STAGE 1 DRAFT FOR PUBLIC REVIEW

Kyte River Watershed TMDL HUC 0709000503 Draft Stage 1 Report

Prepared for Illinois EPA

February 2021

CDM Smith

This page intentionally left blank

Table of Contents

Appendices

List of Tables

List of Figures

Acronyms

BMPs	best management practices
CBOD	carbonaceous biochemical oxygen demand
cfs	cubic feet per second
cfu	colony forming unit
CWA	Clean Water Act
DO	dissolved oxygen
GIS	geographic information system
IDA	Illinois Department of Agriculture
Illinois EPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
ISWS	Illinois State Water Survey
LA	Load Allocation
LC	Loading Capacity
LRS	load reduction strategy
µg/L	micrograms per liter
mg/L	milligrams per liter
mL	milliliters
MOS	Margin of Safety
NA	not applicable
NASS	National Agricultural Statistics Service
NCDC	National Climatic Data Center
NCEI	National Centers for Environmental Information
NED	National Elevation Dataset
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
RC	Reserve Capacity
SOD	sediment oxygen demand
s.u.	standard units
SSURGO	Soil Survey Geographic
STORET	Storage and Retrieval
TMDL	total maximum daily load
TSS	total suspended solids
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
USLE	Universal Soil Loss Equation
WLA	Waste Load Allocation

This page intentionally left blank

Section 1

Goals and Objectives for the Kyte River Watershed

1.1 Total Maximum Daily Load Overview

A total maximum daily load, or TMDL, is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards. TMDLs are a requirement of Section 303(d) of the Clean Water Act (CWA). To meet this requirement, the Illinois Environmental Protection Agency (Illinois EPA) must identify water bodies not meeting water quality standards and then establish TMDLs for restoration of water quality. Illinois EPA develops a list every two years known as the "303(d) list" of water bodies not meeting water quality standards, and it is included in the Integrated Water Quality Report. Water bodies on the 303(d) list are then targeted for TMDL development. Illinois EPA's most recent draft 2018 Integrated Water Quality Report was issued on November 14, 2018[1], and the Agency is working with USEPA to address comments received during the public notice period. Water bodies listed as impaired in this TMDL report are from the most recent final Integrated Water Quality Report and 303(d) List from 2016[2]. In accordance with USEPA's guidance, the report assigns all waters of the state to one of five categories. 303(d) listed water bodies make up category five in the integrated report (Appendix A of the final 2016 Integrated Water Quality Report[3]).

In general, a TMDL is a quantitative assessment of water quality impairments, contributing potential sources, and pollutant reductions needed to attain water quality standards. The TMDL specifies the amount of pollutant or other stressor that needs to be reduced to meet water quality standards, allocates pollutant control or management responsibilities among sources in a watershed, and provides a scientific and policy basis for taking actions needed to restore a water body.

Water quality standards are laws or regulations that states authorize to enhance water quality and protect public health and welfare. Water quality standards provide the foundation for accomplishing two of the principal goals of the CWA. These goals are:

- Restore and maintain the chemical, physical, and biological integrity of the nation's waters; and
- Where attainable, to achieve water quality that promotes protection and propagation of fish, shellfish, and wildlife, and provides for recreation in and on the water.

Water quality standards consist of three elements:

---

[1] https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Documents/Draft-2018-Integrated-Report-11-14-2018.pdf
[2] https://www2.illinois.gov/epa/Documents/iepa/water-quality/watershed-management/tmdls/2016/303-d-list/iwq-report-surface-water.pdf
[3] https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Pages/303d-list.aspx

- The designated beneficial use or uses of a water body or segment of a water body;
- The water quality criteria necessary to protect the use or uses of that particular water body; and
- An antidegradation policy.

Examples of designated uses are primary contact (swimming), protection of aquatic life, aesthetic quality, and public and food processing water supply. Water quality criteria describe the quality of water that will support a designated use. Water quality criteria can be expressed as numeric limits or as a narrative statement. Antidegradation policies are adopted so that water quality improvements are conserved, maintained, and protected.

1.2 TMDL Goals and Objectives for the Kyte River Watershed

The Illinois EPA has a three-stage approach to TMDL development. The stages are:

Stage 1 – Watershed Characterization, Data Analysis, Methodology Selection;

Stage 2 – Data Collection (optional); and

Stage 3 – Model Calibration, TMDL Scenarios, Implementation Plan.

