Shoal Creek Watershed (II) Total Maximum Daily Load

Final Stage 1 Report

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Acronyms and Abbreviations

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

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 Shoal Creek watershed in south-central Illinois. The project area, referred to as the Shoal Creek II watershed, is approximately 310 square miles and includes multiple impairments (Figure 1). A TMDL study was previously completed for the Shoal Creek watershed. Relevant information from the study is included herein where applicable (IEPA 2008).

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

1.1 Water Quality Impairments

Numerous segments are included on the draft 303(d) list of impaired waters; however, only four segments are addressed as part of this project. Segment OI-05 within the Shoal Creek watershed has been placed on the State of Illinois §303(d) list (Table 1 and Figure 1) and requires development of a TMDL. The segment was previously recommended for delisting based on data collected during two periods of continuous monitoring in 2006 as part of the previous completed Shoal Creek TMDL (IEPA 2008). Since the 2006 monitoring, however, water quality standard violations have been observed in this segment.

Table 1. Shoal Creek watershed impairments and pollutants (2016 Illinois 303(d) Draft List)

Name	Segment ID	Segment Length (Miles)	Watershed Area (Sq. Miles)	Designated Uses	Cause of Impairment
Shoal Creek	OI-05	13.37	917	Aquatic Life	**Dissolved Oxygen**
Shoal Creek	OI-08	14.29	745	Public and Food Processing Water Supply	Iron [a]
Shoal Creek	OI-13	11.49	726	Aquatic Life	Dissolved Oxygen [b]
Shoal Creek	OI-15	11.12	685	Aquatic Life	Dissolved Oxygen [c]

BOLD – TMDLs are addressed in this Stage 1 report.
a. Impairment was removed from the 2018 draft 303(d) list and is not addressed further in this report.
b. Additional data are needed to verify impairment.
c. While recent data show no impairment, the assessment is still undergoing quality control review.

