDL* (Limno-Tech 2006) and the *East Fork Kaskaskia Watershed TMDL Report* (Baetis Environmental Services, Inc. 2007). The project area is primarily located in Marion County with portions of Fayette, Clinton, and Bond counties.

3.2 Climate

Relevant information on climate can be found in the *North Fork Kaskaskia River Watershed Final Approved TMDL* (Limno-Tech 2006, p. 13) and the *East Fork Kaskaskia Watershed TMDL Report* (Baetis Environmental Services, Inc. 2007, p. 11). IEPA considers the climate summary from the 2006 and 2007 TMDL reports to be representative of current climactic conditions. In general, the climate of the region is continental with hot, humid summers and cold winters.

3.3 Land Use and Land Cover

Relevant information on land use and land cover can be found in the *North Fork Kaskaskia River Watershed Final Approved TMDL* (Limno-Tech 2006, p. 13-17), the *East Fork Kaskaskia Watershed TMDL Report* (Baetis Environmental Services, Inc. 2007, p. 6-8), and Section 2.2 in the *East Fork Kaskaskia River/ Farina Lake Watershed Simazine Total Maximum Daily Load (TMDL)* (IEPA 2015). Most of the land cover in the watershed is agricultural. Primary crops are soy, corn, and wheat.

3.4 Topography

Relevant information on topography can be found in the *North Fork Kaskaskia River Watershed Final Approved TMDL* (Limno-Tech 2006, p. 10-11) and the *East Fork Kaskaskia Watershed TMDL Report* (Baetis Environmental Services, Inc. 2007, p. 8-11).

3.5 Soils

Relevant information on soils can be found in the *North Fork Kaskaskia River Watershed Final Approved TMDL* (Limno-Tech 2006, p. 10-11) and the *East Fork Kaskaskia Watershed TMDL Report* (Baetis Environmental Services, Inc. 2007, p. 8-11). Bluford-Ava-Hickory and Cisne-Hoyleton-Darmstadt are the predominant soil associations in the watershed, both derived from glacial till.

3.6 Hydrology

Relevant information on hydrologic conditions can be found in the *North Fork Kaskaskia River Watershed Final Approved TMDL* (Limno-Tech 2006, p. 17) and the *East Fork Kaskaskia Watershed TMDL Report* (Baetis Environmental Services, Inc. 2007, p. 11-12). IEPA considers the hydrology summary from the 2006 and 2007 TMDL reports to be representative of current hydrologic conditions. Note that IEPA uses recent flow data to develop the load duration curves discussed in Section 6.1.

There is one U.S. Geological Survey (USGS) flow gage on the East Fork Kaskaskia near Sandoval, IL (05592900).

3.7 Watershed Studies and Information

Relevant information for this section can be found in the following reports and studies:

- **Kaskaskia River Watershed, An Ecosystem Approach to Issues and Opportunities** (Southwestern Illinois RC&D, Inc. 2002)

  The plan encompasses the larger Kaskaskia River watershed from Champaign County to Randolph County in southwestern Illinois, covering over 10 percent of the state of Illinois. The purpose of the plan was to begin a coordinated restoration process in the Kaskaskia River watershed based on sound ecosystem principles. The plan made recommendations on sustainability, diversity, health, variety, connectivity, and the ecosystem's ability to thrive and reproduce in order to promote the sustainability of the ecosystem and strengthen the economic base and the quality of life of residents in the region.

- **East Fork Kaskaskia River/Farina Lake Watershed Simazine TMDL** (IEPA 2015)

  This previous TMDL provides information on Farina Lake and its simazine impairment.

- **North Fork Kaskaskia River Watershed Final Approved TMDL** (Limno-Tech 2006)

  This previous TMDL provides watershed characterization for the northern half of the East Fork Kaskaskia River and Farina Lake watershed TMDL project area. TMDLs were developed for manganese, pH, iron, and fecal coliform.

- **East Fork Kaskaskia Watershed TMDL Report** (Baetis Environmental Services, Inc. 2007)

  This previous TMDL provides information for the watershed characterization for the southern half of the East Fork Kaskaskia River and Farina Lake watershed TMDL project area. TMDLs were developed for manganese, pH, iron, and fecal coliform.

4. Watershed Source Assessment

Source assessments are an important component of water quality management plans and TMDL development. 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.

As part of the water resource assessment process, IEPA identified several sources as contributing to the East Fork Kaskaskia River and Farina Lake watershed impairments (Table 4). Descriptions of these and other sources are provided in the following sections.

Table 4. Potential sources in project area based on the Draft 2016 305(b) list

Watershed	Segment	Pollutant	Sources
North Fork Kaskaskia River	IL_OKA-01	Atrazine, Terbufos	Agriculture, unknown, crop production (crop land or dry land)

4.1 Pollutants of Concern

Pollutants of concern evaluated in this source assessment include phosphorus, atrazine, terbufos, and parameters influencing pH. These pollutants can originate from an array of sources including point and nonpoint sources.

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 sewage treatment plants (STPs), industrial facilities, CAFOs, or regulated storm water including municipal separate storm sewer systems.

There are no permitted CAFOs or municipal separate storm sewer systems in the watershed.

There are two individual NPDES permitted facilities in the East Fork Kaskaskia River and Farina Lake project area (Table 5). Five additional facilities are covered by one of two general NPDES permits: ILG670 (hydrostatic testing of pipelines and tanks) or ILG580 (publicly owned domestic lagoon system). None of the facilities dicharge directly to an impaired segment. Design average and maximum flows and downstream impairments are included in the facility summaries.

Table 5. NPDES permitted facilities in the impairment watersheds

IL Permit ID	Facility Name	Type of Discharge	Receiving Water	Downstream Impairment(s)	Design Average Flow (MGD)	Design Maximum Flow (MGD)
Individual NPDES Permits						
IL0075001	Kinmundy Energy Center	Misc. equipment and floor drain wastewater	Unnamed tributary to Louse Run	IL_OKA-01	0.026	--
IL0076422	Alma STP	STP	Unnamed tributary to East Fork Kaskaskia River	--	0.05	0.199
Domestic Lagoon Systems covered by a General NPDES Permit (ILG580)						
ILG580007	St. Peter STP	STP	Unnamed tributary to Lone Grove Branch	--	0.042	0.17
ILG580022	Patoka STP	STP	Unnamed tributary to North Kaskaskia River	IL_OKA-01	0.072	0149
ILG580047	Farina STP	STP	East Fork Kaskaskia River	--	0.105	0.62
ILG580123	Kinmundy STP	STP	Unnamed tributary to Schneider Springs Branch	--	0.146	0.442
Industrial Stormwater covered by a General NPDES Permit (ILG670)						
ILG670059 [a]	Marathon Pipeline Company	Hydrostatic test water	Unnamed tributary to North Fork Kaskaskia River	IL_OKA-01	1.44	--

Note: STP – Sewage treatment plant, MGD – Million gallons per day

NPDES permits for some STPs refer to the facilities as wastewater treatment plants. The terms “sewage treatment plant” and “wastewater treatment plant” are interchangeable.

a. Marathon Pipeline Company was formerly covered by individual NPDES permit IL0060585.

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 municipal separate storm sewer systems is considered a controllable point source.

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, specifically contributing to high biochemical oxygen demand and nutrients that can affect the dissolved oxygen conditions in streams.

In addition to pollutants, alterations to a watershed's hydrology as a result of land use changes 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.

Atrazine is an herbicide that is commonly used in the United States to control broadleaf weeds. In the Mississippi North Central River watershed, atrazine is applied on most corn fields. In Illinois, the use of atrazine is common, having been applied on 73 percent of corn crops in 2021 for a total of 9,249,000 pounds (U.S. Department of Agriculture [USDA] 2022). Atrazine is typically applied in the spring or summer and can be applied pre- or post-emergent. Transport mechanisms include overland runoff, discharge from drainage tiles, and contaminated dust that is delivered to the waterway through wet and dry atmospheric deposition. Atrazine is also transported easily in water, in the dissolved phase.

Terbufos is an orthophosphate pesticide that is applied to the surface of agricultural soil to combat pests. Application requires soil integration and occurs during planting, post plant emergent (applied in bands along row), and at crop cultivation. The typical application rate of terbufos to corn is 1.0 lb. active ingredient per acre and the maximum is 1.3 lbs. active ingredient per acre per year. U.S. EPA use data indicates that from 1987 to 1996 the average nationwide domestic use of terbufos was 7.5 million pounds per year. Terbufos and its two major degradation products, terbufos sulfoxide and terbufos sulfone, have the potential to run off agricultural fields and into surface waters (U.S. EPA 2006).

Most of the land cover in the East Fork Kaskaskia River and Farina Lake watershed is cropland. Atrazine and terbufos application on these cultivated areas contributes loading by runoff and through infiltration into shallow groundwater or drain tiles. Therefore, the location and quantity of atrazine and terbufos applied to the landscape can greatly affect the resulting concentrations in nearby waterbodies. It is also possible that the two pollutants can be released from manufacturing, formulation, transport, and disposal.

5. Water Quality

Background information on water quality monitoring can be found in the *North Fork Kaskaskia River Watershed Final Approved TMDL* (Limno-Tech 2006) and the *East Fork Kaskaskia Watershed TMDL Report* (Baetis Environmental Services, Inc. 2007). In the East Fork Kaskaskia River and Farina Lake watershed, water quality data were found for numerous stations that are part of the IEPA AWQMN. Monitoring stations with data relevant to the impaired segments are presented in Figure 1 and Table 6. Parameters sampled in the streams include field measurements (e.g., water temperature) as well as those that require lab analyses (e.g., nutrients).

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 not included. Each data point was reviewed to ensure the use of quality data in the analysis below. Data were obtained directly from IEPA.

Table 6. East Fork Kaskaskia River and Farina Lake watershed water quality data

Waterbody	Impaired Segment	AWQMN Sites	Location	Period of Record
North Fork Kaskaskia River	IL_OKA-01	OKA-01	County Rd 250E Br 1.5 mile north of Patoka	*1999*–2007, 2012

Note: *Italics* – Data are more than 10 years old

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 IEPA.

North Fork Kaskaskia River (IL_OKA-01) is listed as impaired for aquatic life due to atrazine and terbufos. There is one IEPA sampling site located on segment IL_OKA-01 (sampling site OKA-01).

As discussed in the Stage 1 Report (Appendix A), seven samples were evaluated for atrazine and terbufos (Table 7). One of the seven samples exceeded the chronic standard for atrazine, and none exceeded the acute standard. As for terbufos, all seven samples exceeded the acute standard. Refer to the Stage 1 Report (Appendix A) for charts of these 14 pesticide results.

Table 7. Data summary, North Fork Kaskaskia River (IL_OKA-01)

Pollutant	No. of Samples	Minimum (µg/L)	Average (µg/L)	Maximum (µg/L)	CV	Number of Exceedances of General Use Water Quality Standard
Atrazine	7	0.02	5.31	32.00	11.81	1
Terbufos	7	0.01	0.09	0.23	0.44	7

Note: CV = coefficient of variation (standard deviation / average)

6. TMDL Derivation

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 WLAs for regulated sources and load allocations (LAs) for unregulated sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody and may contain a reserve capacity (RC) if needed. Conceptually, this is defined by the equation:

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

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

TMDL targets are discussed in the Stage 1 report and briefly summarized herein:

- The atrazine TMDL on the North Fork Kaskaskia River (IL_OKA-01) is based on compliance with both the chronic standard (9 µg/L) and the acute standard (82 µg/L).
- The terbufos TMDL on the North Fork Kaskaskia River (IL_OKA-01) is based on compliance with the acute standard (0.024 µg/L). The Stage 1 report also identified a derived chronic standard of 0.002 µg/L. The derived chronic standard is not used for TMDL development because the value was "not calculated according to the regulations due to limited data" and such "values should only be used for advisory purposes" (IEPA 2013).

6.1 Loading Capacity

A duration curve approach is used to evaluate the relationships between hydrology and water quality and calculate the TMDLs for atrazine and terbufos stream 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.

Allowable pollutant loads have been determined using load duration curves (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 water quality standard/target for a contaminant (microgram per liter [µg/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 an 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 water quality standard/target, or LDC.
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 LDC approach allows IEPA to determine which implementation practices are most effective for reducing loads based on 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 8 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 8. 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 based on 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.

Stream flow for the North Fork Kaskaskia River impairments was estimated from USGS gauge 05592900 (East Fork Kaskaskia River near Sandoval, IL) along the East Fork Kaskaskia River. Stream flow data for the USGS gauge were downloaded from the National Water Information System (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. The gauge location on the East Fork Kaskaskia River was reviewed and determined to be representative of conditions along the North Fork Kaskaskia River based on similar land use and watershed size.

Reductions for the atrazine and terbufos TMDLs are based on the maximum observed load and the median allowable loading in each flow regime.

6.2 Load Allocations

LA represent the portion of the allowable daily load that is reserved for nonpoint sources and natural background conditions. The LAs are based on subtracting the WLAs and MOS from allowable loads. The LAs are summarized for each of the waterbody pollutant combinations along with the baseline loads.

6.3 Wasteload Allocations

NPDES-permitted STPs, industrial facilities, and regulated stormwater within the watershed are not considered sources of atrazine or terbufos and therefore WLAs are not provided for the discharges. The source of atrazine and terbufos is agricultural operations where the pesticides are applied to crop fields (i.e., plant leaves, soil).

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 to both TMDLs. A moderate MOS was specified for streams 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.

6.5 Reserve Capacity

RC is provided to those watersheds that are expected to further develop. A 10% RC is set aside to accommodate future growth.

6.6 Critical Conditions and Seasonality

The CWA requires that TMDLs take into account critical conditions for flow, 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 CWA also requires that TMDLs be established with consideration of seasonal variations. For streams, the LDC 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 North Fork Kaskaskia River (IL_OKA-01) Atrazine TMDL

An atrazine TMDL has been developed for the North Fork Kaskaskia River segment IL_OKA-01. Figure 2 presents the atrazine LDC and Table 9 and Table 10 summarize the TMDL and required reductions for both the chronic and acute standard, respectively. A pollutant reduction of 54% is needed under dry conditions to meet the chronic standard (9 µg/L). No reduction is needed to meet the acute standard (82 µg/L).