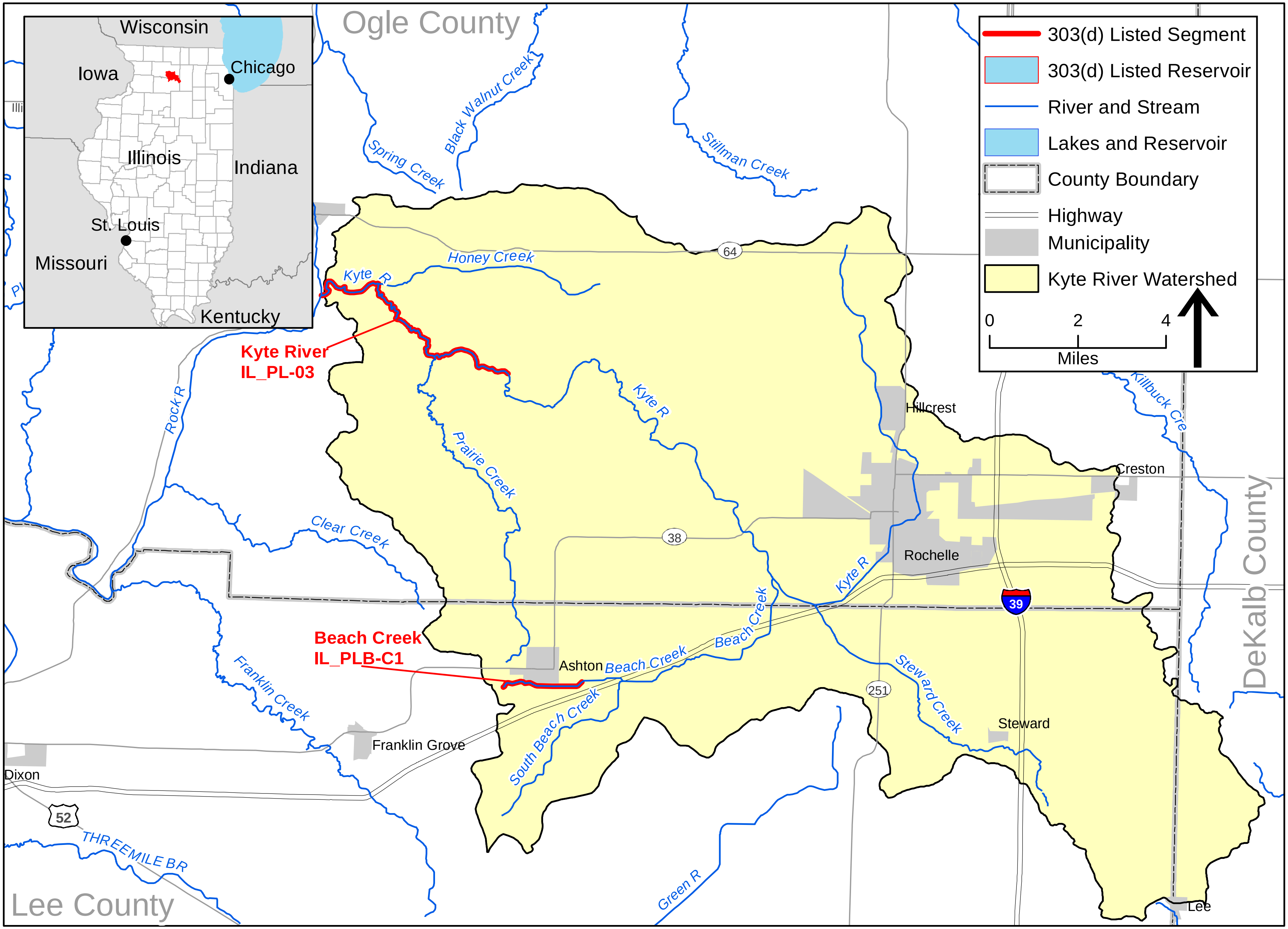
Illinois EPA uses the US Geologic Survey (USGS) 10-digit hydrologic unit code (HUC) to group subbasins into TMDL watersheds. This report addresses Stage 1 TMDL development for the Kyte River watershed (HUC 070900503). Stages 2 and 3 will be conducted upon completion of Stage 1. Stage 2 is optional as data collection may not be necessary if additional data are not required to establish the TMDL.

Following this process, the TMDL goals and objectives for the Kyte River watershed will include developing TMDLs for all impaired water bodies within the watershed, describing all of the necessary elements of the TMDL, developing a watershed-based plan (WBP) for each TMDL, and gaining public acceptance of the process. Following are the impaired water body segments in the Kyte River watershed:

- Kyte River (PL-03)
- Beach Creek (PLB-C1)

The impaired water body segments are shown on **Figure 1-1**. There are two impaired stream segments within the Kyte River watershed addressed in this report. **Table 1-1** lists the water body segment, potential causes of impairment, use description and potential sources of impairment for the water body.

Illinois EPA is currently only developing TMDLs for parameters that have numeric water quality standards. For potential causes that do not have numeric water quality standards, as noted in Table 1-1, TMDLs will be deferred until those criteria are developed. However, until numeric criteria are adopted, WBPs will be developed using percent reduction goals established by Illinois EPA. In addition, some of these potential causes may be addressed by implementation of controls for the pollutants with numeric water quality standards.



DRAFT

Figure 1-1: Kyte River Watershed, HUC 0709000503

CDM Smith

This page intentionally left blank.

Table 1-1 Impaired Water Bodies in Kyte River Watershed

Segment ID	Segment Name	Potential Causes of Impairment	Use Description	Potential Sources (as identified by the 2016 303(d) list)
PL-03	Kyte River	**Fecal Coliform**	Primary Contact Recreation	Agriculture
PLB-C1	Beach Creek	**Dissolved Oxygen**	Aquatic Life	Municipal point source discharges
		Phosphorus (Total)	Aquatic Life	Municipal point source discharges

Bold Causes of Impairment have numeric water quality standards and TMDLs will be developed. *Reduction goals established by Illinois EPA will be applied to Italicized Causes of Impairment.*

The TMDL for the segments listed above will specify the following elements:

- Loading Capacity (LC) or the maximum amount of pollutant loading a water body can receive without violating water quality standards
- Waste Load Allocation (WLA) or the portion of the TMDL allocated to existing or future point sources
- Load Allocation (LA) or the portion of the TMDL allocated to existing or future nonpoint sources and natural background
- Margin of Safety (MOS) or an accounting of uncertainty about the relationship between pollutant loads and receiving water quality
- Reserve Capacity (RC) or a portion of the load explicitly set aside to account for growth in the watershed

These elements are combined into the following equation:

$$\mathbf{TMDL = LC = \Sigma WLA + \Sigma LA + MOS + RC}$$

TMDLs will also consider the seasonal variability of pollutant loads so that applicable water quality standards are met during all seasons of the year. Also, reasonable assurance that the TMDLs and percent reduction goals will be achieved will be described in the WBPs. The WBP for the Kyte River watershed will describe how water quality standards and goals will be met and attained. This WBP will include recommendations for implementing best management practices (BMPs), cost estimates, institutional needs to implement BMPs and controls throughout the watershed, and a timeframe for completion of implementation activities.

1.3 Report Overview

The remaining sections of this report contain:

- **Section 2 Kyte River Watershed Characteristics** provides a description of the watershed's location, topography, geology, land use, soils, population, and hydrology.
- **Section 3 Public Participation and Involvement** discusses public participation activities that will occur throughout TMDL development.
- **Section 4 Kyte River Watershed Water Quality Standards and Guidelines** defines the water quality standards and water quality guidelines for the impaired water bodies.
- **Section 5 Kyte River Watershed Data and Potential Pollutant Sources** presents the available water quality data needed to develop TMDLs, discusses the characteristics of

the impaired stream segments in the watershed, and also describes the point and nonpoint sources with potential to contribute to the watershed load.