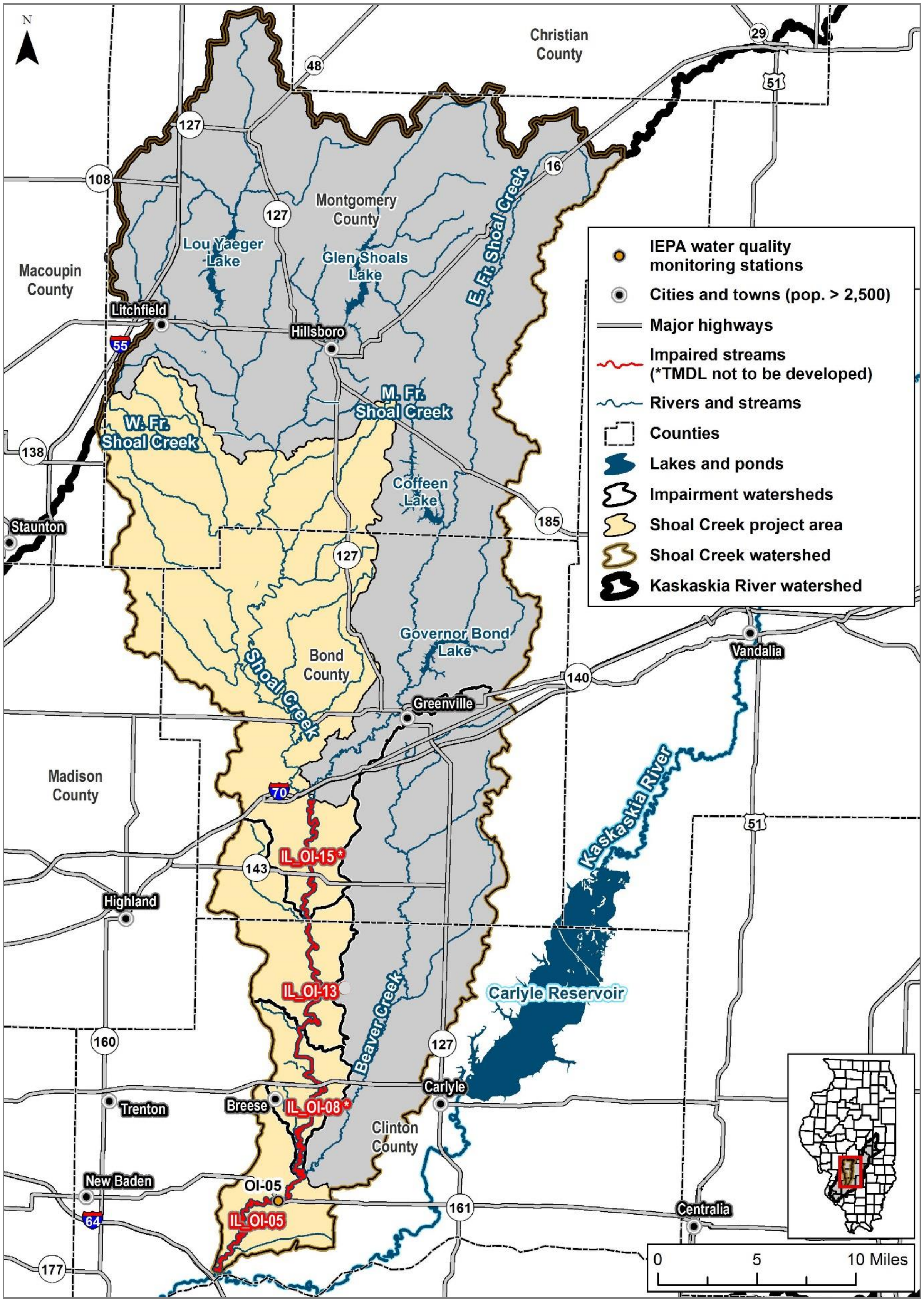

Figure 1. Shoal Creek watershed, TMDL project area.

1.2 TMDL Endpoints

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

1.2.1 Designated Uses

Illinois EPA uses rules and regulations adopted by the Illinois Pollution Control Board (IPCB) to assess the designated use support for Illinois waterbodies. The following are the use support designations provided by the IPCB that apply to waterbodies in the Shoal Creek 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.

Shoal Creek segment OI-05 is designated for dissolved oxygen enhanced protection according to 35 Ill Adm. Code 302.206. Waters with enhanced protection have a more stringent dissolved oxygen standard than other waters of the State. These waters were chosen based on the potential biota (fish early life stages present) and the dissolved oxygen needed for these biota to thrive.

1.2.2 Water Quality Standards and TMDL Endpoints

Environmental regulations for the State of Illinois are contained within 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 within the study area. Water quality standards are the endpoints to be used for TMDL development in the Shoal Creek watershed (Table 2).

Table 2. Summary of water quality standards for the Shoal Creek watershed

Parameter	Units	General Use Water Quality Standard for Waters with Enhanced Protection
Dissolved Oxygen [a]	mg/L	March-July > 5.0 min & > 6.25 7-day mean Aug-Feb > 4.0 min, > 4.5 7-day mean, & > 6.0 30-day mean

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

2. Watershed Characterization

The Shoal Creek watershed is located in southwestern Illinois (Figure 1). The headwaters begin in northern Montgomery County and Christian County, IL and flow south towards its confluence with the Kaskaskia River. Shoal Creek joins the Upper Kaskaskia River downstream of Carlyle Lake and the Kaskaskia River eventually joins the Mississippi River south of St. Louis, Missouri. A TMDL has recently been developed for a portion of the Shoal Creek watershed (IEPA 2008) therefore the previous Shoal Creek Watershed TMDL provides the basis for the watershed characterization and source assessment for the Shoal Creek project area below.

2.1 Jurisdictions and Population

Relevant information on jurisdictions and population can be found within the recently completed Shoal Creek Total Maximum Daily Load (IEPA 2008). The project area is located within Bond, Montgomery, Clinton, Madison, and Macoupin counties.

2.2 Climate

In general, the climate of southern Illinois is temperate with hot summers and cold, snowy winters. Relevant information on climate can be found within the recently completed Shoal Creek Total Maximum Daily Load (IEPA 2008).

2.3 Land Use and Land Cover

Relevant information on land use and land cover can be found within the recently completed Shoal Creek Total Maximum Daily Load (IEPA 2008). Cultivated crops make up the majority of the land cover in the project area.

2.4 Topography

Relevant information on topography can be found within the recently completed Shoal Creek Total Maximum Daily Load (IEPA 2008).

2.5 Soils

Relevant information on soils can be found within the recently completed Shoal Creek Total Maximum Daily Load (IEPA 2008). Soils are primarily category C soils that are defined as "soils having a slow infiltration rate when thoroughly wet" with slow infiltration rates. They typically consist of "soils having a layer that impedes the downward movement of water or soils of moderately fine texture or find texture" (IEPA 2008).

2.6 Hydrology

Relevant information on hydrologic conditions can be found within the recently completed Shoal Creek Total Maximum Daily Load (IEPA 2008). An active U.S. Geological Survey (USGS) flow gage site is located on the Shoal Creek OI-08 segment (USGS gage 05594000).

2.7 Watershed Studies and Information

Relevant information for this section can be found within the recently completed Shoal Creek Total Maximum Daily Load (IEPA 2008). County soil and water conservation districts and health departments were contacted for additional information; no new information was provided.

3. Watershed Source Assessment

Source assessments are an important component of water quality management plans and TMDL development. This section provides a summary of potential sources that contribute to low dissolved oxygen conditions in Shoal Creek.

3.1 Pollutants of Concern

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

3.2 Point Sources

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

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

Under the CWA, all point sources are regulated under the NPDES program. A municipality, industry, or operation must apply for an NPDES permit if an activity at that facility discharges wastewater to surface water. Point sources can include facilities such as municipal wastewater treatment plants (WWTPs), industrial facilities, CAFOs, or regulated storm water including municipal separate storm sewer systems (MS4s).