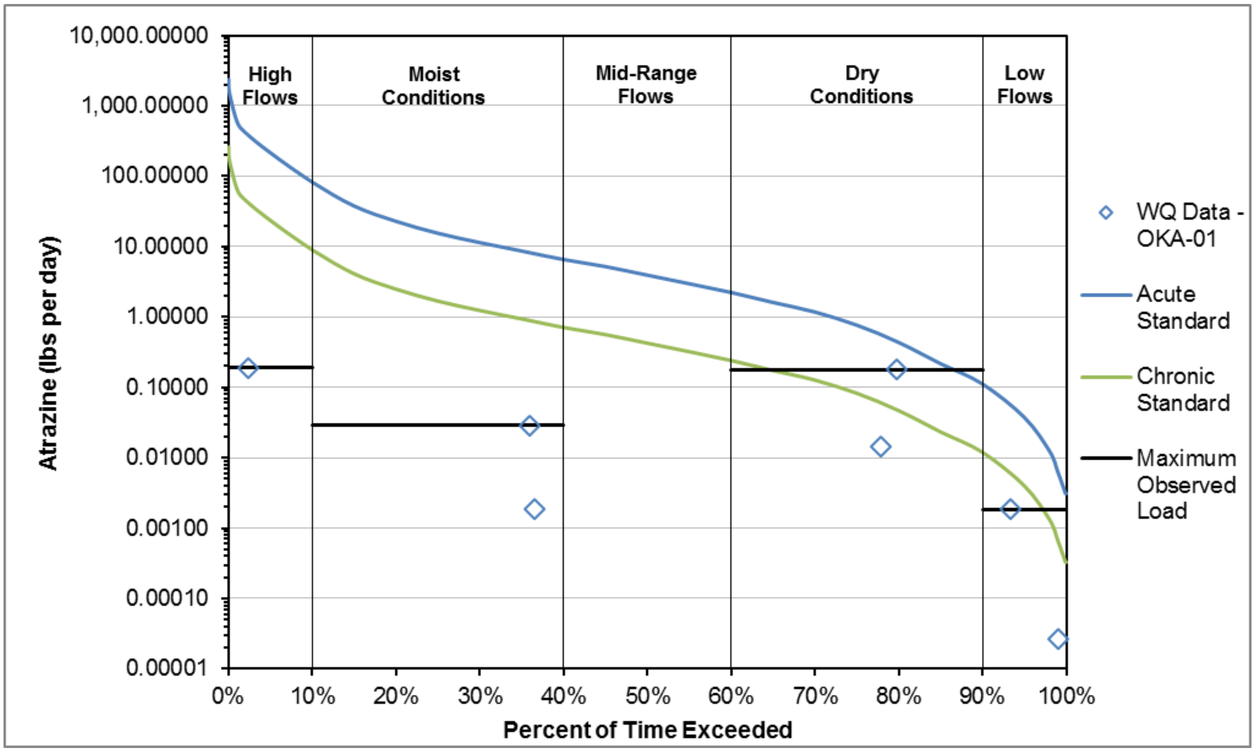

Figure 2. Atrazine load duration curve, North Fork Kaskaskia River IL_OKA-01.

Table 9. Atrazine TMDL summary (chronic standard; North Fork Kaskaskia River IL_OKA-01)

TMDL Parameter	Flow Zones				
	High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
	Atrazine Load (lbs./day)				
Load Allocation	18	1.4	0.34	0.066	0.0032
RC	2.3	0.17	0.043	0.0083	0.00040
MOS	2.3	0.17	0.043	0.0083	0.00040
Loading Capacity	**23**	**1.7**	**0.43**	**0.083**	**0.0040**
Existing Load	0.19	0.029	-	0.18	0.0019
Load Reduction [a]	0%	0%	-	54%	0%

Note: No permitted sources are in this TMDL subwatershed, therefore there is no wasteload allocation.

No samples were collected during mid-range flow conditions; therefore, no existing load or necessary reduction are calculated.

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

Table 10. Atrazine TMDL summary (acute standard; North Fork Kaskaskia River IL_OKA-01)

TMDL Parameter	Flow Zones				
	High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
	Atrazine Load (lbs./day)				
Load Allocation	170	12	3.1	0.60	0.030
RC	21	1.5	0.39	0.075	0.0037
MOS	21	1.5	0.39	0.075	0.0037
Loading Capacity	**212**	**15**	**3.9**	**0.75**	**0.037**
Existing Load	0.19	0.029	-	0.18	0.0019
Load Reduction [a]	0%	0%	-	0%	0%

Note: No permitted sources are in this TMDL subwatershed, therefore there is no wasteload allocation.

No samples were collected during mid-range flow conditions; therefore, no existing load or necessary reduction are calculated.

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

7.2 North Fork Kaskaskia River (IL_OKA-01) Terbufos TMDL

A terbufos TMDL has been developed for the Kaskaskia River segment IL_OKA-01. Figure 3 presents the terbufos LDC and Table 11 summarize the TMDL and required reductions for the acute standard. Pollutant reduction is needed under all sampled flow conditions to meet the acute standard (0.024 µg/L), except for low flow conditions.

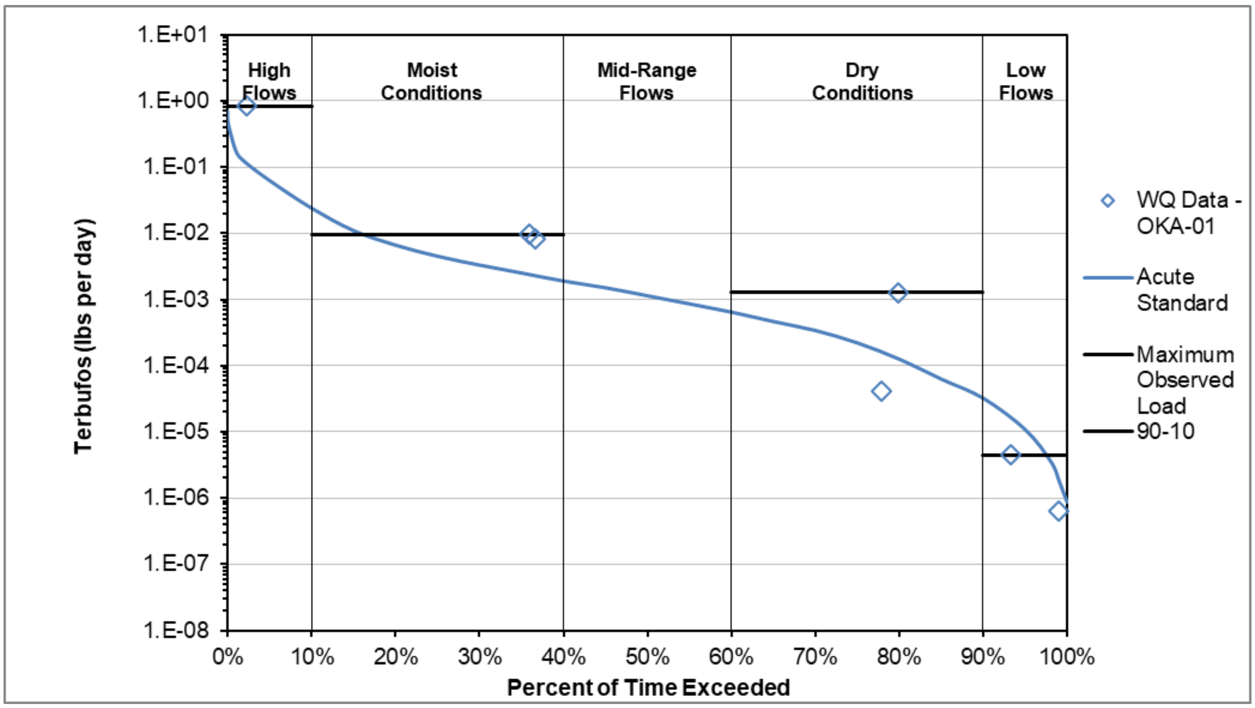

Figure 3. Terbufos load duration curve, North Fork Kaskaskia River IL_OKA-01.

Table 11. Terbufos TMDL summary (acute standard; North Fork Kaskaskia River IL_OKA-01)

TMDL Parameter	Flow Zones				
	High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
	Terbufos Load (lbs./day)				
Load Allocation	0.050	0.0036	0.00088	0.00018	8.8×10^{-6}
RC	0.0062	0.00045	0.00011	0.000022	1.1×10^{-6}
MOS	0.0062	0.00045	0.00011	0.000022	1.1×10^{-6}
Loading Capacity	**0.062**	**0.0045**	**0.0011**	**0.00022**	1.1×10^{-5}
Existing Load	0.84	0.010	-	0.0013	4.5×10^{-6}
Load Reduction [a]	93%	55%	-	83%	0%

Note: No permitted sources are in this TMDL subwatershed, therefore there is no wasteload allocation.

No samples were collected during mid-range flow conditions; therefore, no existing load or necessary reduction are calculated.

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

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 East Fork Kaskaskia River and Farina Lake watershed in a cost effective and timely manner. These activities will help to achieve reductions and attain water quality standards 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 atrazine, and terbufos TMDLs in the East Fork Kaskaskia River and Farina Lake watershed. This framework is flexible and incorporates adaptive management to allow watershed stakeholders to adjust the implementation plan to align with their 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 phosphorus and pesticide levels may originate from a combination of point and nonpoint sources, only nonpoint sources will be evaluated further in this plan. The East Fork Kaskaskia River and Farina Lake watershed TMDL report, including this implementation plan, are considered a watershed plan that meets U.S. EPA's nine elements. Table 12 illustrates which sections of the document contain information that fulfills U.S. EPA's nine elements.

Table 12. 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 8.3.2
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. 0An **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 one of the requirements 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 source areas (CSAs) are the focus of outcome-based plans because they represent those locations where project funding will provide the greatest environmental benefit. Upon identification of CSAs, BMPs can be evaluated and selected to address the needs of each area. CSAs for implementation were determined for each impaired subwatershed and then analyzed for any overlapping area or multi-pollutant reduction to further prioritize actions.

CSAs 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 4). In accordance with this guidance, CSAs were selected 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. The U.S. EPA's (2018) suggested process for CSA selection is summarized by step in this section.

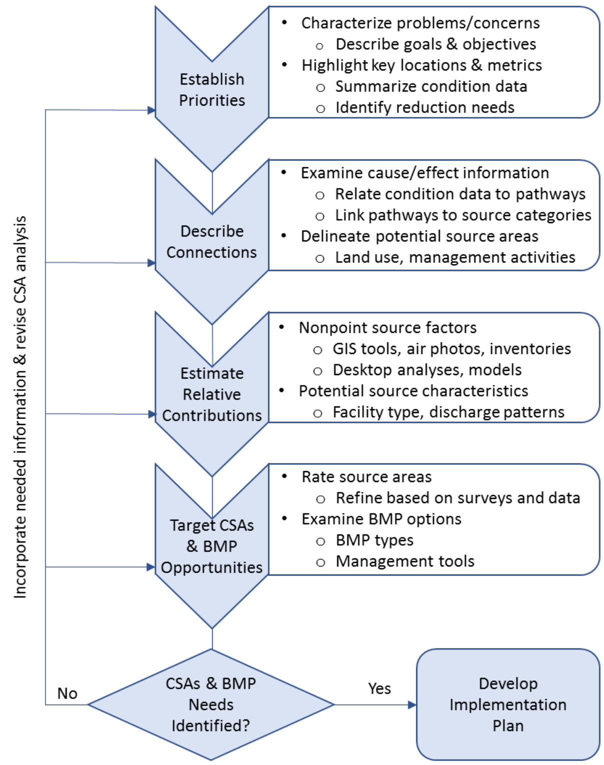

Figure 4. Critical source area selection process (U.S. EPA 2018).

8.2.1 Step 1: Establish Priorities

The Illinois 303(d) list and the East Fork Kaskaskia River and Farina Lake watershed TMDLs establish the priorities of this implementation plan. The objective of this implementation plan is to restore North Fork Kaskaskia River (IL_OKA-01). TMDL reductions for atrazine and terbufos were developed in Section 7 and are summarized in Table 13.

Table 13. Summary of East Fork Kaskaskia River and Farina Lake watershed TMDLs

Name	Designated Uses	Cause of Impairment	Water Quality Standard	Required Reduction
North Fork Kaskaskia River (IL_OKA-01)	Aquatic Life	Atrazine	9 µg/L (acute) 82 µg/L (chronic)	54% reduction in acute atrazine concentrations (no reduction for chronic atrazine concentrations)
		Terbufos	0.024 µg/L	93% reduction in terbufos concentrations

8.2.2 Step 2: Describe Connections

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

Potential non-point sources of pesticides to impaired waters include runoff from locations of pesticide application, storage, and disposal. These sources are connected to North Fork Kaskaskia River (IL_OKA-01) via the following pathways:

- **Pesticide application.** Atrazine and terbufos are pesticides which are seasonally applied to cropland. Both pesticides are primarily applied to fields producing corn and/or soybeans. Cropland runoff from fields where atrazine and terbufos have been applied may transport pesticides to nearby waterbodies. The contribution of pesticide loading is also exacerbated by the presence of tile drainage that can transport pesticides downstream.
- **Pesticide storage and disposal.** Improper storage and disposal of pesticides can result in pesticide-laden runoff to nearby waterbodies from storage and containment facilities, transport vehicles, application equipment, or disposal areas.

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. Estimates of relative contributions for each pollutant are described in the following subsections.

Atrazine and terbufos are pesticides which are applied on agricultural land in the watershed, most commonly on cultivated cropland where corn and/or soybeans are produced. Pesticide use is typically limited to a single annual application and is amount of active ingredient applied during this application is based on manufacturer instructions and regulatory guidelines.

In Illinois, the use of atrazine is common, being applied on 73% of corn crops in 2021 for a total of 9,249,000 lbs. (USDA 2022). In a recent report, the U.S. EPA reported that during the most recent five years of available survey data (2013-2017), an annual average of 72,000,000 pounds of atrazine were applied to agricultural crops nationwide, 87% of which were applied to corn (U.S. EPA 2020). Atrazine is often less readily broken down in soils with high pH (greater than 7.2) and remains in the soil solution for longer period of times, creating a longer opportunity for the chemical to be washed away via surface runoff or tile drainage (University of Illinois Extension 2008).

U.S. EPA use data indicates that from 1987 to 1996 the average nationwide domestic use of terbufos was 7.5 million pounds per year. The typical application rate of terbufos to corn is 1.0 lb. active ingredient per acre and the maximum is 1.3 lb. active ingredient per acre per year. Terbufos and its two major degradation products, terbufos sulfoxide and terbufos sulfone, have the potential to run off of agricultural fields and into surface waters (U.S. EPA 2006).

Researchers at Kansas State have found that 90% of atrazine losses occur in the dissolved form during runoff events (Kansas State University 2007; University of Nebraska 1996). In another study conducted at the University of Nebraska, results indicated that sediment-absorbed terbufos accounted for more than 90% of total terbufos transport (Mamo et al. 2006). As such, it can be assumed that fields contribute most of the pesticide loading throughout the East Fork Kaskaskia and Farina Lake watershed. Depending on pesticide storage and disposal practices in the watershed, facilities and disposal infrastructure may also provide significant pesticide contributions.