- **Section 6 Approach to Developing TMDL and Identification of Data Needs** makes recommendations for the models and analysis that are needed for TMDL development and also suggests segments for Stage 2 data collection.
- **Section 7 References**

Section 2

Kyte River Watershed Characteristics

2.1 Kyte River Watershed Location

The Kyte River watershed (HUC 070900503 shown on **Figure 1-1**) is located in northern Illinois and drains approximately 125,600 acres. Approximately 81,300 acres (64.7 percent of the total watershed) lie in Ogle County, 40,800 acres (32.5 percent of the total watershed) lie in Lee County, and 3,600 acres (2.9 percent of the total watershed) lie in DeKalb County.

2.2 Topography

Topography is an important factor in watershed management because stream types, precipitation, and soil types can vary dramatically by elevation. National Elevation Dataset (NED)[1] coverages containing 30-meter grid resolution elevation data are available from the U.S. Geological Survey (USGS) for each 1:24,000-topographic quadrangle in the United States. Elevation data for the Kyte River watershed were obtained by overlaying the NED grid onto the geographic information system (GIS)-delineated watershed. **Figure 2-1** shows the elevations found within the watershed. Elevation in the Kyte River watershed ranges from approximately 960 feet above sea level in the southeastern portion of the watershed to approximately 660 feet above sea level where the Kyte River meets the Rock River.

2.3 Land Use

Land use data for the Kyte River watershed were extracted from the U.S. Department of Agriculture's (USDA) National Agriculture Statistics Service (NASS) 2018 Cropland Data Layer (CDL)[2]. The CDL is a raster-based, geo-referenced, crop-specific land cover data layer created to provide acreage estimates to the Agricultural Statistics Board for the state's major commodities and to produce digital, crop-specific, categorized geo-referenced output products. This information is made available to all agencies and to the public free of charge and represents the most accurate and up-to-date land cover datasets available at a national scale. The most recent available CDL dataset was produced in 2018 and includes 30 separate land use classes applicable to the watershed. The available resolution of the land cover dataset is 30 square meters.

Land use characteristics of the watershed were determined by overlaying the Illinois Statewide 2018 CDL data layers onto the GIS-delineated watershed. **Table 2-1** contains the most prominent categories of land uses in the Kyte River watershed, based on the 2018 CDL land cover categories, and includes the area of each land cover category and percentage of the watershed area. **Figure 2-2** illustrates the land uses of the watershed. Appendix A contains a table of all land uses in the watershed.

---

[1] https://catalog.data.gov/dataset/usgs-national-elevation-dataset-ned

[2] https://www.nass.usda.gov/Research_and_Science/Cropland/Release/index.php

Table 2-1 Land Cover and Land Use in Kyte River Watershed

Land Cover Category	Area (acres)	Percent
Corn	59,889	48%
Soybeans	37,515	30%
Deciduous Forest	7,953	6.3%
Grass/Pasture	5,357	4.3%
Developed/Low Intensity	4,839	3.9%
Developed/Open Space	4,386	3.5%
Developed/Med Intensity	1,771	1.4%
Developed/High Intensity	925	0.7%
Winter Wheat	561	0.4%
Open Water	452	0.4%
Alfalfa	443	0.4%
Oats	390	0.3%
Woody Wetlands	385	0.3%
All Others	810	0.6%
Total	**125,676**	**100.0%**

The land cover data reveal that approximately 98,798 acres, representing 79 percent of the total watershed area, are devoted to agricultural activities. Corn and soybean make up 99% of the agricultural land use within the watershed. Developed areas cover 9.5 percent of the watershed (11,921 acres). Approximately 6.3 percent of the watershed area (7,953 acres) is forested and 4.3% of the land area is grassland or pasture (5,357 acres). The remaining watershed is wetland or open water.