There are two individual NPDES permitted facilities in the Shoal Creek (OI-05) watershed—the Germantown Sewage Treatment Plant (STP) (NPDES permit ILG580186) and one CAFO (NPDES permit ILA010007). There are no permitted MS4s. Germantown STP is a domestic lagoon that discharges to a Shoal Creek tributary with average design flow of 0.135 million gallons per day (MGD) and maximum design flow of 0.330 MGD.

There are three individual NPDES permitted facilities in the Shoal Creek (OI-15) watershed—Pocahontas STP (ILG580010), Pierron East STP (ILG580237), and Louisville STP (ILG580081).

There are no permitted facilities or MS4s in the Shoal Creek (OI-13) watershed.

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. Nonpoint pollutant sources potentially contributing to low dissolved oxygen impairments include agricultural runoff, onsite wastewater treatment systems, and animal agriculture activities. As part of the water resource assessment process, Illinois EPA has identified several sources as contributing to the impairments: loss of riparian habitat, crop production (crop land or dry land), and agriculture, all of which are nonpoint sources.

3.3.1 Agricultural Runoff

During wet-weather events (snowmelt and rainfall), pollutants are incorporated into runoff and can be delivered to downstream waterbodies. The resultant pollutant loads are linked to the land uses and practices in the watershed. Agricultural 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. 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. The majority of land within the Shoal Creek watershed is in cultivated crops.

3.3.2 Onsite Wastewater Treatment Systems

Onsite wastewater treatment systems (e.g., septic systems) that are properly designed and maintained should not serve as a source of contamination to surface waters. However, onsite systems do fail for a variety of reasons. Common soil-type limitations which contribute to failure include seasonally high water tables, compact glacial till, bedrock, and fragipan. When these septic systems fail hydraulically (surface breakouts) or hydrogeologically (inadequate soil filtration) there can be adverse effects to surface waters (Horsley and Witten 1996). Septic systems contain all the water discharged from homes and business and can be significant sources of pollutants.

Illinois EPA estimates that between 20–60% of onsite wastewater treatment systems are failing in the state of Illinois (IEPA 2004). During the development of this TMDL county health departments were contacted for county specific information on septic systems and unsewered communities. Septic systems throughout the watershed are typically inspected during installation and on a complaint basis. There are approximately 20,000 septic systems in Madison County. In 2017, 223 systems were inspected in Madison County and 96.5 percent of systems that were previous found under violation were brought into compliance.

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 nutrients to streams, particularly when direct access is not restricted and/or where feeding structures are located adjacent to riparian areas. Bond and Clinton SWCDs received a 319 grant from IEPA in 2016 to continue work in the two counties assisting livestock producers in making improvements to their animal waste systems to reduce nutrient and sediment loading to waterbodies.

4. Water Quality

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.

Background information on water quality monitoring can be found in the recently completed Shoal Creek Total Maximum Daily Load (IEPA 2008). In the Shoal Creek watershed, water quality data were found for numerous stations that are part of the Illinois EPA Ambient Water Quality Monitoring Network (AWQMN). Parameters sampled in the streams include field measurements (e.g., dissolved oxygen) 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 in impairment status evaluation; however, data from 2002 were available for segment OI-05. Each data point was reviewed to ensure the use of quality data in the analysis below. Data were obtained directly from Illinois EPA.

4.1 Shoal Creek (OI-05)

Shoal Creek (O1-05) is impaired for aquatic life due to low levels of dissolved oxygen. One Illinois EPA sampling site is present on segment OI-05 of Shoal Creek (Table 3 and Figure 2). Ten samples were collected at the site from 2007–2012. Four violations of the general use water quality standard – enhanced protection were observed in June and August 2007 and July of 2012. Continuous dissolved oxygen data were collected in 2007 and 2017; multiple violations of the standard were observed in July and August 2007 (Figure 3). These violations verify impairment.

Table 3. Data summary, Shoal Creek OI-05

Sample Site	No. of samples	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Number of exceedances of general use water quality standard – enhanced protection (>5 mg/L (Mar-Jul) and >4 mg/L (Aug-Feb))
OI-05	10	3.1	5.4	8.8	4