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 the 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 and their relative contributions (Steps 1-3) were used to determine critical areas for the first five years of implementation. Critical area selection is an iterative process (U.S. EPA 2018). 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.

Critical areas for North Fork Kaskaskia River (IL_OKA-01) are croplands growing corn or soybeans (assumed in rotation) within the two impaired subwatersheds. Fields where atrazine or terbufos are applied with soils testing for a pH greater than 7.2, tile drainage systems, and/or fields that are highly connected to shallow groundwater sources, should be a focus for implementation.

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. Practices recommended in this implementation plan are a subset of those provided in the Illinois Nutrient Loss Reduction Strategy (NLRS) and by the Illinois Council on Best Management Practices (ICBMP), as well as the Illinois Agronomy Handbook (IAH) (University of Illinois Extension 2009). Additional information is available in the NLRS (IEPA and Illinois Department of Agriculture [IDOA] 2015) and on the ICBMP website (http://illinoiscbmp.com/).

For watersheds with multiple impairments like the East Fork Kaskaskia River and Farina Lake watershed, suites of BMPs must be identified and evaluated. BMPs recommended in this section can be implemented throughout the watershed, with a focus on implementation in identified critical areas. To ensure that the recommended practices will achieve all required reductions, BMP descriptions and associated costs are summarized the following section. The level of implementation necessary to achieve required reductions is outlined in Section 8.3.2. While there are many different BMP scenarios that could be used to achieve the targeted phosphorus, atrazine, and terbufos load reductions, this plan provides one example.

8.3.1 Pesticide Application, Storage, and Disposal Practices

The following practices are recommended to reduce the loading of pesticides to the North Fork Kaskaskia River (IL_OKA-01). Recommended BMPs address potential pesticide losses during application, storage, and disposal activities.

Atrazine Application (Timing, Rates, and Restrictions) Practices

Atrazine is an herbicide that is commonly used in the U.S. to control broadleaf weeds. As a restricted use pesticide, incorrect application can result in ground water contamination, adverse effects to birds and mammals, and significant human health concerns related to worker exposure. Application requires proper record keeping and an applicator licensing. Collaboration with crop consultants, agricultural professionals, the University of Illinois Extension, and other pesticide application experts is also recommended.

According to U.S. Code of Federal Regulations Title 40 Section 156.10, it is a violation of federal law to use atrazine in a manner inconsistent with its labeling. In addition to following labeling instructions, several other practices are recommended for the application of atrazine to further protect water resources and improve pesticide effectiveness.

The 2008 Illinois Agricultural Pest Management Handbook (University of Illinois Extension 2008) recommends:

- Application between 0.5 to 2.0 lb. active ingredient atrazine/acre.
- Application to soils with pH less than 7.2 to reduce risk of carry over (persistence in the soil longer than anticipated).
- Post application that includes crop oil concentrate
- Broadcast application of atrazine prior to corn maximum height of 12 inches.

The Minnesota Department of Agriculture developed a list of voluntary water quality BMPs for atrazine (2019) and all agricultural herbicide (2018) application, they include:

- Evaluate surface drainage patterns on your field, then identify points where surface runoff leaves the field and consider protective practices in vulnerable areas, including tile inlets, wells, and sinkholes; follow label requirements for application setbacks and planted buffers.
- Adopt conservation tillage practices appropriate for your farm's topography and crops.
- Combine and rotate use of atrazine (and other site-of-action 5 herbicides) with herbicides from different sites-of-action in conjunction with nonchemical methods.

Kansas State University (2007) recommends the following practices for atrazine application:

- Incorporate atrazine into the top two inches of soil.
- Apply between November 1 and April 15 when rainfall events are less frequent and intense.
- Consider post emergence application as they require 60 to 70% less product than application to soil in addition to being more successful for weed control.
- Apply one-half to two-thirds of the application prior to April 15 and the remainder before or immediately following planting.
- Used integrated pest management strategies by employing variable rate herbicide applications, crop rotation, pre-plant tillage, cover crops, row cultivation, hybrid selection, planting techniques, etc.
- Use band application of atrazine with ridge till cultivation.
- Use proper mixing, application, and disposal practices per product label and regulations.

Depending on existing surface drainage patterns, certain fields where atrazine is applied may be more vulnerable to surface runoff. Where vulnerability is high or where drainage issues are common, protective practices may be implemented.

Terbufos Application (Timing, Rates, and Restrictions) Practices

Terbufos is a restricted use herbicide for acute toxicity and bird toxicity and requires a licensed applicator. Practices that reduce sediment erosion and runoff from crop fields, such as conservation tillage, help to reduce the amount of terbufos runoff from fields. The most effective way to minimize terbufos runoff from fields is to follow label directions exactly for application rates. The 2008 Illinois Agricultural Pest Management Handbook (University of Illinois Extension 2008) recommends:

- Band or furrow application at planting for corn crops.
- Use the nematocidal rates of terbufos only when tests indicate nematode populates above threshold and only after pH, fertility, hardpan, soil insects, and other diseases as possible limiting factors have been eliminated.
- Identification of nematode type prior to selecting rotation.
- Use crop rotation where appropriate, avoid small grains in rotations and control grassy weeds for nematode control.
- Application only where soil analysis indicates a nematode population.

Depending on existing surface drainage patterns, certain fields where terbufos is applied may be more vulnerable to surface runoff. Where vulnerability is high or where drainage issues are common, protective practices may be implemented.

Pesticide Storage and Disposal Practices

Proper storage of pesticides, including atrazine and terbufos is regulated through Title 8 Illinois Administrative Code 255 (Illinois Administration Code 2002). Section 255.10 of the administration code defines an agrichemical facility as:

> …a site used for commercial purposes, where bulk pesticides are stored in a single container in excess of 300 gallons of liquid pesticide or 300 pounds of dry pesticide for more than 30 days per year or where more than 300 gallons of liquid pesticide or 300 pounds of dry pesticide are being mixed, repackaged or transferred from one container to another within a 30-day period or a site where bulk fertilizers are stored, mixed, repackaged or transferred from one container to another.

Administrative Code 255 lists requirements for agrichemical facilities that include requirements on: registration, permits, compliance schedules, containment, storage, reporting, inspection, and maintenance. Continued compliance will help to maintain and/or reduce future atrazine levels in the watershed.

Proper disposal practices also protect water resources from potential detrimental impacts of atrazine. IDOA in cooperation with the Illinois Department of Public Health hold annual Pesticide Clean Sweep Program collection days, funded through U.S. EPA funds (IDOA 2020). The program responsibly collects waste pesticides in addition to crop oil, surfactants, stickers, and foaming agents. More information can be found here: https://www2.illinois.gov/sites/agr/Pesticides/Pages/Pesticide-Clean-Sweep-Program.aspx.

Recommended disposal practices include:

- Triple rinse or pressure rinse containers and pour the rinse water into the spay tank
- Follow disposal recommendations on labels exactly
- Do not drain rinse water from equipment near or into water sources (ditches, ponds, streams, etc.)

8.3.2 Level of Implementation

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

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.

To the extent possible, implementation of this TMDL implementation plan should align with the goals of previous plans such as the East Fork Kaskaskia Watershed TMDL (Baetis Environmental Services, Inc. 2007), the North Fork Kaskaskia River Watershed TMDL (Limno-Tech 2006), and the East Fork Kaskaskia River/Farina Lake Simazine TMDL (IEPA 2015).

A 54% reduction in atrazine concentrations and a 93% reduction in terbufos concentrations in North Fork Kaskaskia River (IL_OKA-01) are required to achieve atrazine and terbufos water quality standards. Implementation will be derived from changes in application practices. The following level of implementation is recommended to achieve pesticide reductions in the North Fork Kaskaskia River (IL_OKA-01):

- **Atrazine application practices** on 100% of cropland where atrazine is applied
- **Terbufos application practices** on 100% of cropland where terbufos is applied.

Outreach program and training modules should also be developed for all pesticide-impaired watersheds to provide information on recommended storage and disposal practice. Modules should also encourage row crop producers and pesticide applicators to reduce application rates, incorporate on-field pH testing for targeting pesticide applications, adhere to labeling instructions, and adopt integrated pest management strategies across both impaired subwatersheds.

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. As 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 will likely play a role in implementation.

8.4.1 Implementation Costs

Total cost to implement the East Fork Kaskaskia River and Farina Lake watershed will depend on current application, storage, and disposal practices, costs of alternative pesticide products, improvements to storage infrastructure, and the development of alternate disposal methods may increase costs.

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 14. 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 14. 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

Funding Program	Type of Funding	Entity	Eligible Projects	Eligible Applicants	Available Funding	Website
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).	Corporations, partnerships, governmental entities, tribal governments, state infrastructure financing authorities	Varies	https://www.epa.gov/cwsrf
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	10-year restoration cost-share agreement: up to 50% of average cost of approved conservation practices 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 30-year contract on acreage owned by Indian Tribes 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: Short term funding to leverage larger financing for targeted watershed protection Funds to help build the capacity of local organizations for sustainable, long term watershed protection 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: OSLDA program will not be available for Fiscal Year 2021 according to IDNR 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/gigo.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.

Note: BMP = best management practice; EQIP = Environmental Quality Incentive Program; IDNR = Illinois Department of Natural Resources; IEPA = Illinois Environmental Protection Agency; NRCS = Natural Resources Conservation Service; USDA = U.S. Department of Agriculture; U.S. EPA = U.S. Environmental Protection Agency; USFWS = U.S. Fish and Wildlife Service.

8.4.3 Partners

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

- Army Corps of Engineers
- Carlyle Lake Association
- Carlyle Lake Ecosystem Partnership
- County Forest Preserve Districts
- Farm Service Agency
- Heartlands Conservatory
- IDOA
- Illinois Department of Natural Resources
- Illinois Certified Crop Adviser Program
- IEPA
- Illinois Farm Bureau
- Illinois Rural Water Association
- Illinois State Water Survey
- Kaskaskia Watershed Association
- Kaskaskia Regional Port District
- Kaskia-Kaw Rivers Conservancy
- Local and regional governments
- Local school districts
- Natural Resources Conservation Service
- Original Kaskaskia Area Wilderness Inc.
- Soil and Water Conservation District offices
- Southern Till Prairie Reserve
- Southwestern Illinois RC&D
- University of Illinois Extension
- U.S. EPA Region 5

8.5 Public Education and Outreach

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 East Fork Kaskaskia River and Farina Lake 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 East Fork Kaskaskia River and Farina Lake watershed may include row crop producers and pesticide applicators. 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 15.

Table 15. Potential audience concerns and communication channels

Key Target Audiences	Potential Audience Concerns	Potential Communication Channels
Pesticide applicators	• Public and occupational health • Pesticide safety, training, and liability • Costs and savings from changes to pesticide application, storage, and disposal practices • Potential future regulation	• University of Illinois Extension • Commodity groups • Agricultural associations • 4-H groups • Soil and water conservation districts • Watershed groups • Demonstration farms • Field days • Radio and newspapers • Word of mouth • On-site visits • Informational meetings
Agricultural producers	• Potential future regulation • Cost and programmatic requirements of funding programs • Water quality issues (safety, aesthetics)	
Certified Crop Advisors	• Areas and practices to target for implementation • Costs and programmatic requirements for funding programs • Updated information to pass along to agricultural producers	• Training sessions • Outreach and distributed information from research institutions • Informational meetings

Resources exist which are relevant to several of these stakeholders. Training programs for pesticide applicators and effective communication channels between applicators, farmers, and neighboring areas can help support successful implementation of the implementation plan. Examples in the watershed include:

- **Pesticide Safety Education Program:** The University of Illinois Extension trains and certifies commercial and private pesticide applicators on behalf of the IEPA through the Pesticide Safety Education Program. The program works to ensure the health and safety of humans and the environment in accordance with state and federal law. This program is run throughout the state of Illinois. More information is available here: https://web.extension.illinois.edu/psep/
- **Drift Watch:** Drift Watch is a free, online, and voluntary mapping program that helps to establish communication between pesticide applicators, specialty crop producers, and beekeepers to work together to protect specialty crops in the Midwest. It promotes both the freedom to operate and growing good neighbors in the pesticide industry. It was developed out of Purdue University and is maintained by non-profit Field Watch. More information is available here: https://il.driftwatch.org/
- **University of Illinois Extension Units:** The University of Illinois Extension has several units within the East Fork Kaskaskia River and Farina Lake 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.
    - Bond-Clinton-Jefferson-Marian-Washington Extension Unit (https://web.extension.illinois.edu/bcjmw/)
    - Clay-Effingham-Fayette-Jasper Extension Unit (http://web.extension.illinois.edu/cefj/).

Training and education programs for crop and livestock producers are also effective methods of increasing implementation and long-term maintenance of agricultural BMPs.

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 16.

A minimum of a 15-year implementation schedule is assumed and divided into two phases: 2020-2025 and 2026-2035. 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. Longer-term efforts (Year 6-15) are intended to build on the results of short-term implementation activities and will result in the watershed reaching full pollutant load reductions. This includes evaluating the success of Phase 1 projects installed (success rate, BMP performance, improvements or reductions actualized, actual costs, etc.).

Table 16. Schedule and milestones for TMDL implementation

Watershed (AUID)	Pollutant	Recommended BMP Category	Milestones	
			Year 1-5	Year 6-15
North Fork Kaskaskia River (IL_OKA-01)	Atrazine	Atrazine application practices	Implement on 20% of cropland where atrazine is applied, beginning in critical areas.	Implement on 100% of cropland where atrazine is applied.
	Terbufos	Terbufos application practices	Implement on 20% of cropland where terbufos is applied, beginning in critical areas.	Implement on 100% of cropland where terbufos is applied.
All pesticide impaired waters	Atrazine, terbufos	Outreach program and training modules	Develop outreach program and training modules. Implement outreach program and training modules, beginning in critical areas.	Continue implementing outreach program and training modules throughout impaired subwatersheds.

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 water quality standards. Progress benchmarks (Table 17) 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 17. Progress benchmarks summary

Segments	Indicator	In-Stream/ In-Lake Target	Timeframe	Progress Benchmark [a]
North Fork Kaskaskia River (IL_OKA-01)	**Atrazine**	9 µg/L (acute) 82 µg/L (chronic)	Year 1-5	20% of load reductions
			Year 6-15	Full attainment of load reductions and full attainment of water quality standards.
	Terbufos	0.024 µg/L	Year 1-5	20% of load reductions
			Year 6-15	Full attainment of load reductions and full attainment of water quality standards.

a. Required load reductions summarized in Table 13 in Section 8.2.1.

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 (Figure 5). 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.