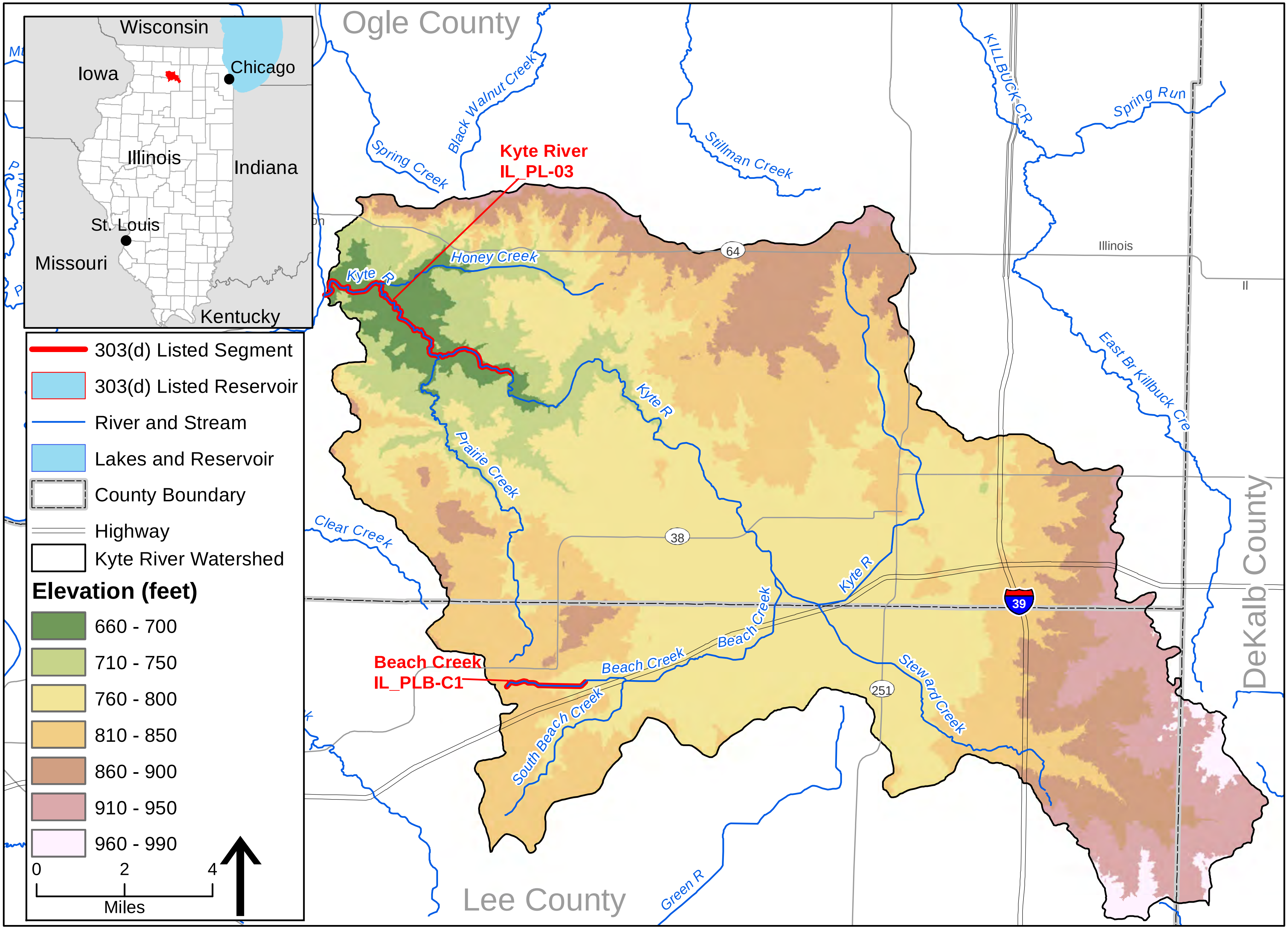
2.3.1 Subbasin Land Use

The subbasin areas draining to each impaired segment were further delineated through GIS (see Figure 2-2). Land cover data were then intersected with the subbasin boundaries to determine the land uses contributing runoff to Beach Creek segment PLB-C1 and Kyte River segment CL-03.

Kyte River segment CL-03 receives drainage from all upgradient land areas of the watershed (**Table 2-1)**, which includes Beach Creek segment PLB-C1. The land areas within the PLB-C1 subbasin are shown in **Table 2-2.**

Table 2-2 Land Cover and Land Use in the Beach Creek segment PLB-C1 Subbasin

Land Cover Category	Area (Acres)	Percentage
Corn	534	58.4%
Soybeans	111	12.1%
Developed/Low Intensity	107	11.7%
Developed/Medium Intensity	57	6.2%
Grass/Pasture	48	5.2%
Developed/Open Space	28	3.1%
Developed/High Intensity	18	2.0%
Open Water	6.8	0.7%
Deciduous Forest	3.4	0.4%
All Others	1.7	0.2%
Total	**915**	**100%**