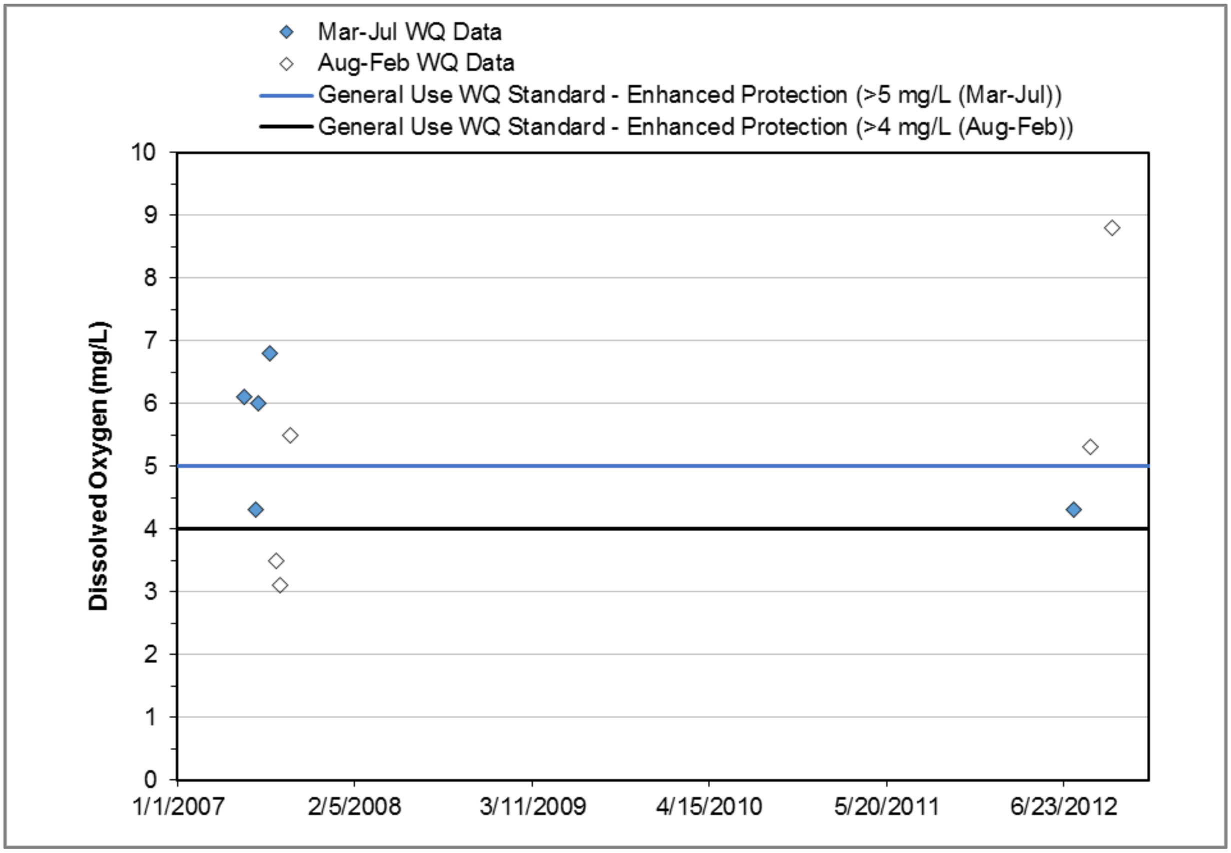

Figure 2. Dissolved oxygen water quality time series, Shoal Creek OI-05.