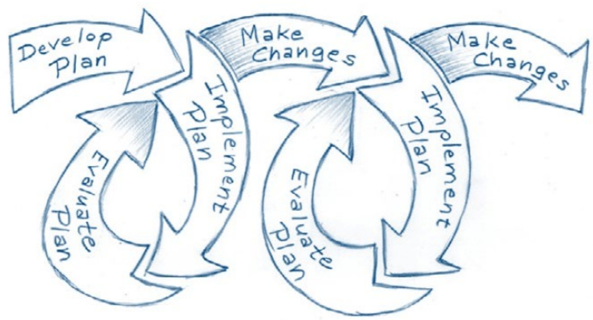

Figure 5. Adaptive management iterative process (U.S. EPA 2008).

Adaptive management is a 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 14, 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 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 17 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 water quality standards and designated uses.

8.8.1 Water Quality Monitoring

Progress towards achieving water quality standards will be determined through ambient monitoring by IEPA (i.e., AWQMN). The state conducts routine water quality monitoring by evaluating watersheds on a rotating basis, collecting measurements of physical, chemical, and biological parameters. This ambient monitoring program will continue as the East Fork Kaskaskia River and Farina Lake watershed TMDL is implemented.

Recommended monitoring in the watershed includes collection of chemical and flow data. At a minimum, to track changes in water quality in impaired streams, and as recommended in the Stage 1 document (Appendix A), pesticide levels should continue to be monitored. Synoptic stream sampling can be used to better understand sources of pollutants and identify hot spots or additional critical areas in the impaired streams.

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

8.8.2 BMP Effectiveness Monitoring

Multiple BMPs will be needed to address water quality impairments in the East Fork Kaskaskia River and Farina Lake 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 pesticide and phosphorus load reductions will be achieved, and water quality will be restored. A few watershed groups are already active in the TMDL watershed and have developed strategic plans, projects, and on-going programming that will support successful attainment of the water quality standards outlined in this implementation plan. Several relevant groups and projects are summarized below:

- **Kaskaskia Watershed Association:** The Kaskaskia Watershed Association partners across the watershed to protect the watershed and balance navigation, recreation, water supply, and conservation. Recent projects include the establishment of an Illinois conservation 2000 Ecosystem Partnership with the Illinois Department of Natural Resources for financial support on 88 projects within the larger Kaskaskia River basin and development of a comprehensive watershed management strategy. The Kaskaskia Watershed Association also hosts an Annual Summit where regional leaders and stakeholders share knowledge and information about ongoing and future water quality concerns.
- **Heartlands Conservancy:** Dedicated to protecting open spaces, farmland, and cultural assets in Southwestern Illinois, the Heartlands Conservancy provide consultation, support, funding, and outreach activities to local communities and partners. Their work involves a wide range of ongoing projects, including the purchase and preservation of conservation easements, targeted BMP implementation, regional watershed and ecological planning support, and a wide range of education and outreach activities for local communities. Heartlands supports and partners with many local organizations and supports the Kaskaskia Watershed Association's annual conference.
- **The Kaskaskia Project:** An ongoing University of Illinois Urbana-Champaign project study is currently researching the impact of existing and projected environmental and socio-cultural stressors on agro-ecosystem services in the Kaskaskia River watershed. More information on this project is available on their website (https://publish.illinois.edu/kaskaskia/)

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

Technical and financial assistance, as summarized in Section 8.4, provides the resources needed to improve water quality and meet watershed goals. Additional assurance can be achieved in implementation of the TMDLs through contracts, memorandums of understanding, and other similar agreements, especially for BMPs that are eligible to receive the support of outside funds and cost shares. 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.

9. Public Participation

A public meeting was held on December 12, 2018, at the Carlyle Lake Visitor Center in Carlyle, 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 the US Army Corps of Engineers, the Kaskaskia Watershed Association, and the Original Kaskaskia Area Wilderness, Inc. The public comment period closed on January 12, 2019. No written comments were provided on the draft Stage 1 report.

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

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Appendix A—Stage 1 Report

East Fork Kaskaskia River and Farina Lake Watershed Total Maximum Daily Load

Final Stage 1 Report

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Acronyms and Abbreviations

AFOs	animal feeding operations
AQI	Aesthetic Quality Index
AWQMN	Ambient Water Quality Monitoring Network
BOD	biochemical oxygen demand
CAFO	confined animal feeding operation
CWA	Clean Water Act
DO	dissolved oxygen
fIBI	fish Index of Biotic Integrity
Illinois EPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
lbs	pounds
L	liter
mg	milligram
µg	microgram
mIBI	macroinvertebrate Index of Biotic Integrity
MCL	Maximum Contaminant Level
MGD	millions of gallons per day
MS4	municipal separate storm sewer system
NPDES	National Pollutant Discharge Elimination System
NVSS	nonvolatile suspended solids
SOD	sediment oxygen demand
STEPL	Spreadsheet Tool for Estimating Pollutant Load
STP	sewage treatment plant
TMDL	total maximum daily load
TSI	Trophic Status Index
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 standards. This TMDL study addresses the East Fork Kaskaskia River and Farina Lake watershed in central Illinois. The project area is approximately 536 square miles and includes impairments in the East Fork and North Fork Kaskaskia River watershed (Figure 1). Two previous TMDL studies were completed in the project area: the North Fork Kaskaskia River TMDL (Limno-Tech 2006), which covers the northern half of the project area, and the East Fork Kaskaskia Watershed TMDL (Baetis Environmental Services, Inc. 2007), which covers the southern portion of the project area. Relevant information from the studies is included herein where applicable.

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 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.

1.2 Water Quality Impairments

Several waters in the East Fork Kaskaskia River Farina Lake project area have been placed on the State of Illinois §303(d) list (Table 1 and Figure 1). Of the waters being addressed by this TMDL study, Farina Lake was determined to be unimpaired for copper (see italics in Table 1 and Appendix A – Unimpaired Stream Data Analysis). In addition, total phosphorus impairments in streams are not being addressed as part of this project.

Table 1. East Fork Kaskaskia River and Farina Lake watershed impairments and pollutants (2016 Illinois 303(d) Draft List [IEPA 2016])

Name	Segment ID	Segment Length (Miles)	Watershed Area (Sq. Miles)	Designated Uses	Cause of Impairment
East Fork Kaskaskia River	IL_OK-02	18.72	78	Aquatic Life	**Dissolved Oxygen**, Phosphorus (Total) [a]
North Fork Kaskaskia River	IL_OKA-01	11.83	78	Aquatic Life	**Atrazine, Terbufos,** Phosphorus (Total) [a]
Kinmundy Old Lake	IL_ROZY	20 ac (surface area)	0.5	Aesthetic Quality	**Phosphorus (Total)**
Farina Lake	IL_SOB	4 ac (surface area)	0.05	Aquatic Life	*Copper*, **Dissolved Oxygen, pH, Terbufos**

a. These causes of impairment are not being addressed as part of this project.
Italics – Based on evaluation of the last ten years of available data (2007-2016), it was determined that Farina Lake (IL_SOB) is not impaired for copper (see Appendix A – Unimpaired Stream Data Analysis). A TMDL is not provided for this cause of impairment.
Bold – Impairments are addressed in this Stage 1 report.

1.3 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.

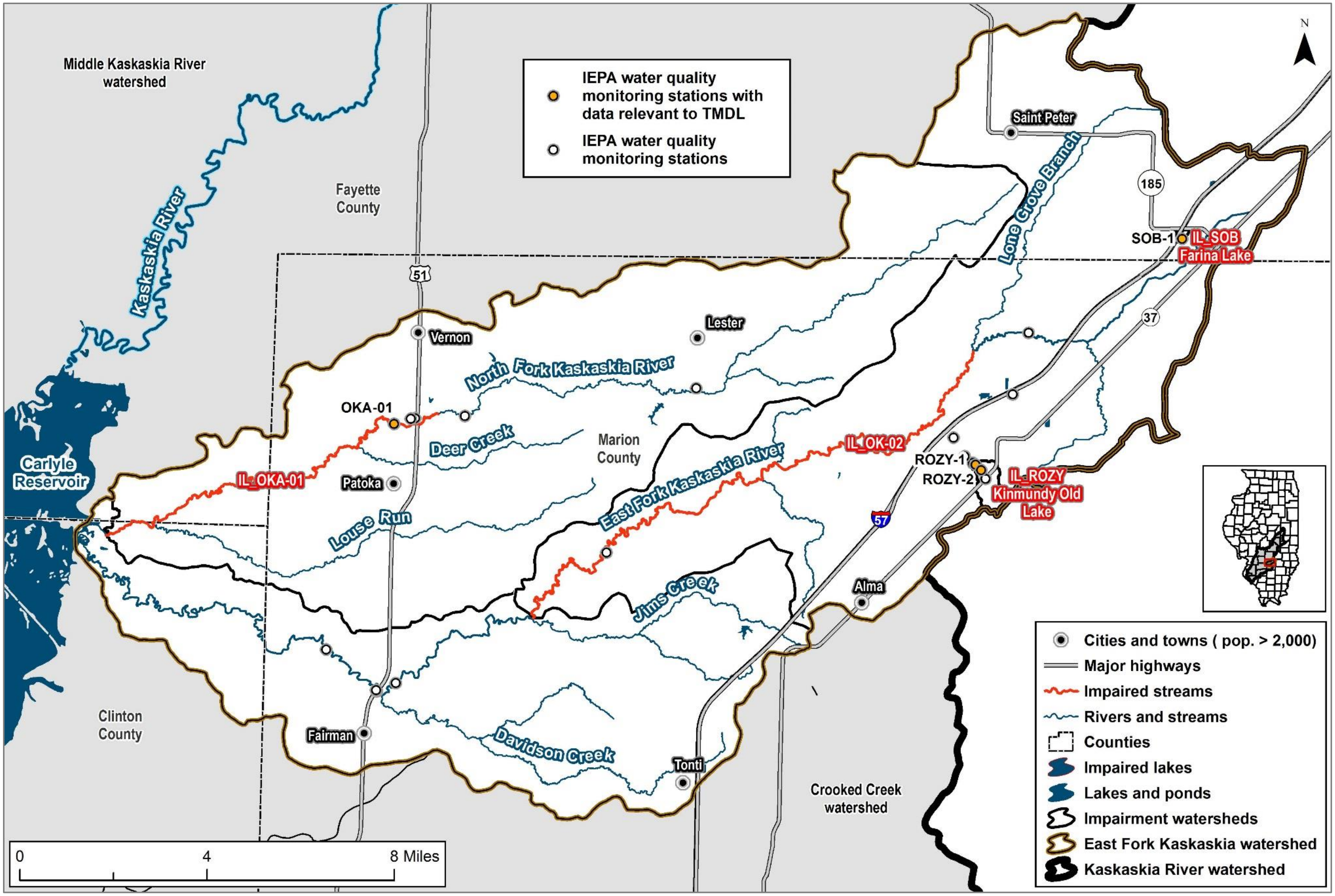

Figure 1. East Fork Kaskaskia Farina Lake TMDL project area.

1.3.1 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 waterbodies in the East Fork Kaskaskia Farina Lake 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.

1.3.2 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 302 contains water quality standards promulgated by the IPCB. This section presents the standards applicable to impairments in the study area. Water quality standards are the endpoints to be used for TMDL development in the East Fork Kaskaskia Farina Lake project area (Table 2).

Table 2. Summary of water quality standards for the East Fork Kaskaskia Farina Lake watershed

Parameter	Units	General Use Water Quality Standard
Atrazine	µg/L	If fewer than 10 samples, not to exceed the chronic 9 µg/L nor acute 82 µg/L standard. If greater than 10 samples, not to exceed the chronic standard and fewer than two observations exceed the acute standard.
Terbufos	µg/L	If fewer than 10 samples, not to exceed the chronic 0.002 µg/L nor acute 0.024 µg/L standards. If greater than 10 samples, not to exceed the chronic standard and fewer than two observations exceed the acute standard.
Dissolved Oxygen [a]	mg/L	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 If fewer than 10 samples, not to exceed two violations of the standard. If greater than 10 samples, not to exceed one violation of the standard.
pH	s.u.	Within the range of 6.5 - 9.0 (s.u.)
Phosphorus (Total)	mg/L	0.05

a. 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.

Aquatic Life Use

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; 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).

Aesthetic Quality

The Aesthetic Quality Index (AQI; Table 3) is the primary tool used to assess *aesthetic quality* for freshwater lakes. The AQI represents the extent to which pleasure boating, canoeing, and aesthetic enjoyment are attained at a lake. The Trophic State Index (TSI; Carlson 1977), the percent-surface-area macrophyte coverage during the peak growing season (June through August), and the median concentration of nonvolatile suspended solids (NVSS) are used to calculate the AQI score. Higher AQI scores indicate increased impairment (Table 4).

Assessments of aesthetic quality use are based primarily on physical and chemical water quality data collected by the Illinois EPA through the Ambient Lake Monitoring Program or the Illinois Clean Lakes Program, or by non-Illinois EPA persons under an approved quality assurance project plan. The physical and chemical data used for aesthetic quality use assessments include Secchi disk transparency, chlorophyll *a*, total phosphorus (epilimnetic samples only), nonvolatile suspended solids (epilimnetic samples only), and percent surface area macrophyte coverage. Data are collected a minimum of five times per year (April through October) from one or more established lake sites. Data are considered usable for assessments if meeting the following minimum requirements: 1) At least four out of seven months (April through October) of data are available, 2) At least two of these months occurs during the peak growing season of June through August (this requirement does not apply to nonvolatile suspended solids), and 3) Usable data are available from at least half of all lake sites in any given lake each month. A whole-lake TSI value is calculated for the median Secchi disk transparency, median total phosphorus (epilimnetic sample depths only), and median chlorophyll *a* values. A minimum of two parameter-specific TSI values are required to calculate a parameter-specific use support determination. An assessment is then made based on the parameter specific use support determinations. The 0.05 mg/L Illinois General Use Water Quality Standard for total phosphorus in lakes (35 Ill. Adm. Code 302.205) has been incorporated into the weighting criteria used to assign point values for the AQI.