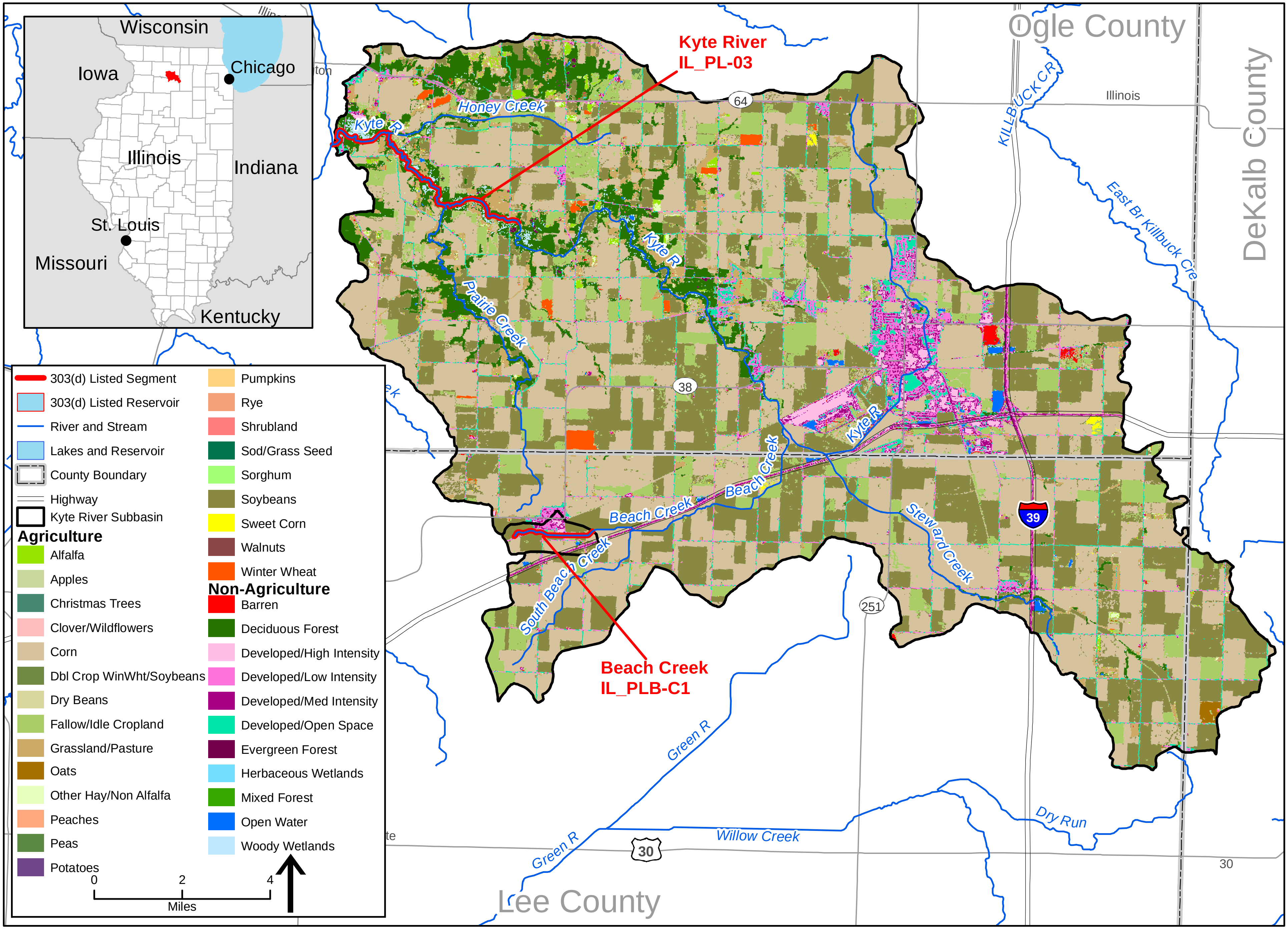


DRAFT

CDM Smith

Figure 2-1: Kyte River Watershed, Elevation

This page intentionally left blank



DRAFT

CDM Smith

Figure 2-2: Kyte River Watershed, Land Use

This page intentionally left blank

2.4 Soils

Soils data are available through the Soil Survey Geographic (SSURGO) database[3]. For SSURGO data, field mapping methods using national standards are used to construct the soil maps. Mapping scales generally range from 1:12,000 to 1:63,360 making SSURGO the most detailed level of soil mapping done by the Natural Resources Conservation Service (NRCS).

Attributes of the spatial coverage can be linked to the SSURGO databases, which supply information on various chemical and physical soil characteristics for each map unit and soil series. Of interest for TMDL development are the hydrologic soil groups as well as the K-factor of the Universal Soil Loss Equation (USLE). The following sections describe and summarize the specified soil characteristics for the Kyte River watershed.

2.4.1 Kyte River Watershed Soil Characteristics

Appendix B contains a table of the SSURGO soil series for the Kyte River watershed. A total of 182 soil types exist in the watershed. The most common type—Drummer silty clay loam (0 to 2 percent slopes) – covers 11.7 percent of the watershed. The second most common type – Elburn silt loam (0 to 2 percent slopes) covers 9.2% of the watershed. All other individual soil types each represent approximately six percent or less of the total watershed area with a majority of soils representing 0-200 acres throughout the whole watershed. The table in Appendix B also contains the area, dominant hydrologic soil group, and k-factor range. Each of these characteristics is described in more detail in the following paragraphs.

Figure 2-3 shows the hydrologic soils groups found within the Kyte River watershed. Hydrologic soil groups are used to estimate runoff from precipitation. Soils are assigned to one of four groups according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms:

- Group A: Soils in this group have low runoff potential when thoroughly wet. Water is transmitted freely through the soil.
- Group B: Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded.
- Group C: Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted.
- Group D: Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted.

While hydrologic soil groups A, B, C, D, A/D, B/D, and C/D are all found within the Kyte River watershed, group B/D soils are the most common type representing 43 percent of the watershed. Group B/D is a dual hydrologic soil group. Dual hydrologic soil groups can be adequately drained. The first letter applies to the drained condition and the second letter to the undrained condition.

---

[3] https://www.nrcs.usda.gov/wps/portal/nrcs/surveylist/soils/survey/state/?stateId=IL

For the purpose of hydrologic soil group, adequately drained means that the seasonal high-water table is kept at 24 inches below the surface[4].

A commonly used soil attribute is the K-factor. The K-factor:

> *Indicates the susceptibility of a soil to sheet and rill erosion by water. (The K-factor) is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion. Losses are expressed in tons per acre per year. These estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water (NRCS 2005).*

The distribution of K-factor values in the Kyte River watershed range from 0.02 to 0.47 (**Figure 2-4**).