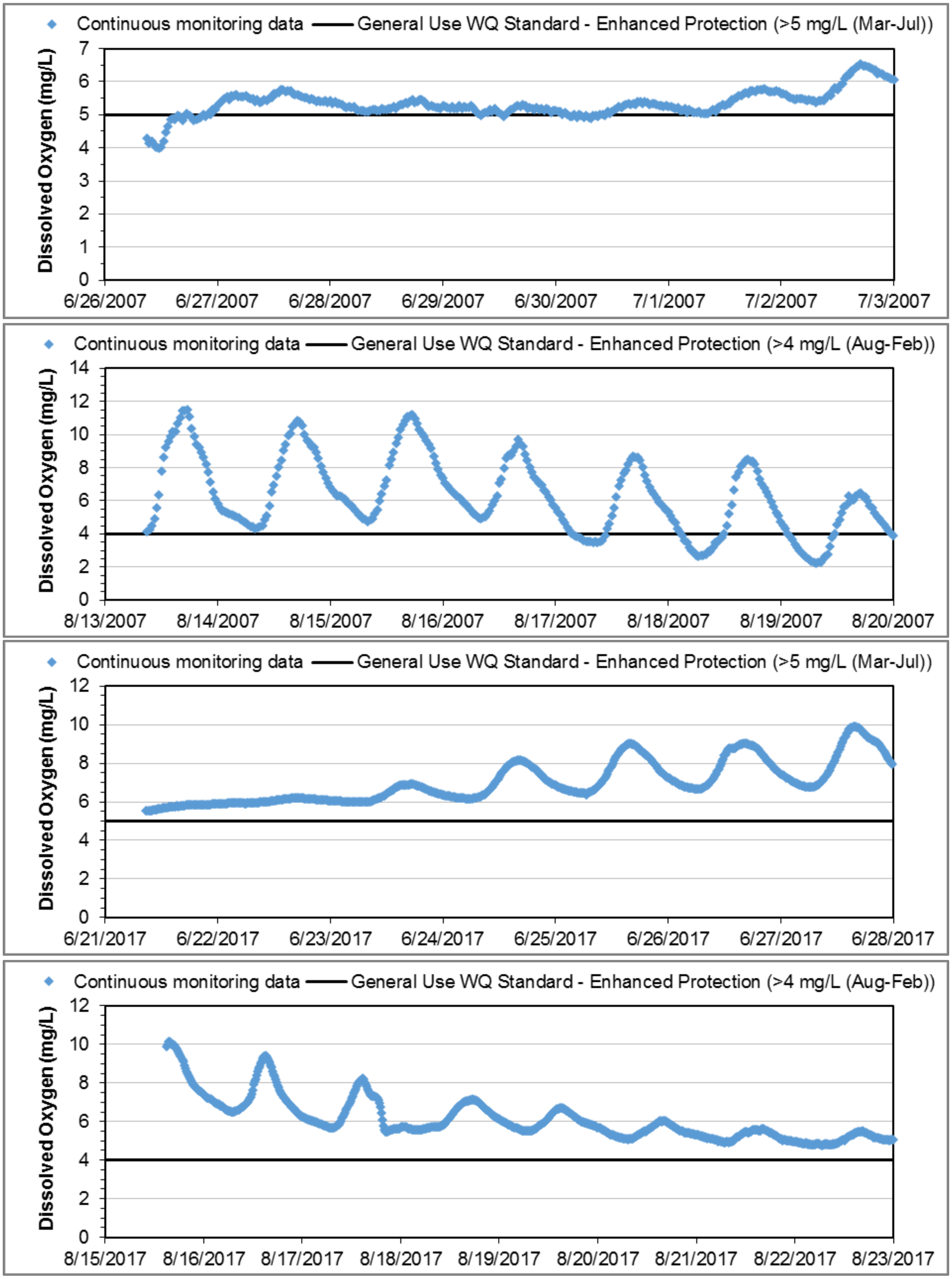

Figure 3. Continuous water quality time series for dissolved oxygen, Shoal Creek OI-05 segment.

Further review of available data was conducted to determine the cause of impairment:

- **Point Sources:** The point source discharging into Shoal Creek is downstream from the monitoring station (OI-05) and is therefore not contributing to the impairment.

- **Eutrophication:** Available phosphorus data were evaluated to determine if eutrophication was contributing to low dissolved oxygen conditions; however, no eutrophication relationship exists between high levels of phosphorus and low levels of dissolved oxygen (Figure 4).

Although the impairment has been verified, a strong link to a pollutant is not present and there are no point sources contributing to the impairment that has been assessed based on data at OI-05.