Table 3. Aesthetic Quality Index

Evaluation Factor	Parameter	Weighting Criteria	Points
1. Median Trophic State Index (TSI)	For data collected May-October: Median lake TSI value calculated from total phosphorus (samples collected at one foot depth), chlorophyll *a*, and Secchi disk transparency	Actual Median TSI Value	Actual Median TSI Value
2. Macrophyte Coverage	Average percentage of lake surface area covered by macrophytes during peak growing season (June through August). Determined by: a. Macrophyte survey conducted during same water year as the chemical data used in the assessment; <u>or</u> b. Average value reported on the VLMP Secchi Monitoring Data form	a. <5 b. ≥5<15 c. ≥15<25 d. ≥25	a. 0 b. 5 c. 10 d. 15
3. Nonvolatile Suspended Solids (NVSS) Concentration	Median lake surface NVSS concentration for samples collected at one foot depth (reported in mg/L)	a. <3 b. ≥3<7 c. ≥7<15 d. ≥15	a. 0 b. 5 c. 10 d. 15

Table 4. Guidelines for Assessing Aesthetic Quality Use in Illinois Freshwater Lakes

Degree of Use Support	Guidelines
Fully Supporting (Good)	Total AQI points are <60
Not Supporting (Fair)	Total AQI points are ≥60<90
Not Supporting (Poor)	Total AQI points are ≥90

2. Watershed Characterization

The East Fork Kaskaskia Farina Lake watershed is located in central Illinois (Figure 1). The headwaters begin in Fayette and Marion counties. East Fork Kaskaskia flows west until its confluence with the Kaskaskia River at Carlyle Lake. The Kaskaskia River eventually joins the Mississippi River south of St. Louis, Missouri. Much of the information presented in previous TMDL reports (Limno-Tech 2006, Baetis Environmental Services, Inc. 2007) is applicable to the East Fork Kaskaskia Farina Lake project area. There have been no known changes in the project area; therefore, the two previous TMDLs provide much of the basis for the watershed characterization and source assessment for the East Fork Kaskaskia Farina Lake TMDL.

2.1 Jurisdictions and Population

Relevant information on jurisdictions and population can be found in the North Fork Kaskaskia River TMDL (Limno-Tech 2006) and the East Fork Kaskaskia Watershed TMDL (Baetis Environmental

Services, Inc. 2007). The project area is primarily located in Marion County with portions of Fayette, Clinton, and Bond counties.

2.2 Climate

In general, the climate of the region is continental with hot, humid summers and cold winters. Relevant information on climate can be found in the North Fork Kaskaskia River TMDL (Limno-Tech 2006) and the East Fork Kaskaskia Watershed TMDL (Baetis Environmental Services, Inc. 2007).

2.3 Land Use and Land Cover

Relevant information on land use and land cover can be found in the North Fork Kaskaskia River TMDL (Limno-Tech 2006) and the East Fork Kaskaskia Watershed TMDL (Baetis Environmental Services, Inc. 2007). The majority of land cover in the watershed is agricultural. Primary crops are soy, corn, and wheat.

2.4 Topography

Relevant information on topography can be found in the North Fork Kaskaskia River TMDL (Limno-Tech 2006) and the East Fork Kaskaskia Watershed TMDL (Baetis Environmental Services, Inc. 2007).

2.5 Soils

Relevant information on soils can be found in the North Fork Kaskaskia River TMDL (Limno-Tech 2006) and the East Fork Kaskaskia Watershed TMDL (Baetis Environmental Services, Inc. 2007). Bluford-Ava-Hickory and Cisne-Hoyleton-Darmstadt are the predominant soil associations in the watershed, both derived from glacial till.

2.6 Hydrology

Relevant information on hydrologic conditions can be found in the North Fork Kaskaskia River TMDL (Limno-Tech 2006) and the East Fork Kaskaskia Watershed TMDL (Baetis Environmental Services, Inc. 2007). There is one USGS flow gage site on the East Fork Kaskaskia near Sandoval, IL (05592900).

2.7 Watershed Studies and Information

Relevant information for this section can be found in the following reports and studies:

- **Kaskaskia River Watershed, An Ecosystem Approach to Issues and Opportunities** (Southwestern Illinois RC&D, Inc. 2002)

  The plan encompasses the larger Kaskaskia River watershed from Champaign County to Randolph County in southwestern Illinois, covering over 10 percent of the state of Illinois. The purpose of the plan was to begin a coordinated restoration process in the Kaskaskia River watershed based on sound ecosystem principles. The plan made recommendations on sustainability, diversity, health, variety, connectivity, and the ecosystem's ability to thrive and reproduce in order to promote the sustainability of the ecosystem and strengthen the economic base and the quality of life of residents in the region.

- **East Fork Kaskaskia River/Farina Lake Watershed Simazine TMDL** (IEPA 2015)

This previous TMDL provides information on Farina Lake and its simazine impairment.

- **North Fork Kaskaskia River TMDL** (Limno-Tech 2006)

  This previous TMDL provides watershed characterization for the northern half of the East Fork Kaskaskia River TMDL project area. TMDLs were developed for manganese, dissolved oxygen, and fecal coliform.

- **East Fork Kaskaskia Watershed TMDL** (Baetis Environmental Services, Inc. 2007)

  This previous TMDL provides information for the watershed characterization for the southern half of the East Fork Kaskaskia River TMDL project area. TMDLs were developed for manganese, pH, iron, and fecal coliform.

3. Watershed Source Assessment

Source assessments are an important component of water quality management plans and TMDL development. As part of the water resource assessment process, Illinois EPA identified several sources as contributing to the East Fork Kaskaskia River watershed impairments (Table 5). Descriptions of these and other sources are provided in the following sections.

Table 5. Potential sources in project area based on the Draft 2016 305(b) list

Watershed	Segment	Pollutant	Sources
East Fork Kaskaskia River	IL_OK-02	Dissolved oxygen	Source unknown and crop production (crop land or dry land)
North Fork Kaskaskia River	IL_OKA-01	Atrazine, Terbufos	Agriculture, unknown, crop production (crop land or dry land)
Kinmundy Old Lake	IL_ROZY	Phosphorus (Total)	Source unknown, crop production (crop land or dry land), runoff from forest/grassland/parkland
Farina Lake	IL_SOB	Dissolved oxygen, pH, Terbufos	Crop production (crop land or dry land), pesticide application

3.1 Pollutants of Concern

Pollutants of concern evaluated in this source assessment include phosphorus, atrazine, terbufos, and parameters influencing dissolved oxygen and pH 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 potentially 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, concentrated feeding operations (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-CAFO or stormwater)

There are seven individual NPDES permitted facilities in the East Fork Kaskaskia Farina Lake project area (Table 6) however, none of the facilities dicharge directly to an impaired segment. Average and maximum design flows and downstream impairments are included in the facility summaries.

Table 6. Individual NPDES permitted facilities discharging to impaired segments

IL Permit ID	Facility Name	Type of Discharge	Receiving Water	Downstream Impairment(s)	Average Design Flow (MGD)	Maximum Design Flow (MGD)
IL0060585	*Marathon Pipeline Company*	*Hydrostatic test water*	*Unnamed tributary to North Fork Kaskaskia River*	*OKA-01*	*1.44*	*--*
IL0075001	*Kinmundy Energy Center*	*Misc. equipment and floor drain wastewater*	*Unnamed tributary to Louse Run*	*OKA-01*	*0.026*	*--*
IL0076422	*Alma STP*	*STP outfall*	*Unnamed tributary to East Fork Kaskaskia River*	*OK-02*	*0.05*	*0.199*
ILG580007	*St. Peter STP*	*STP outfall*	*Unnamed tributary to Lone Grove Branch*	*OK-02*	*0.042*	*0.17*
ILG580022	*Patoka STP*	*STP outfall*	*Unnamed tributary to North Kaskaskia River*	*OKA-01*	*0.072*	*0149*
ILG580047	*Farina STP*	*STP outfall*	*East Fork Kaskaskia River*	*OK-02*	*0.105*	*0.62*
ILG580123	*KINMUNDY STP*	*STP outfall*	*Unnamed tributary to Schneider Springs Branch*	*OK-02*	*0.146*	*0.442*

Italics – NPDES facility draining to unimpaired segment.
STP – Sewage treatment plant
MGD – Million gallons per day

3.2.2 Municipal Separate Storm Sewer Systems

Regulated stormwater 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 stormwater. Impervious areas associated with developed land uses can result in higher peak flow rates, higher runoff volumes, and larger pollutant loads. Stormwater runoff often contains sediment and nutrients, among 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 control measures including public education, public involvement, illicit discharge and detection programs, control of construction site runoff, post construction stormwater management in new development and redevelopment, and pollution prevention/good housekeeping for municipal operations. Foster Township MS4 (ILR400052) is the only entity operating under the General Storm Water Permit and is located in the both the North Fork Kaskaskia River (OKA-01) and East Fork Kaskaskia River (OK-02) impairment subwatersheds.

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.

3.3.1 Agricultural and Stormwater 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, specifically contributing to high biochemical oxygen demand and nutrients that can affect the dissolved oxygen conditions in streams.

In addition to pollutants, alterations to a watershed's hydrology as a result of land use changes 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.

Atrazine is an herbicide that is commonly used in the U.S. to control broadleaf weeds. In the Mississippi North Central River watershed, atrazine is applied on most corn fields. In Illinois, the use of atrazine is common, having been applied on 67 percent of corn crops in 2014 for a total of 8,622,000 pounds (USDA 2015). Atrazine is typically applied in the spring or summer and can be applied pre- or post-emergent. Transport mechanisms include overland runoff, discharge from drainage tiles, and contaminated dust that is delivered to the waterway through wet and dry atmospheric deposition. Atrazine is also transported easily in water, in the dissolved phase.

Terbufos is an orthophosphate pesticide that is applied to the surface of agricultural soil to combat pests. Application requires soil integration and occurs during planting, post plant emergent (applied in bands along row), and at crop cultivation. The typical application rate of terbufos to corn is 1.0 lb active ingredient per acre and the maximum is 1.3 lbs active ingredient per acre per year. U.S. EPA use data indicates that from 1987 to 1996 the average nationwide domestic use of terbufos was 7.5 million pounds per year. Terbufos and its two major degradation products, terbufos sulfoxide and terbufos sulfone, have the potential to run off of agricultural fields and into surface waters (U.S. EPA 2006).

The majority of land cover in the East Fork Kaskaskia Farina Lake watershed is cropland. Atrazine and terbufos application on these cultivated areas contributes loading by runoff and through infiltration into shallow groundwater or drain tiles. Therefore, the location and quantity of atrazine and terbufos applied to the landscape can greatly affect the resulting concentrations in nearby waterbodies. It is also possible that the two pollutants can be released from manufacturing, formulation, transport, and disposal.

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 that 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.

Relevant information for this section can be found in the North Fork Kaskaskia River TMDL (Limno-Tech 2006) and the East Fork Kaskaskia Watershed TMDL (Baetis Environmental Services, Inc. 2007). County health departments were contacted for information on septic systems and unsewered communities. From 2009–2016, between 49 and 90 new private sewage disposal permits were issued in Fayette County. This number, however, is not indicative of the number of sewage systems previously installed.

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 6,615 animals are in the project area.

3.3.4 Internal Loading

Internal phosphorus loading from lake bottom sediments can be a substantial component of the phosphorus budget in lakes. The sediment phosphorus originates as an external phosphorus load that settles out of the water column to the lake bottom. There are multiple mechanisms by which phosphorus can be released back into the water column as internal loading:

- Low oxygen concentrations (also called anoxia) in the water overlying the sediment can lead to phosphorus release. In a shallow lake that undergoes intermittent mixing of the water column throughout the growing season, the released phosphorus can mix with surface waters throughout the summer and become available for algal growth. In deeper lakes with a more stable summer stratification period, the released phosphorus remains in the bottom water layer until the time of fall mixing, when it mixes with surface waters.
- Bottom-feeding fish such as carp and black bullhead forage in lake sediments. This physical disturbance can release phosphorus into the water column.
- Wind energy in shallow areas can mix the water column and disturb bottom sediments, which leads to phosphorus release.
- Other sources of physical disturbance, such as boating in shallow areas, can disturb bottom sediments and lead to phosphorus release.

4. Water Quality

Background information on water quality monitoring can be found in the North Fork Kaskaskia River TMDL (Limno-Tech 2006) and the East Fork Kaskaskia Watershed TMDL (Baetis Environmental Services, Inc. 2007). In the East Fork Kaskaskia River Farina Lake watershed, water quality data were found for numerous stations that are part of the Illinois EPA Ambient Water Quality Monitoring Network (AWQMN). Monitoring stations with data relevant to the impaired segments are presented in Figure 1 and Table 7. Parameters sampled in the streams include field measurements (e.g., water temperature) as well as those that require lab analyses (e.g., nutrients).

The most recent 10 years of data collection, 2007–2016, were used to evaluate impairment status, with the exception of Farina Lake (SOB). 2017 monitoring data were collected on Farina Lake and are included here. Data that are greater than 10 years old are not included. Each data point was reviewed to ensure the use of quality data in the analysis below. Many sites have historical data that are greater than 10 years old. Data were obtained directly from Illinois EPA.

Table 7. East Fork Kaskaskia Lake Fork watershed water quality data

Waterbody	Impaired Segment	AWQMN Sites	Location	Period of Record
East Fork Kaskaskia River	IL_OK-02	OK-02	2 mile west of Alma	*2006*–2007
North Fork Kaskaskia River	IL_OKA-01	**OKA-01**	County Rd 250E Br 1.5 mile north of Patoka	*1999*–2007, 2012
Kinmundy Old Lake	IL_ROZY	**ROZY-1**	No location information	2011 (5 days), 2016 (1 day)
		ROZY-2	No location information	2011 (5 days), 2016 (1 day)
Farina Lake	IL_SOB	**SOB-1**	No location information	2012, 2017

BOLD – Indicates station with data relevant to impairment
Italics – Data are more than 10 years old

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.

4.1 East Fork Kaskaskia River (OK-02)

East Fork Kaskaskia River (OK-02) is listed as being impaired for aquatic life due to low levels of dissolved oxygen. There were no dissolved oxygen data available for OK-02; additional data collection is needed to verify the dissolved oxygen impairment on segment OK-02.

4.2 North Fork Kaskaskia River (OKA-01)

North Fork Kaskaskia River (OKA-01) is listed as impaired for aquatic life due to atrazine and terbufos. There is one Illinois EPA sampling site located on segment OKA-01 (sampling site OKA-01).

Seven terbufos samples were collected on OKA-01 (Table 8 and Figure 2). All samples exceeded the acute standard for terbufos, confirming impairment. Seven atrazine samples were collected on OKA-01 (Table 8 and Figure 3). One sample exceeded the chronic standard and no samples exceeded the acute standard, confirming impairment.