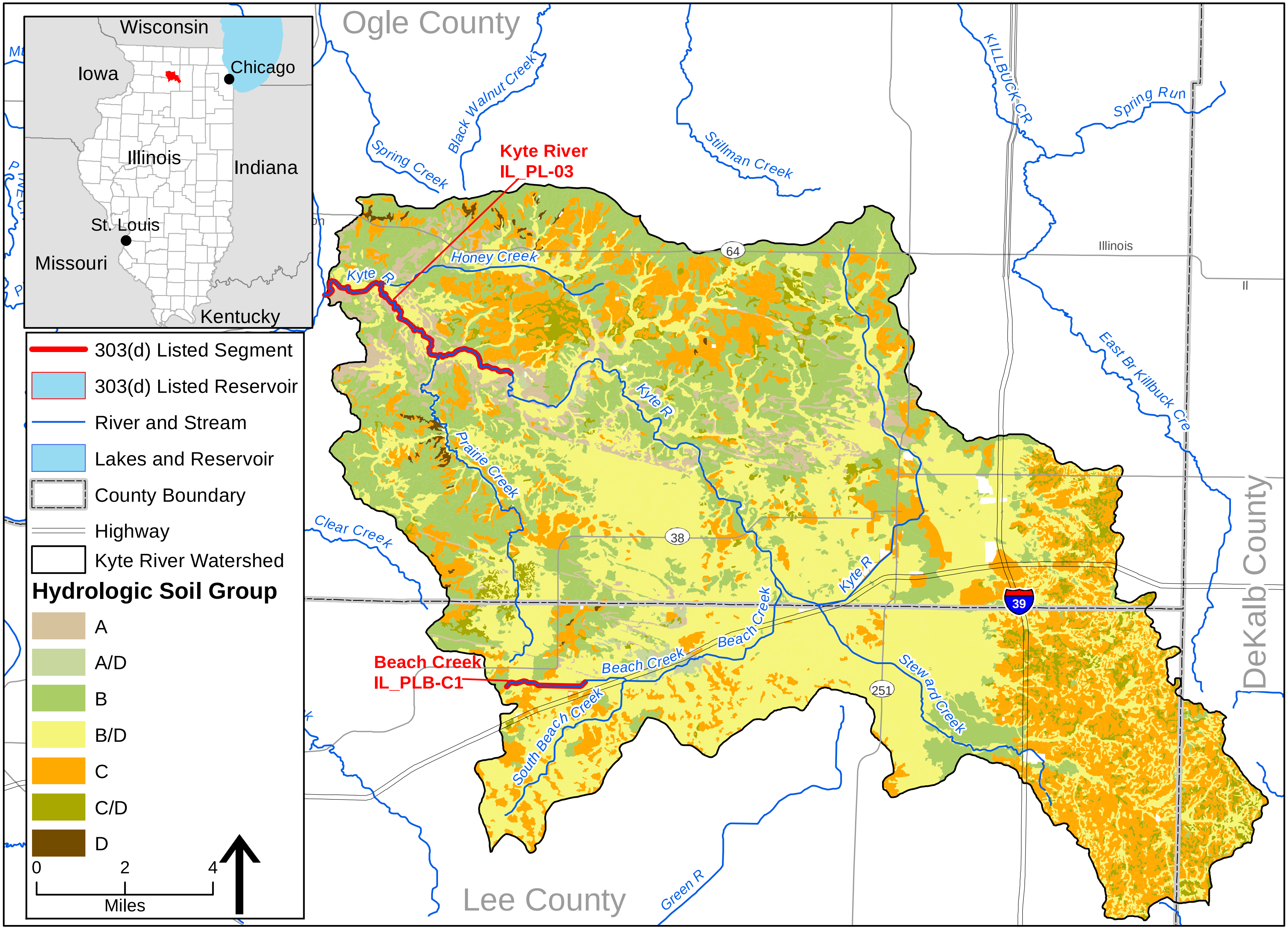
2.5 Population

The Census TIGER/Line data[5] from the U.S. Census Bureau were reviewed along with shapefiles of census blocks[6] that are available for the entire state of Illinois. All census blocks that have geographic center points (centroids) within the watershed were selected and tallied in order to provide an estimate of populations in all census blocks both completely and partially contained by the watershed boundary. Given that the optimal size of a census block group is 1,500 people, and 16 block group centroids are located within the watershed, it is estimated that approximately 24,000 people reside in the Kyte River watershed. The major municipalities in the watershed are shown in **Figure 1-1**. The largest urban development in the watershed is the city of Rochelle, which lies partially within the watershed and has an estimated population of approximately 9,574 people.

[4] Natural Resources Conservation Service. Part 630 Hydrology National Engineering Handbook. 2007. https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=22526.wba

[5] https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html

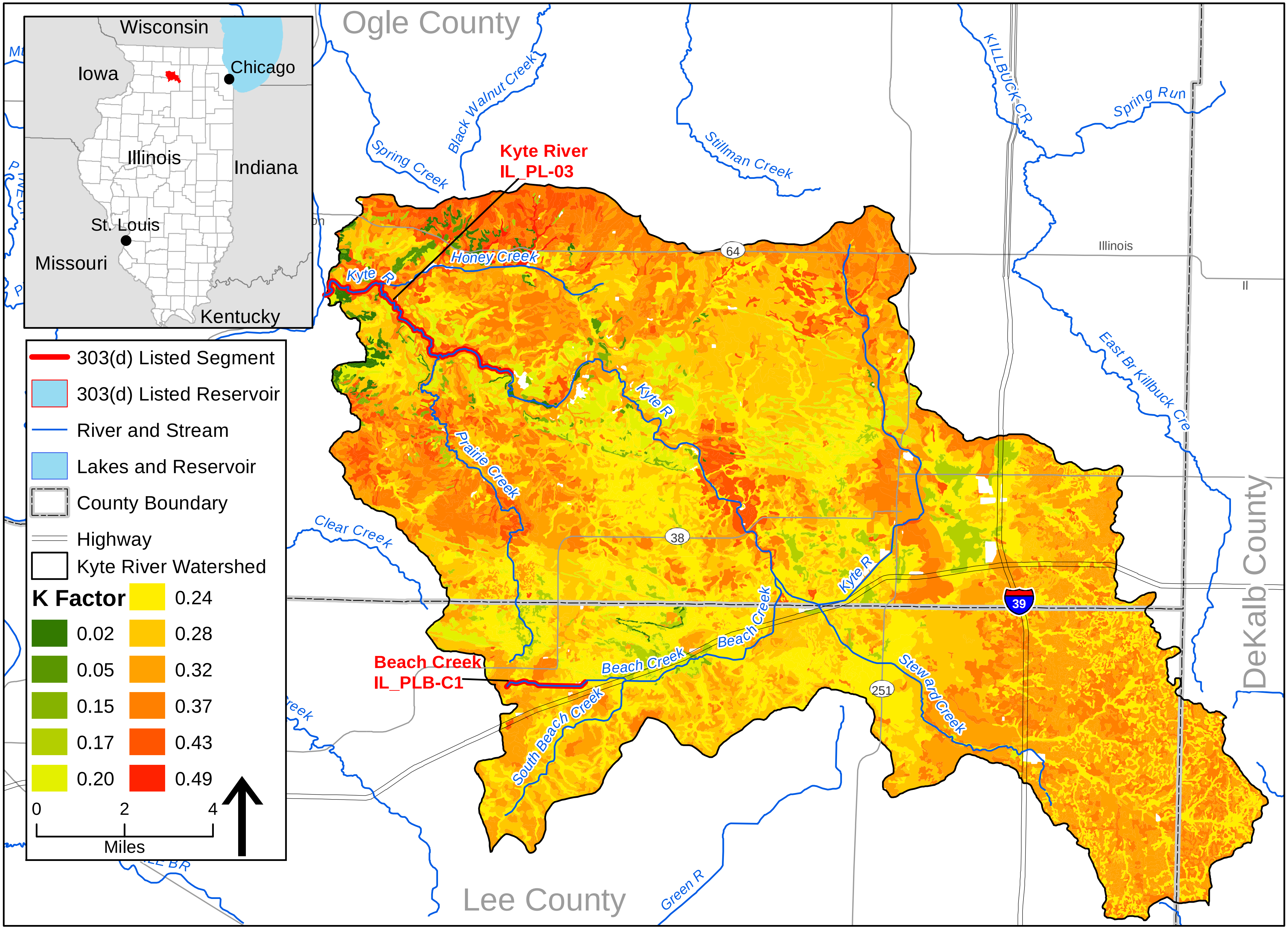
[6] https://www.census.gov/geographies/reference-maps/2010/geo/2010-census-block-maps.html



DRAFT

Figure 2-3: Kyte River Watershed, Soils

This page intentionally left blank



DRAFT

CDM Smith

Figure 2-4: Kyte River Watershed, K-Factor Ranges

This page intentionally left blank

2.6 Climate and Streamflow

2.6.1 Climate

Northern Illinois has a temperate climate with hot summers and cold, moderately snowy winters. Monthly temperature and precipitation data from Rochelle, Illinois (station id USC00117354) were extracted from the National Centers for Environmental Information (NCEI)[7] database for the years 1978 through 2019. This station was selected due to its location within the watershed and completeness of its dataset.