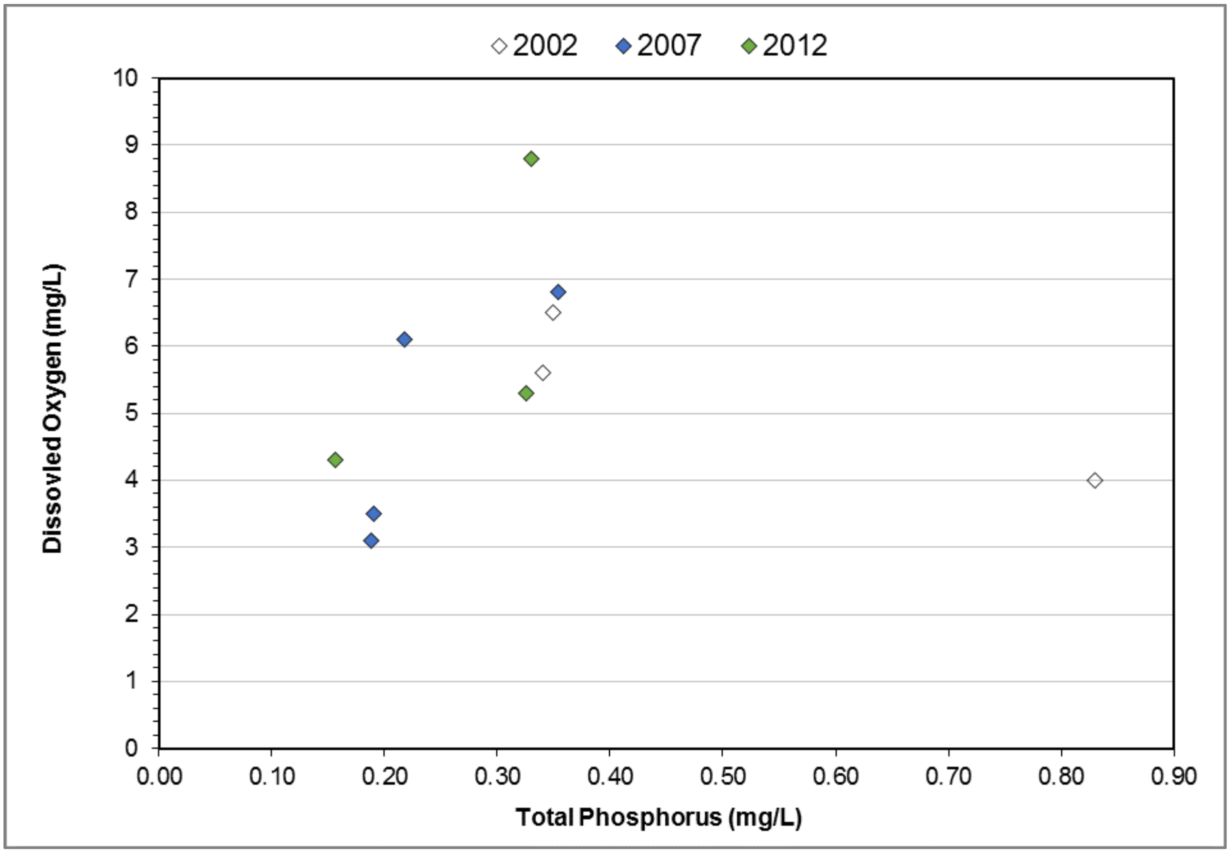

Figure 4. Total phosphorus verse dissolved oxygen, Shoal Creek OI-05.

4.2 Shoal Creek (OI-13)

Shoal Creek segment OI-13 is listed as impaired for aquatic life due to dissolved oxygen. One IEPA sampling site (OI-13) was identified on the segment. Data collection between 2007–2016 does not indicate impairment in the segment (Figure 5); however, due to the small sample size, additional data are needed to verify impairment.

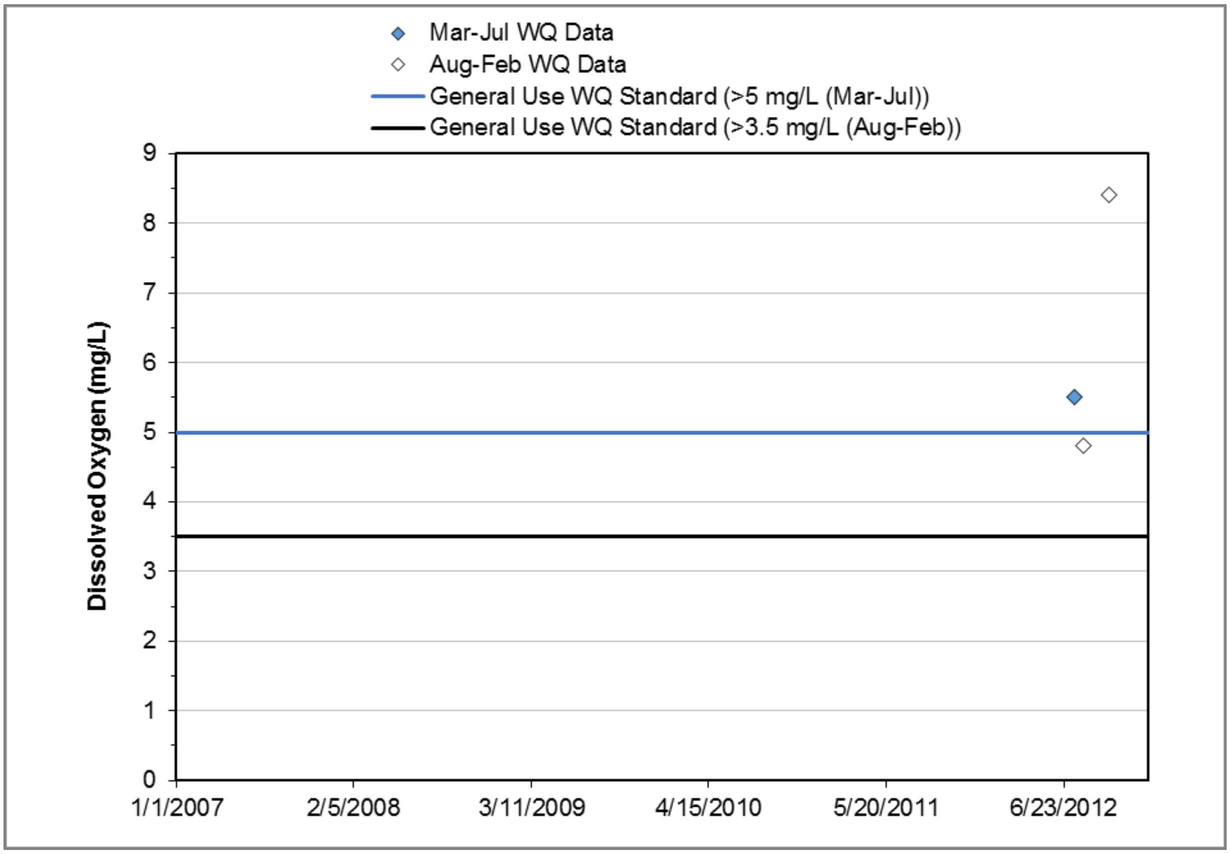

Figure 5. Dissolved oxygen water quality time series, Shoal Creek OI-13.

4.3 Shoal Creek (OI-15)

Shoal Creek segment OI-15 is listed as impaired for aquatic life due to dissolved oxygen. One IEPA sampling site was identified on the segment, OI-15. Data collection between 2007–2012 (Figure 6) and continuous data from June and August 2017 (Figure 7) do not indicate impairment. While the data do not show impairment, the assessment is still undergoing quality control review.