Table 8. Data summary, North Fork Kaskaskia River (OKA-01)

Sample Site	No. of samples	Minimum (µg/L)	Average (µg/L)	Maximum (µg/L)	CV (standard deviation/ average)	Number of exceedances of general use water quality standard
Atrazine						
OKA-01	7	0.02	5.31	32.00	11.81	1
Sample Site	**No. of samples**	**Minimum (µg/L)**	**Average (µg/L)**	**Maximum (µg/L)**	**CV (standard deviation/ average)**	**Number of exceedances of general use water quality standard**
Terbufos						
OKA-01	7	0.01	0.09	0.23	0.44	7

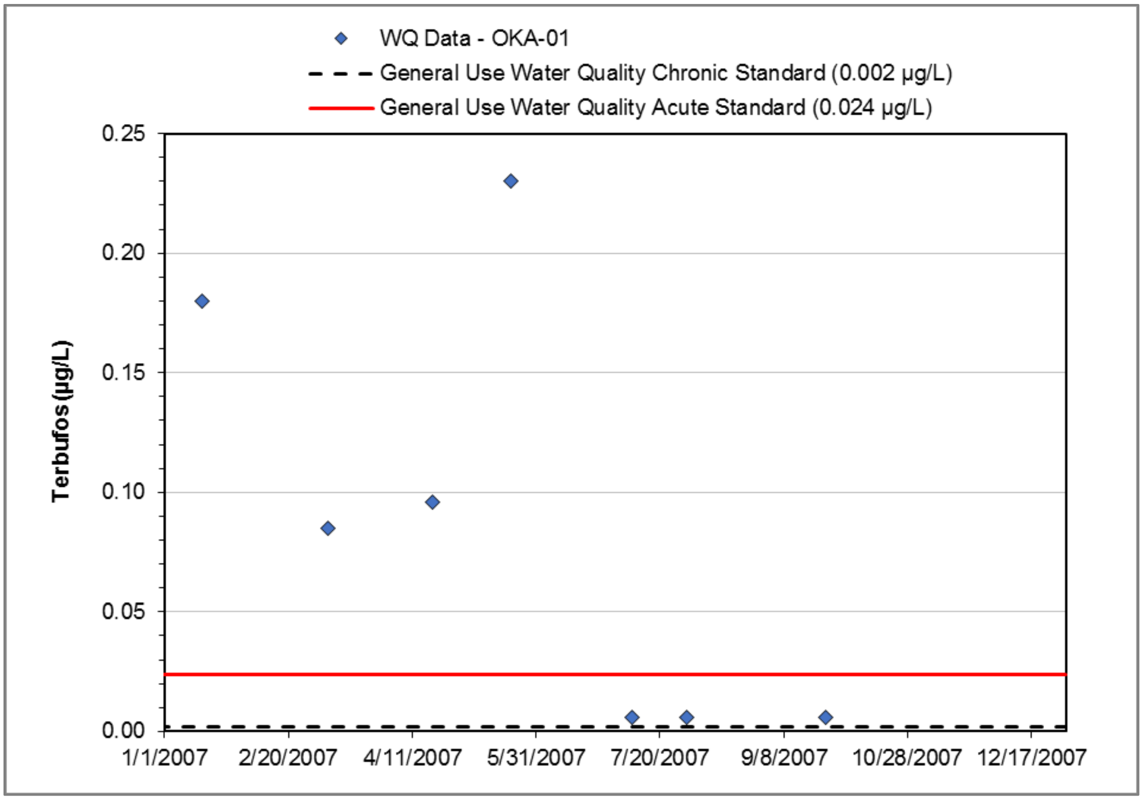

Figure 2. Water quality time series for terbufos, North Fork Kaskaskia River (OKA-01).

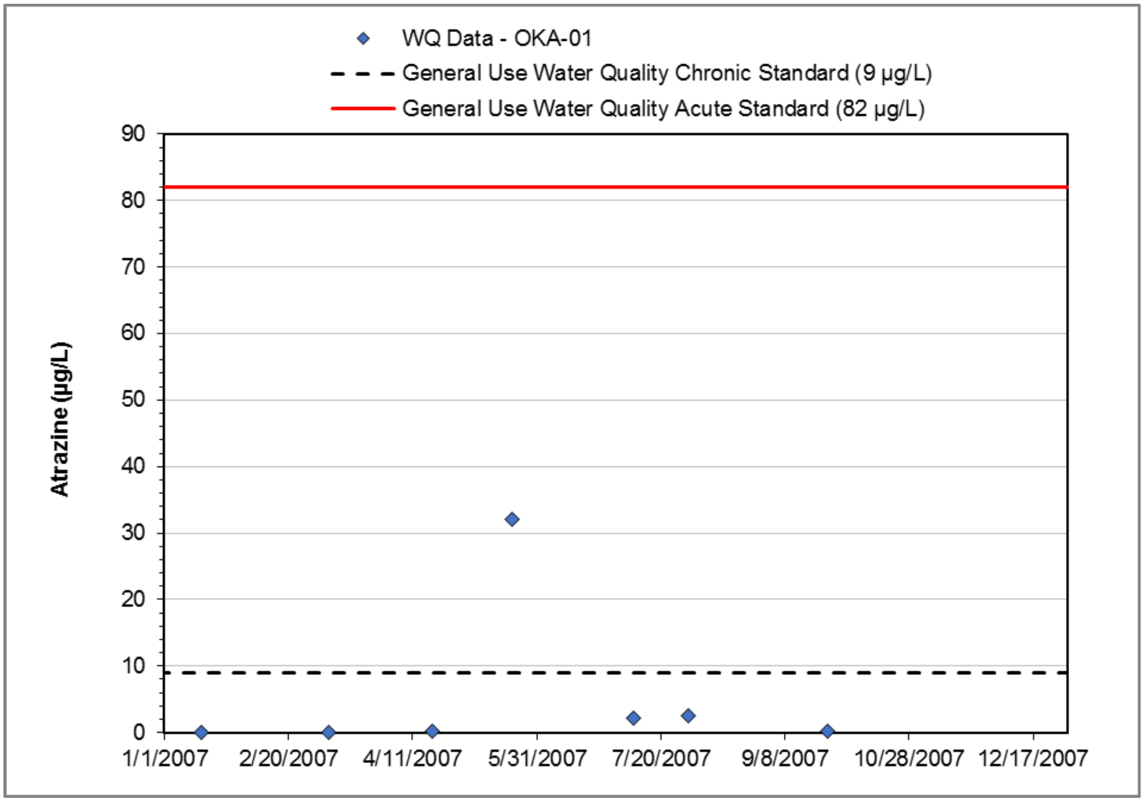

Figure 3. Water quality time series for atrazine, North Fork Kaskaskia River (OKA-01).

4.3 Kinmundy Old Lake (ROZY)

Kinmundy Old Lake (ROZY) is listed as impaired for aesthetic quality due to phosphorus. Kinmundy Old Lake is 20 acres in surface area and is therefore assessed for impairment in the state of Illinois for phosphorus. There are two sampling sites (ROZY-1 and ROZY-2; Table 9 and Figure 4). All 24 samples exceeded the general use water quality standard, confirming impairment. Chlorophyll *a* data are also available (Figure 5).

Table 9. Data summary, Kinmundy Old Lake (ROZY)

Sample Site	No. of samples	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Standard Deviation	Number of exceedances of general use water quality standard 0.05 mg/L
Total Phosphorus						
ROZY-1	18	0.1	0.3	1.6	0.5	18
ROZY-2	6	0.1	0.1	0.3	0.1	6

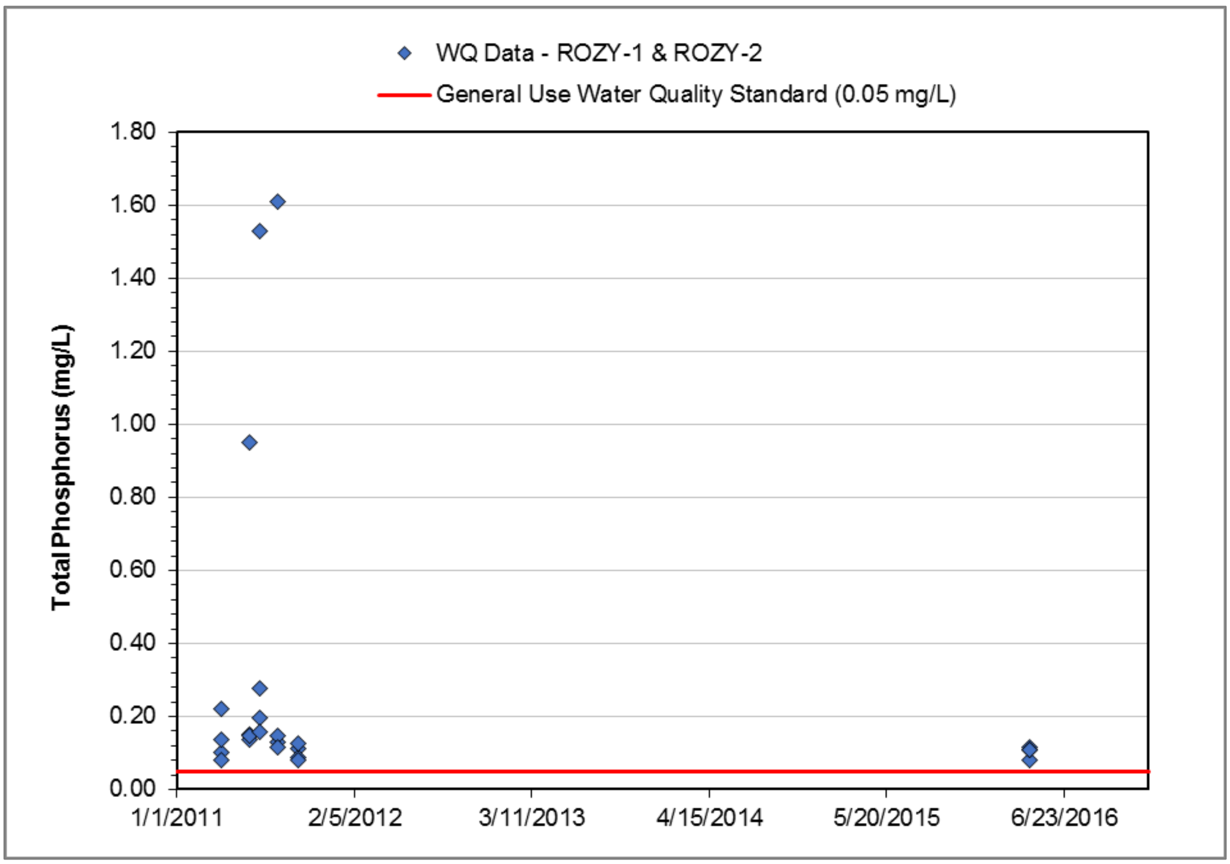

Figure 4. Water quality times series for total phosphorus, Kinmundy Old Lake (ROZY).

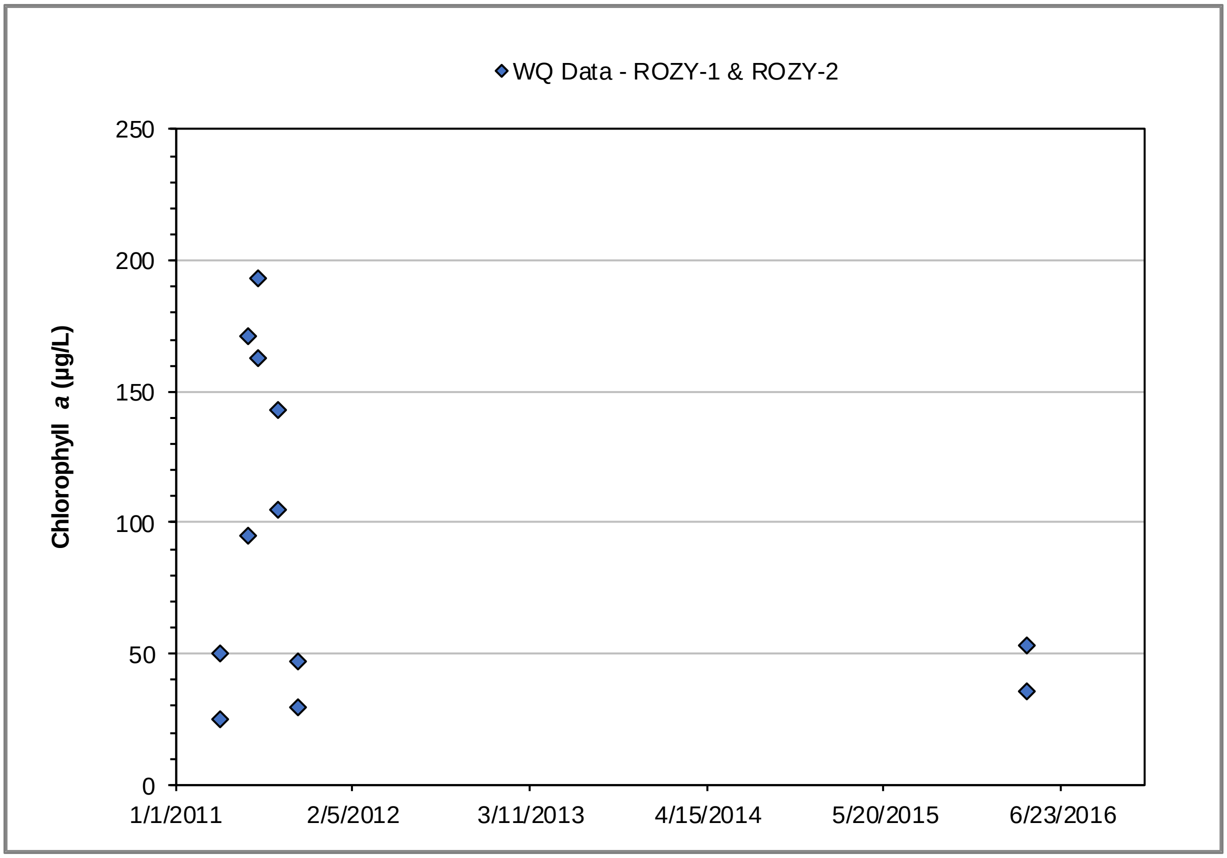

Figure 5. Water quality times series for chlorophyll *a*, Kinmundy Old Lake (ROZY).

4.4 Farina Lake (SOB)

Farina Lake (SOB) is listed as impaired for aquatic life due to dissolved oxygen, pH, and terbufos. The lake is a borrow pit that pumps water from East Fork Kaskaskia. One water quality sampling site (sampling site SOB-1) was identified in the lake.

133 dissolved oxygen measurements were collected from Farina Lake (Figure 6). Of these measurements, the dissolved oxygen standard applies to the 67 measurements that were collected above the thermocline or during periods when Farina Lake was unstratified (Table 10). Six violations of the general use water quality standard for dissolved oxygen were observed in June and October 2012 and May 2017, confirming the dissolved oxygen impairment. 133 pH samples were collected in 2012 and 2017 (Table 10 and Figure 7). 12 violations of the general use water quality standard for pH were observed in June and August 2012 and October 2017, confirming the pH impairment. Five data points were collected for terbufos, and exceedances of the general use water quality standard confirm the terbufos impairment (Table 10 and Figure 8).