Table 2-4 contains the average monthly precipitation along with average high and low temperatures for the period of record (POR). The average annual precipitation is approximately 36 inches. May through August are historically the wettest months while January and February are the driest.

Table 2-4 Average Monthly Climate Data for Rochelle, Illinois

Month	Average Total Precipitation (inches)	Average Daily Maximum Temperature (degrees F)	Average Daily Minimum Temperature (degrees F)
January	1.5	28.2	11.0
February	1.6	32.1	14.7
March	2.0	45.2	26.0
April	3.4	59.1	36.7
May	4.1	70.7	47.7
June	4.6	79.9	57.8
July	3.8	83.0	61.0
August	4.4	81.4	59.6
September	3.2	75.1	50.9
October	2.8	62.4	39.0
November	2.5	47.3	28.8
December	2.0	33.0	16.7
Average	36*	58	37

*Average Annual Precipitation

2.6.2 Streamflow

Analysis of the Kyte River watershed requires an understanding of flow throughout the drainage area. There are no active USGS stream gages[8] in the watershed and one inactive stream gage located along the Kyte River, approximately 8 miles upstream of the impaired stream segment of the Kyte River (**Figure 2-5**). **Table 2-5** summarizes the station information.

Table 2-5 USGS Stream Gages

USGS Gage Number	Name	POR
USGS 05442000	Kyte River near Flagg Center, IL	1939-1951

[7] https://www.ncdc.noaa.gov/data-access/land-based-station-data
[8] https://waterdata.usgs.gov/IL/nwis/current/?type=dailydischarge&group_key=basin_cd

There are four USGS gages in adjacent watersheds with similar characteristics to those of the Kyte River watershed that have available discharge data and may be used to estimate streamflow. These gages are summarized in **Table 2-6**.

Table 2-6 Streamflow Gages in the Watersheds Adjacent to the Kyte River Watershed

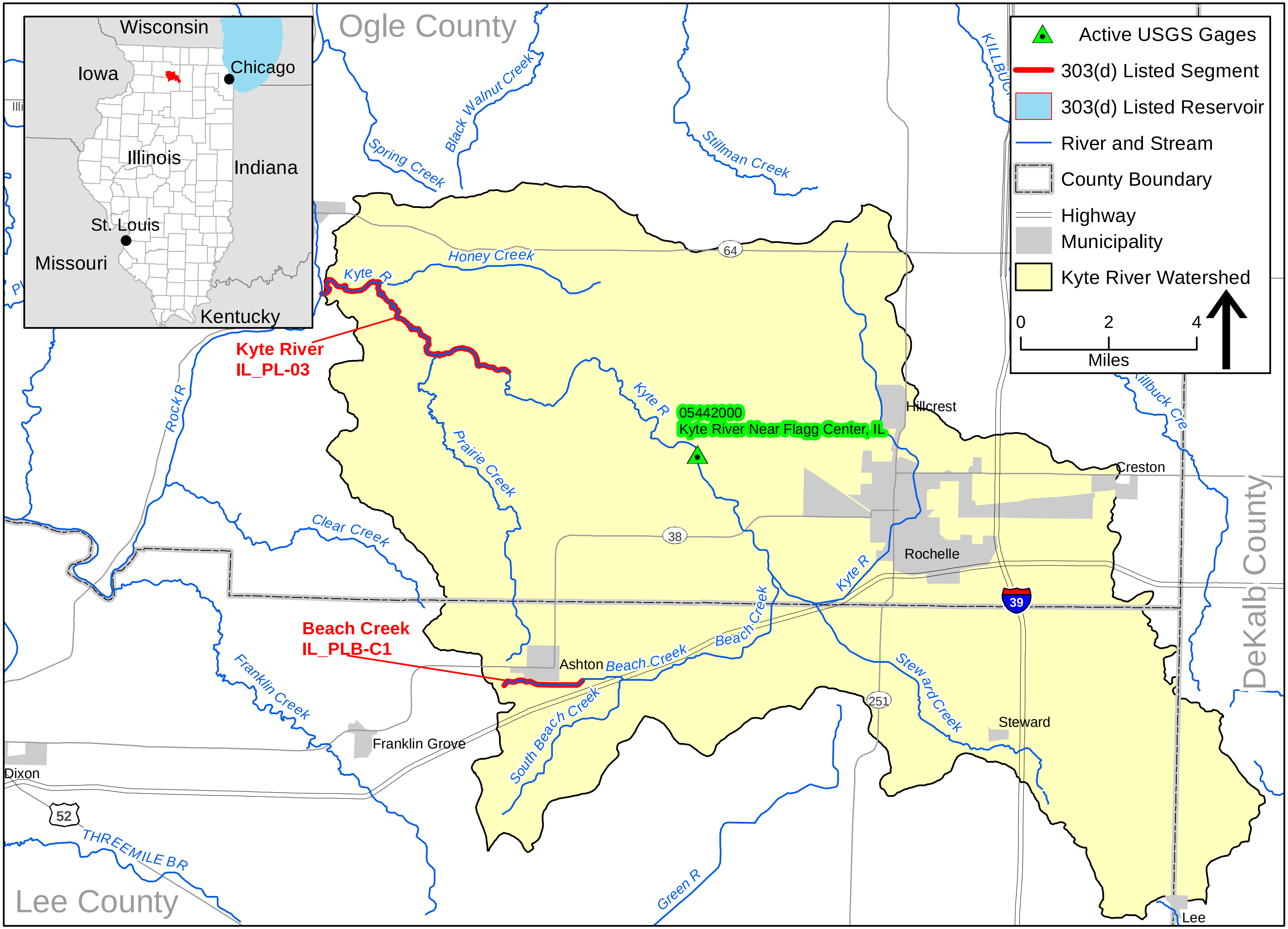
USGS Gage Number	Name	Drainage Area (mi^2)	Approximate Distance from Kyte Watershed (mi)	POR	Minimum Monthly Flow (cfs)	Maximum Monthly Flow (cfs)
USGS 05444000	Elkhorn Creek near Penrose, IL	146	20	1939-2019	10	5,430
USGS 05439000	South Branch Kishwaukee at Dekalb	78	10	1925-2019	<1	2,520
USGS 05439500	South Branch Kishwaukee near Fairdale, IL	387	11	1939-2019	3	14,600
USGS 05438500	Kishwaukee River at Belvidere, IL	538	21	1939-2019	15	8,860