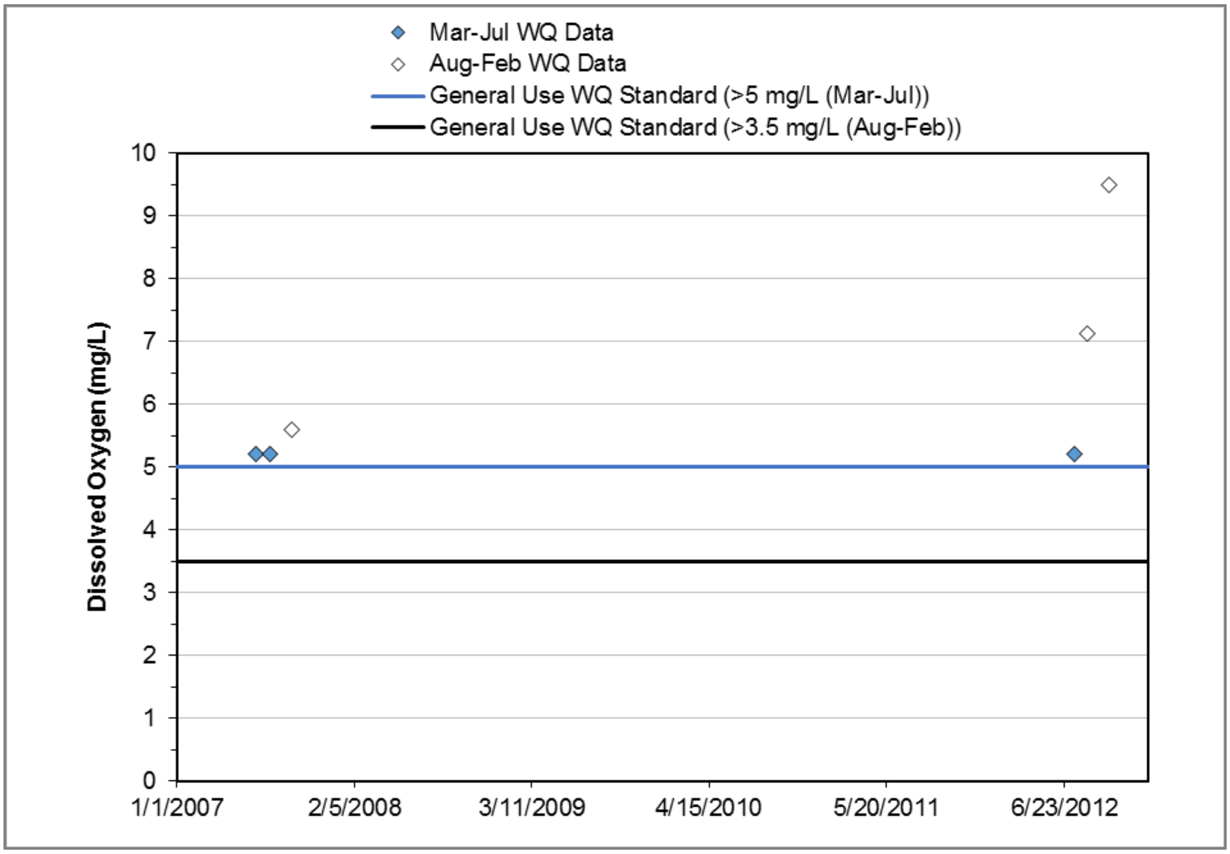

Figure 6. Dissolved oxygen water quality time series, Shoal Creek OI-15.