Existing phosphorus data suggest that the lake is eutrophic; however, Farina Lake is under 20 acres in surface area and was therefore not assessed by IEPA for total phosphorus.

Table 10. Data summary, Farina Lake (SOB)

Sample Site	No. of samples	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	CV (standard deviation/ average)	Number of violations of general use water quality standard (>5 mg/L (Mar–Jul) and >3.5 mg/L (Aug–Feb))
Dissolved oxygen						
SOB-1	67	0.3	7.6	13.3	0.3	6
Sample Site	**No. of samples**	**Minimum (s.u.)**	**Average (s.u.)**	**Maximum (s.u.)**	**CV (standard deviation/ average)**	**Number of samples outside the range of the general use water quality standard (6.5–9.0 s.u.)**
pH						
SOB-1	133	6.2	7.4	9.1	0.1	12
Sample Site	**No. of samples**	**Minimum (µg/L)**	**Average (µg/L)**	**Maximum (µg/L)**	**CV (standard deviation/ average)**	**Number of exceedances of general use water quality standard (0.024 µg/L)**
Terbufos						
SOB-1	5	0.05	0.12	0.18	0.06	4

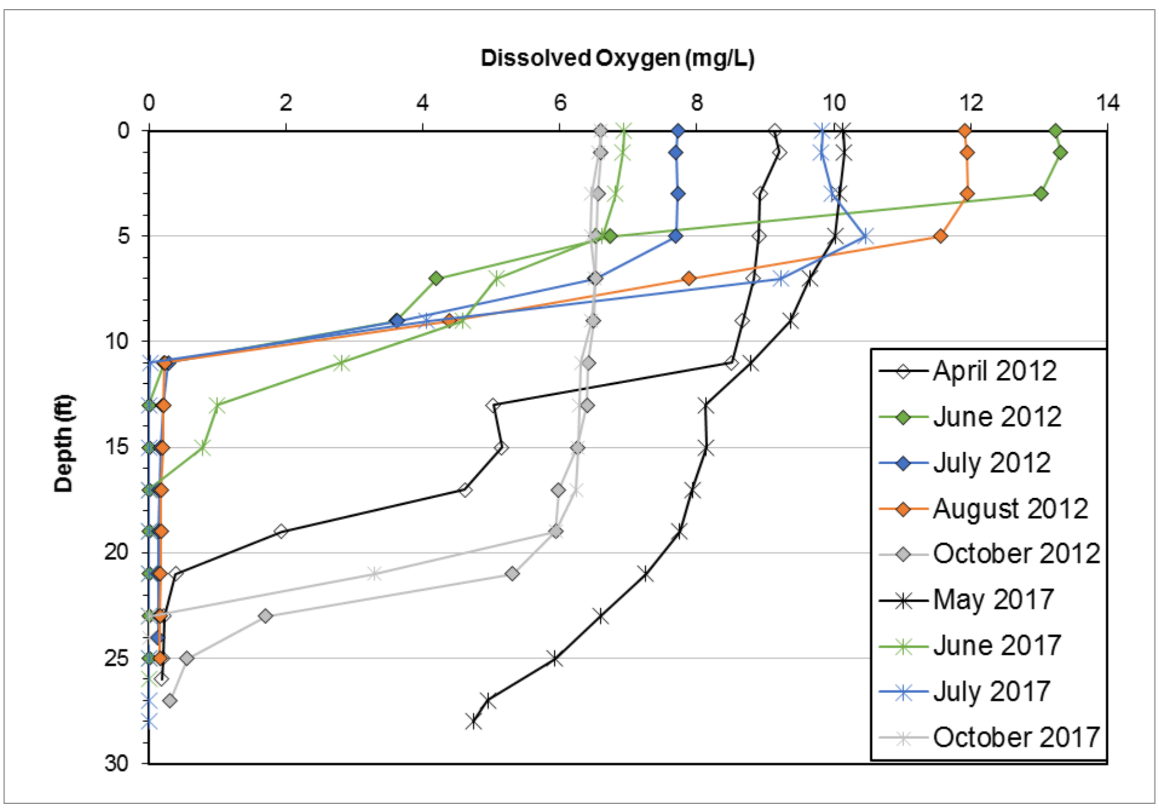

Figure 6. Dissolved oxygen depth profile data, Farina Lake SOB

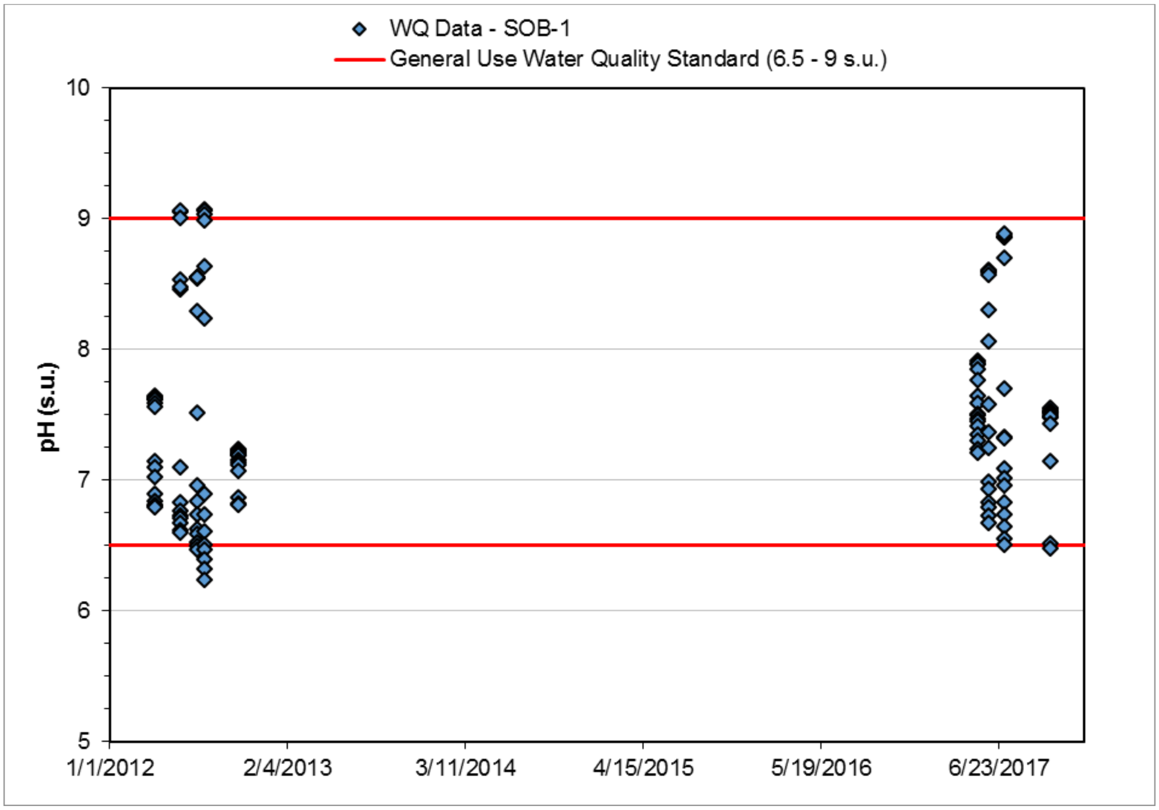

Figure 7. pH water quality time series, Farina Lake SOB

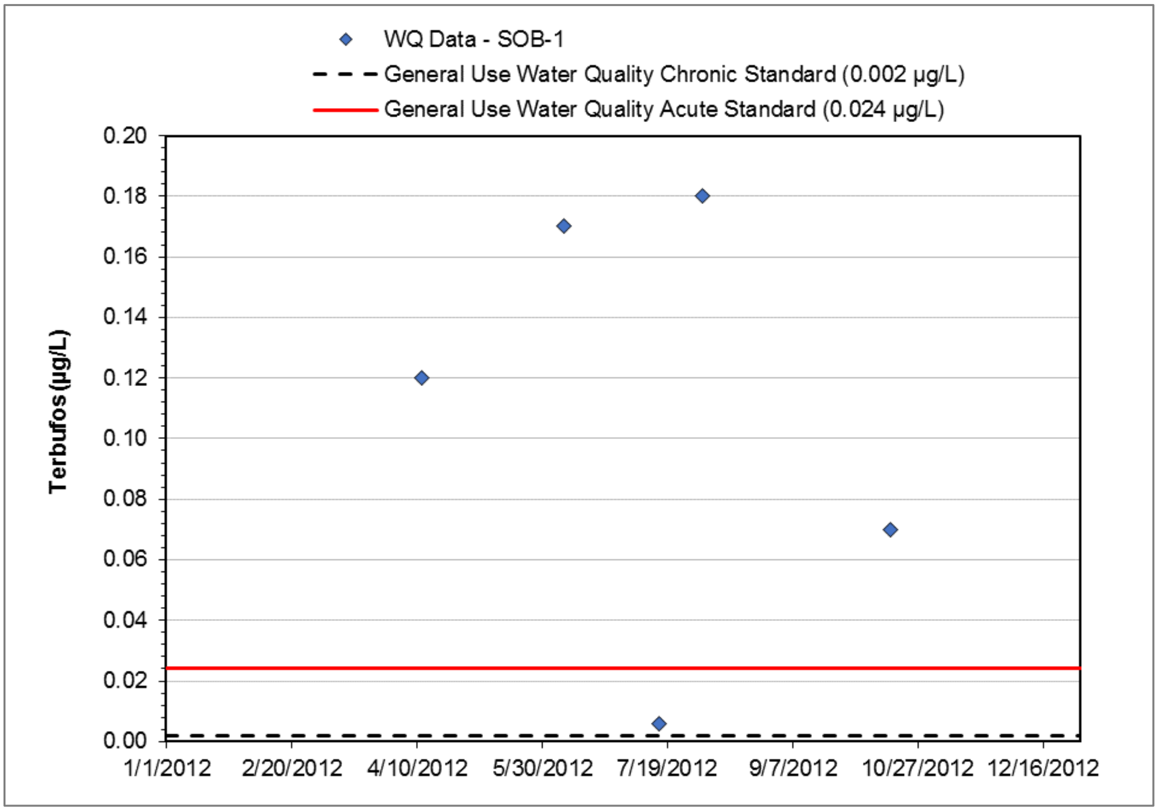

Figure 8. Water quality time series for terbufos, Farina Lake (SOB).

5. TMDL Methods and Data Needs

The first stage of this project is 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 and the additional data needed to develop credible TMDLs.

5.1 Stream Impairments

TMDLs are proposed for segments with verified impairments and known pollutants (Table 11). A duration curve approach is suggested to evaluate the relationships between hydrology and water quality and to calculate the stream TMDLs for atrazine and terbufos. For the dissolved oxygen impairment (pending impairment verification), which is not affected by point sources, it is assumed that the cause of impairment is either eutrophication or non-pollutant based (e.g., the effect of lack of re-aeration in low-gradient streams).

Table 11. Proposed model summary, streams

Name	Segment ID	Designated Uses	TMDL Parameter(s)	Proposed Model	Proposed Pollutant
East Fork Kaskaskia River	IL_OK-02	Aquatic life	Dissolved Oxygen	Load duration curve or 4C classification (pending impairment verification)	Phosphorus or non-pollutant
North Fork Kaskaskia River	IL_OKA-01	Aquatic life	Atrazine	Load duration curve	Atrazine
			Terbufos	Load duration curve	Terbufos

5.1.1 Load Duration Curve

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* (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 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 12 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 12. 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
Onsite 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.

5.2 Lake Impairments

Table 13. Proposed model summary, lakes

Name	Segment ID	Designated Uses	TMDL Parameter(s)	Proposed Model	Proposed Pollutant
Kinmundy Old Lake	IL_ROZY	Aesthetic Quality	Phosphorus	Bathtub	Phosphorus
Farina Lake	IL_SOB	Aquatic life	Dissolved Oxygen, pH	Bathtub	Phosphorus
			Terbufos	Lake volume calculation [a]	Terbufos

a. This approach was used in the previously approved East Fork Kaskaskia/Farina Lake Watershed Simazine TMDL (IEPA 2015)

5.2.1 Bathtub Model

The Bathtub model is proposed to support TMDL development for Kinmundy Old Lake and Farina Lake. Bathtub is a steady state model that predicts eutrophication response in lakes based on empirical formulas developed for nutrient balance calculations and algal response (Walker 1987). The model was developed and is maintained by the U.S. Army Corps of Engineers. The model requires nutrient loading inputs from the upstream watershed and atmospheric deposition, morphometric data for the lake, and estimates of mixing depth and nonalgal turbidity. There are sufficient phosphorus and chlorophyll *a* data to calibrate Bathtub models for both lakes. It is assumed that a phosphorus TMDL will address dissolved oxygen and pH impairments.

Due to a lack of available inflow monitoring data, watershed inputs will be derived from *Spreadsheet Tool for the Estimation of Pollutant Load* (STEPL). STEPL provides a simplified simulation of precipitation-driven runoff and sediment and nutrient delivery. STEPL can estimate loads from land uses, as well as from other sources such as stream bank erosion and failing septic systems. STEPL simulates runoff and stream flow using summary information on precipitation and rain days for the nearest weather station. STEPL has been used extensively in Region 5 for watershed plan development and in support of watershed studies. STEPL is an appropriate model to evaluate the relative contribution of various sources of pollutants and allows for the identification of the priority sources of pollutants for evaluation during implementation planning. STEPL also provides the level of detail needed for external watershed loading to Kinmundy Old Lake and Farina Lake required for Bathtub input.

5.2.2 Lake Volume Calculation

Farina Lake consists of pumping water for public water supply from the East Fork Kaskaskia River. The volume of the lake will be used to determine the allowable loading of terbufos. This method was used in the East Fork Kaskaskia/Farina Lake Simazine TMDL (IEPA 2015) and will be used in this TMDL for consistency.

$$Loading\ Capacity = Maximum\ storage\ \ X\ \ water\ quality\ standard$$

5.3 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)
- 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 14 summarizes the additional data needed for each impaired segment.

Table 14. Additional data needs

Name	Segment ID	Designated Uses	TMDL Parameters	Additional Data Needs
East Fork Kaskaskia	IL_OK-02	Aquatic life	Dissolved oxygen	To confirm impairment and to determine eutrophication relationship
North Fork Kaskaskia	IL_OKA-01	Aquatic life	Atrazine	None
			Terbufos	None
Kinmundy Old Lake	IL_ROZY	Aesthetic Quality	Phosphorus	None
Farina Lake	IL_SOB	Aquatic Life	Dissolved Oxygen, pH, terbufos	None

Specific data needs include:

Confirm DO impairment and determine relationship with eutrophication on East Fork Kaskaskia (IL_OK-02)—A series of DO measurements and chlorophyll-*a* and TP grab samples (two samples per day on three separate sampling days should be collected from the impaired segment to verify impairment and to determine the role of eutrophication, if any, in the impaired segment. Sampling should occur during the warm summer months (July–August) and during low flows, and one of each paired sample should occur in the early morning to ensure that critical conditions are captured.

Additional field based monitoring–Further in-field assessment can help to better determine the sources of impairments and develop an effective TMDL implementation plan. Additional monitoring for impaired waterbodies includes:

- Wind shield surveys
- Streambank survey and stream assessment for East Fork Kaskaskia (IL_OK-02) and associated pollutants (phosphorus or non-pollutant, pending TMDL approach)
- Lakeshore assessment for Kinmundy Old Lake and Farina Lake
- 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 12, 2018 at the Carlyle Lake Visitor Center in Carlyle, 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 the US Army Corps of Engineers, the Kaskaskia Watershed Association, the Original Kaskaskia Area Wilderness, Inc., and others. The public comment period closed on January 12, 2019. No written comments were provided on the draft Stage 1 report.

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Appendix A – Unimpaired Stream Data Analysis

Farina Lake (IL_SOB) is listed as impaired for copper (dissolved). According to Illinois Administrative Code, Title 35, Part 302, Subpart B, 302.208, a segment is impaired for copper if:

- The Acute Standard (AS) of $e^{(A+B\ln(H))} \times 0.960$, where A= -1.464 and B= 0.9422; H= hardness, is exceeded at any point, or
- The geometric mean of four consecutive samples over at least four days exceeds the Chronic standard (CS) $e^{(A+B\ln(H))} \times 0.960$, where A= -1.465 and B= 0.8545; H= hardness

One IEPA sampling site was identified in the lake (SOB-1). No samples of dissolved copper are available; however, total copper was below the dissolved copper standard (Figure 9). The dissolved concentration by definition is less than the total copper concentration and therefore does not exceed the standard. It is recommended that the segment be delisted for copper and no TMDL for copper be developed.

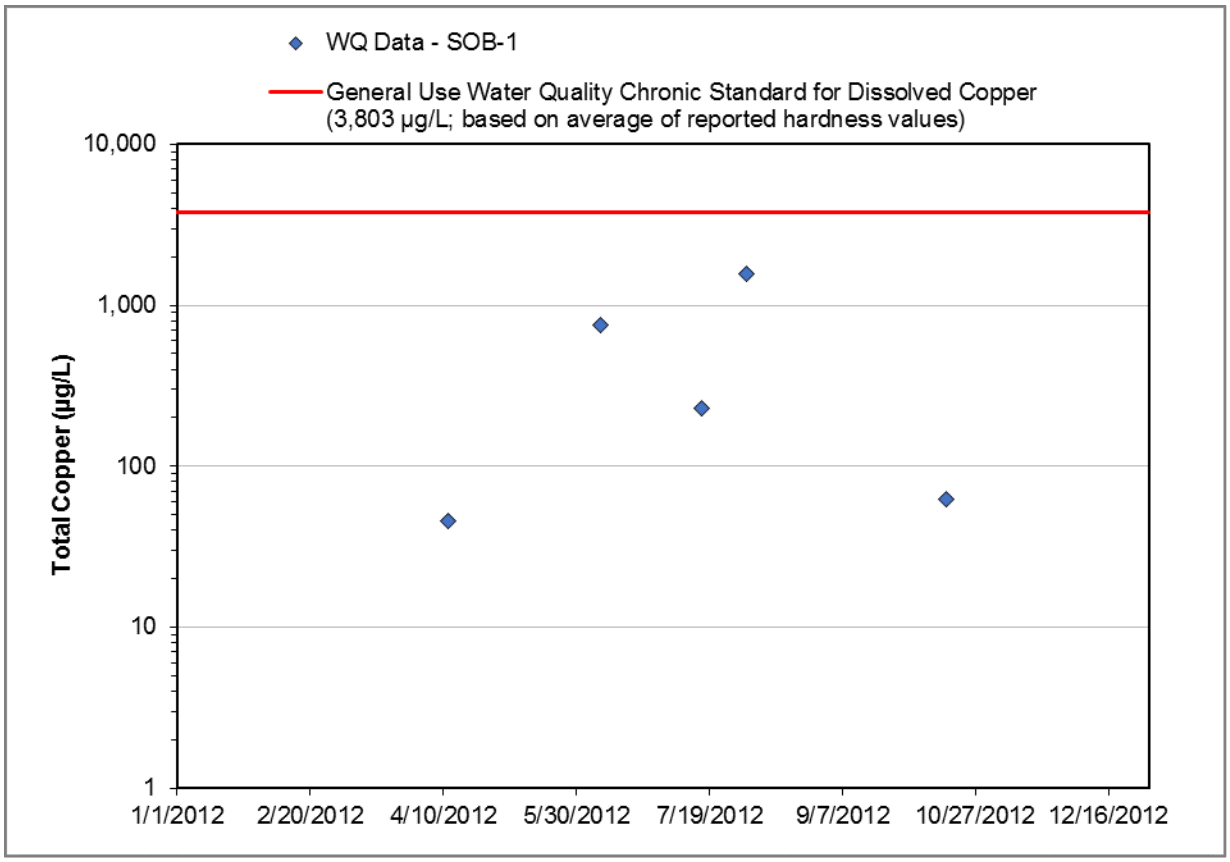

Figure 9. Water quality time series for total copper, Farina Lake (SOB).
The chronic standard of 3,803 µg/L is based on an average hardness of 90,160 CaMg mg/L, from the five samples graphed in this figure.

Appendix B – Stage 2 Data

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	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:	**19I1103-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/25/19 14:33
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)	**2.67**		0.50	
Chlorophyll-A (unco)	**0.59**		0.50	
Chlorophyll-B	ND		0.50	
Chlorophyll-C	ND		0.50	
Pheophytin-A	ND		0.50	

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:

10/15/19 11:19

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	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

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:
10/15/19 11:19

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/13/19 11:20 by LAUREN AIELLO
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	Temperature C:	3.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190911INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	MFS	Lab Sample ID:	**19I0550-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/11/19 9:38
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

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

Method:	EPA 365.1	Prepared:	10/09/19 09:00
Units:	mg/L	Analyzed:	10/09/19 16:44

Analyte	Result	Qualifier	Reporting Limit	MDL
Phosphorus as P	**0.111**		0.0050	0.0042

Reported:
10/15/19 11:23

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/13/19 11:20 by LAUREN AIELLO
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	Temperature C:	3.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190911INHS	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 11:23

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/13/19 11:20 by LAUREN AIELLO
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190911INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	CHLOROPHYLL	Collected By:	MFS	Lab Sample ID:	**19I0551-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/11/19 9:38
Sample Fraction:	Total	Chlorophyll volume filtered (ml):	200	Sample Depth:	

Chlorophyll by Standard Method 10200 H

Method: 10200 H

Units: ug/L

Prepared: 09/26/19 13:00

Analyzed: 09/30/19 13:45

Analyte	Result	Qualifier	Reporting Limit	MDL
Chlorophyll-A (corr)	**1.34**		0.50	
Chlorophyll-A (unco)	**1.11**		0.50	
Chlorophyll-B	**0.51**		0.50	
Chlorophyll-C	ND		0.50	
Pheophytin-A	ND		0.50	

Reported:
10/04/19 09:18

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

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/13/19 11:20 by LAUREN AIELLO
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190911INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

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* Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Reported:
10/04/19 09:18

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

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/13/19 11:20 by LAUREN AIELLO
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	Temperature C:	3.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190911INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	TOTAL	Collected By:	VIT	Lab Sample ID:	**19I0552-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/11/19 13:05
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

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

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

Units: mg/L — Analyzed: 10/09/19 16:44

Analyte	Result	Qualifier	Reporting Limit	MDL
Phosphorus as P	**0.102**		0.0050	0.0042

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Reported:
10/15/19 11:23

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

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/13/19 11:20 by LAUREN AIELLO
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	Temperature C:	3.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190911INHS	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 11:23

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/13/19 11:20 by LAUREN AIELLO
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190911INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	CHLOROPHYLL	Collected By:	VIT	Lab Sample ID:	**19I0553-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/11/19 13:05
Sample Fraction:	Total	Chlorophyll volume filtered (ml):	200	Sample Depth:	

Chlorophyll by Standard Method 10200 H

Method:	10200 H	Prepared:	09/26/19 13:00
Units:	ug/L	Analyzed:	09/30/19 13:45

Analyte	Result	Qualifier	Reporting Limit	MDL
Chlorophyll-A (corr)	**1.34**		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:
10/04/19 09:17

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

LABORATORY RESULTS

Station Code:	OK-02			Received : 09/13/19 11:20	by LAUREN AIELLO
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190911INHS	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:
10/04/19 09:17

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702   217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/19/19 16:00 by Amber Royster
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	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:	**19I0833-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/18/19 13:39
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

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

Method:	EPA 365.1	Prepared:	10/15/19 10:00
Units:	mg/L	Analyzed:	10/15/19 17:14

Analyte	Result	Qualifier	Reporting Limit	MDL
Phosphorus as P	**0.102**		0.0050	0.0042

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Reported:
10/29/19 15:01

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/19/19 16:00 by Amber Royster
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	Temperature C:	6.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190918INHS	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:
10/29/19 15:01

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/19/19 16:00 by Amber Royster
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	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:	**19I0834-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/18/19 11:24
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

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

Method:	EPA 365.1	Prepared:	10/15/19 10:00
Units:	mg/L	Analyzed:	10/15/19 17:15

Analyte	Result	Qualifier	Reporting Limit	MDL
Phosphorus as P	**0.101**		0.0050	0.0042

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Reported:

10/29/19 15:01

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/19/19 16:00 by Amber Royster
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	Temperature C:	6.00
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190918INHS	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:
10/29/19 15:01

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

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/19/19 16:00 by Amber Royster
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190918INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	CHLOROPHYLL	Collected By:	MFS	Lab Sample ID:	**19I0840-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/18/19 13:39
Sample Fraction:	Total	Chlorophyll volume filtered (ml):	200	Sample Depth:	

Chlorophyll by Standard Method 10200 H

Method:	10200 H	Prepared:	09/30/19 12:01
Units:	ug/L	Analyzed:	10/03/19 10:31

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 11:22

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/19/19 16:00 by Amber Royster
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190918INHS	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 11:22

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702   217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/19/19 16:00 by Amber Royster
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190918INHS	Visit Number:	001	Monitoring Program:	TMDL

Client Sample ID:	CHLOROPHYLL	Collected By:	VIT	Lab Sample ID:	**19I0841-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/18/19 10:24
Sample Fraction:	Total	Chlorophyll volume filtered (ml):	200	Sample Depth:	

Chlorophyll by Standard Method 10200 H

Method:	10200 H	Prepared:	09/30/19 12:01
Units:	ug/L	Analyzed:	10/03/19 10:31

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 11:22

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702   217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/19/19 16:00 by Amber Royster
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	Temperature C:	
Funding Code:	WP06			Monitoring Unit:	TMDL
Trip ID:	20190918INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

ND	Analyte NOT DETECTED at or above the method detection limit
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Laboratory Manager

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Reported:
10/15/19 11:22

Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code:	OK-02			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	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:	**19I1100-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/25/19 10:50
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

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 16:51

Analyte	Result	Qualifier	Reporting Limit	MDL
Phosphorus as P	**0.121**		0.0050	0.0042

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Reported:
10/29/19 14:59

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	Temperature C:	2.00
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:
10/29/19 14:59

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	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:	**19I1101-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/25/19 10:50
Sample Fraction:	Total	Chlorophyll volume filtered (ml):	200	Sample Depth:	

Chlorophyll by Standard Method 10200 H

Method: 10200 H

Units: ug/L

Prepared: 10/02/19 14:30

Analyzed: 10/04/19 11:14

Analyte	Result	Qualifier	Reporting Limit	MDL
Chlorophyll-A (corr)	**2.67**		0.50	
Chlorophyll-A (unco)	**1.18**		0.50	
Chlorophyll-B	ND		0.50	
Chlorophyll-C	ND		0.50	
Pheophytin-A	ND		0.50	

Reported:

10/15/19 11:19

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	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

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Tom Weiss
Laboratory Manager

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Reported:
10/15/19 11:19

Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702   217.782.9780

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	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:	**19I1102-01**
Sample Medium:	Water	PWS Intake:		Date/Time Collected:	09/25/19 14:33
Sample Fraction:	Total	Chlorophyll volume filtered (ml):		Sample Depth:	

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 16:52

Analyte	Result	Qualifier	Reporting Limit	MDL
Phosphorus as P	**0.105**		0.0050	0.0042

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Reported:

10/29/19 14:58

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

LABORATORY RESULTS

Station Code:	OK-02			Received :	09/26/19 16:21 by Amber Royster
Waterbody Name:	EAST FORK KASKASKIA RIVER	County:	MARION	Temperature C:	2.00
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:
10/29/19 14:58

Appendix C – Recommendations for Delisting

One stream segment is recommended for delisting and one lake was recommended for delisting in the Stage 1 report (Appendix A). Each segment is discussed separately in the following subsections. Refer to the Stage 1 Report in Appendix A for a discussion of the dissolved oxygen and copper standards.

C.1 East Fork Kaskaskia River (IL_OK-02)

East Fork Kaskaskia River (IL_OK-02) is listed as being impaired for aquatic life due to low levels of dissolved oxygen. As discussed in the Stage 1 Report (Appendix A), no dissolved oxygen data were previously available for this segment. Dissolved oxygen data were collected during September 2019.

Continuously recording data sondes were used to collect dissolved oxygen measurements in the morning and afternoon on each day of sampling at site OK-02. The data were averaged for each morning and each afternoon (Table C - 1).

Table C - 1. Dissolved oxygen data (East Fork Kaskaskia River at site OK-02)

Date	Time of Day	Dissolved oxygen (milligram per liter)
9/11/2019	AM	5.49
	PM	6.46
9/18/2019	AM	5.63
	PM	6.47
9/25/2019	AM	5.67
	PM	6.34

All the measurements were greater than the 3.5 milligrams per liter instantaneous minimum standard for August through February. As the data do not indicate impairment, this segment is recommended for delisting.

C.2 Farina Lake (IL_SOB)

As discussed in the Stage 1 Report (Appendix A), Farina Lake (IL_SOB) is listed as being impaired by dissolved copper. The only sampling site on Farina Lake (SOB-1) was sampled five times in 2012, and the samples were evaluated for total copper. All five samples total copper concentrations were less than the corresponding hardness-based standards for dissolved copper. As the data do not indicate impairment, this segment is recommended for delisting.

Appendix D – Stage 3 Comments and Responses

<to be included once developed>