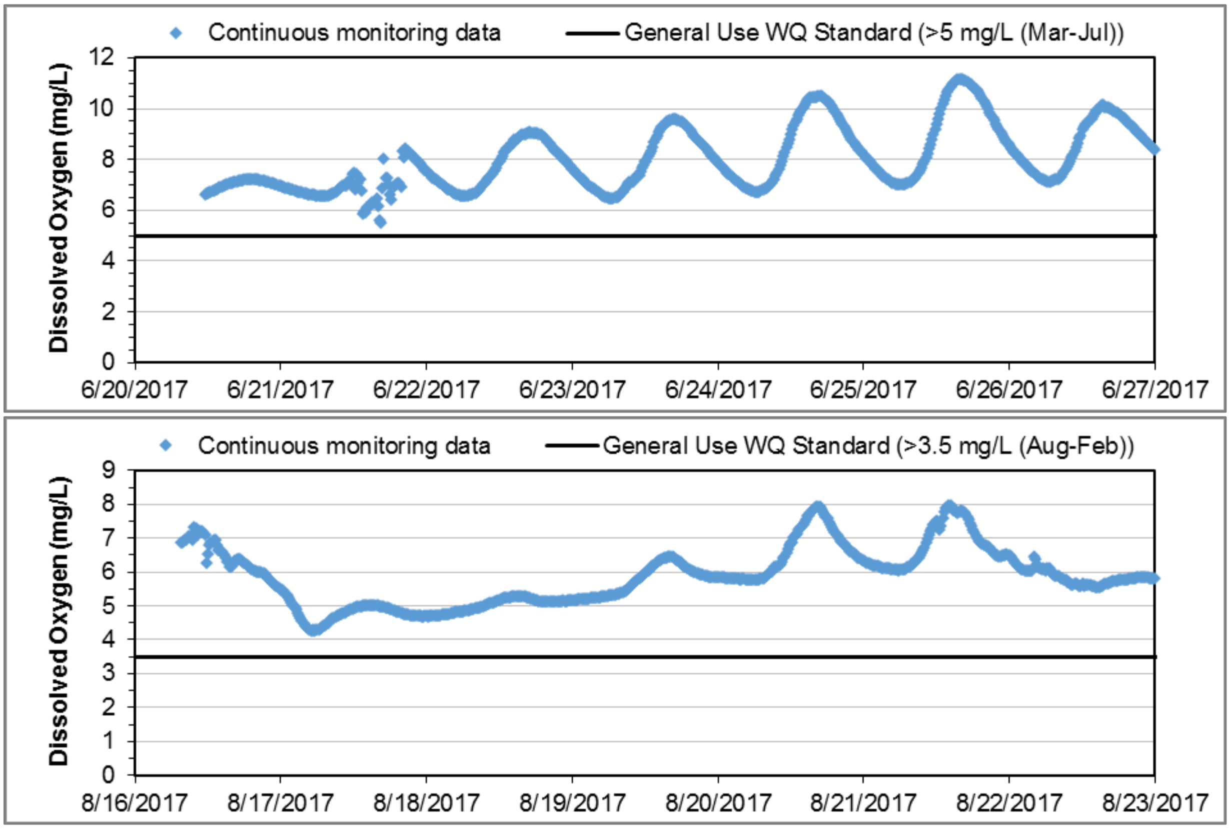

Figure 7. Continuous water quality time series for dissolved oxygen, Shoal Creek OI-15 segment.

5. TMDL Methods and Data Needs

The first stage of this project assesses 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 TMDL Methods

TMDLs are proposed for segments with verified impairments and known pollutants (Table 4). If point sources are not present and if there is a correlation with eutrophication (i.e., phosphorus concentration or high levels of algae and/or plant growth), a duration curve approach is suggested to develop a phosphorus TMDL. The phosphorus target will be derived from the relationship between phosphorus and dissolved oxygen in the impaired stream. TMDLs are not proposed for dissolved oxygen impairments that are not affected by point sources and do not show a correlation with eutrophication. In these cases, it is assumed that the cause of impairment is non-pollutant based (e.g., the effect of lack of re-aeration in low-gradient streams or the effect of hydromodification).

Table 4. Proposed model summary

Name	Segment ID	Designated Uses	TMDL Parameter(s)	Proposed Model	Proposed Pollutant
Shoal Creek	OI-05	Aquatic life	Dissolved Oxygen	4C classification	Non-pollutant
Shoal Creek	OI-13	Aquatic life	Dissolved Oxygen	Load duration curve or 4C classification, pending impairment verification	Phosphorus or non-pollutant, pending impairment verification

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 among sources. Table 5 summarizes the general relationship among the five hydrologic zones and potentially contributing source areas (the table is not specific to an 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 5. Relationship between duration curve zones and contributing sources

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

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

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

5.2 Additional Data Needs

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

- Determine if the impaired areas are meeting applicable water quality standards for their respective designated use(s)

- 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 6 summarizes the additional data needed for each impaired segment.

Table 6. Additional data needs

Name	Segment ID	Designated Uses	TMDL Parameters	Additional Data Needs
Shoal Creek	OI-05	Aquatic Life	Dissolved Oxygen	To determine relationship with eutrophication
Shoal Creek	OI-13	Aquatic Life	Dissolved Oxygen	To verify impairment and determine relationship with eutrophication
All	All	All	All	Implementation plan development

Specific data needs include:

Additional data collection on Shoal Creek (OI-05)—If additional data are necessary for 4C classification, collect DO, chlorophyll-*a*, and TP grab samples at station OI-05; two samples per day (one per day in the early morning) on three separate sampling days, during the warm summer months and during low flows.

Additional data collection on Shoal Creek (OI-13)—To verify impairment, preferably collect continuous dissolved oxygen data at OI-13 for 7 days during low flow conditions. Alternatively, collect DO, chlorophyll-*a*, and TP grab samples at station OI-13; two samples per day (one per day in the early morning) on three separate sampling days, during the warm summer months and during low flows. This grab sampling will also satisfy the monitoring needs to determine the relationship with eutrophication and evaluate 4C classification.

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 Shoal Creek (OI-05 and OI-13) and associated pollutants (phosphorus or non-pollutant, pending TMDL approach)
- 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 Army Corps of Engineers, the Kaskaskia Watershed Association, 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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