USGS gages 05444000 and 05439500 have drainage areas most similar in scale to the Kyte River watershed. Land use and land cover characteristics are also similar between the basins. Data from these gages may be used to estimate flow values for TMDL development for the impaired water bodies using the drainage area ratio method, represented by the following equation:

$$Q_{gaged}\left(\frac{Area_{ungaged}}{Area_{gaged}}\right) = Q_{ungaged}$$

where Q_{gaged} = Streamflow of the gaged basin
$Q_{ungaged}$ = Streamflow of the ungaged basin
$Area_{gaged}$ = Area of the gaged basin
$Area_{ungaged}$ = Area of the ungaged basin

The assumption behind the equation is that the flow per unit area is equivalent in watersheds with similar characteristics. Therefore, the flow per unit area in the gaged watershed multiplied by the area of the ungaged watershed estimates the flow for the ungaged watershed.



DRAFT

CDM Smith

Figure 2-5: Kyte River Watershed, Active USGS Gages

Page intentionally left blank

Section 3

Kyte River Watershed Public Participation and Involvement

3.1 Kyte River Watershed Public Participation and Involvement

Public knowledge, acceptance, and follow-through are necessary to implement a plan to meet recommended TMDLs and WBPs. It is important to involve the public as early in the process as possible to achieve maximum cooperation and counter concerns as to the purpose of the process and the regulatory authority to implement any recommendations.

Illinois EPA, along with CDM Smith, will hold a public meeting for the Kyte River watershed at the completion of Stages 1 and 3. Comments received through the public meeting process will be included in an appendix. This section will be updated following each public meeting.

This page intentionally left blank.

Section 4

Kyte River Watershed Water Quality Standards and Guidelines

4.1 Illinois Water Quality Standards

Water quality standards are developed and enforced by the state to protect the "designated uses" of the state's waterways. In the state of Illinois, water quality standards are established by the Illinois Pollution Control Board (IPCB). Illinois is required to update water quality standards every 3 years in accordance with the CWA. The standards requiring modifications are identified and prioritized by Illinois EPA, in conjunction with USEPA. New standards are then developed or revised during the 3-year period.

Illinois EPA is also responsible for developing scientifically based water quality criteria and proposing them to the IPCB for adoption into state rules and regulations. The Illinois water quality standards are established in the Illinois Administrative Rules Title 35, Environmental Protection; Subtitle C, Water Pollution; Chapter I, Pollution Control Board; Part 302, Water Quality Standards[1].

4.2 Designated Uses

The waters of Illinois are classified by designated uses, which include: General Use, Public and Food Processing Water Supplies, Lake Michigan Basin, and Secondary Contact and Indigenous Aquatic Life Use[2]. The designated uses applicable to the impairments within the Kyte River watershed fall under General Use (described below).

4.2.1 General Use

The General Use classification is defined by IPCB as standards that "will protect the state's water for aquatic life, wildlife, agricultural use, secondary contact use and most industrial uses, and ensure the aesthetic quality of the state's aquatic environment." Primary contact uses are protected for all General Use waters whose physical configuration allows such use.

4.3 Water Quality Criteria

According to the Illinois EPA Integrated Report, aquatic life use assessments in streams are typically based on the interpretation of biological information, physicochemical water data, and physical habitat. The primary biological measures used are the fish Index of Biotic Integrity (fIBI), the macroinvertebrate Index of Biotic Integrity (mIBI) and the Macroinvertebrate Biotic Index (MBI). 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 [DO], pH, and temperature), priority pollutants, non-priority pollutants, and other pollutants.

---

[1] https://pcb.illinois.gov/SLR/IPCBandIEPAEnvironmentalRegulationsTitle35
[2] https://pcb.illinois.gov/documents/dsweb/Get/Document-16952/.

Table 4-1 presents the numeric water quality standards of the potential causes of impairment for rivers in the Kyte River watershed. Only constituents with numeric water quality standards will have TMDLs developed at this time.

Table 4-1 Summary of Numeric Water Quality Standards for Potential Causes of Stream Impairments in Kyte River Watershed

Parameter	Units	General Use Water Quality Standard	Regulatory Reference
Dissolved Oxygen	mg/L	*March through July* ≥5.0 minimum & ≥6.0 7-day daily mean averaged over 7 days *August through February* ≥3.5 minimum, ≥4.0 7-day minimum averaged over 7 days & ≥5.5 30-day daily mean(1)	302.206(b)
Total Fecal Coliform	Count / 100 mL	*May through October* 200(2), 400(3)	302.209

mg/L = milligrams per liter

(1) 302.206(d) provides further information on detailed calculations for determining the acute and chronic standards for DO

(2) Geometric mean based on a minimum of five samples taken over not more than a 30-day period.

(3) Standard shall not be exceeded by more than 10 percent of the samples collected during any 30-day period.

4.4 Illinois Nutrient Loss Reduction Strategy

In addition to the water quality standards provided above, the Illinois EPA has also established water quality guidelines for nutrients in accordance with the Illinois Nutrient Loss Reduction Strategy (NLRS)[3]. The NLRS was developed in response to hypoxia in the Gulf of Mexico and all 12 states within the Mississippi River Basin were called upon by the USEPA to reduce nutrient loads flowing into the Mississippi River. Water quality goals will be incorporated into the WBPs based on the NLRS, which calls for an overall 45% load reduction of total phosphorus leaving the state of Illinois, and an interim target of 25% load reduction by 2025. A WBP will be developed using the interim total phosphorus load reduction goal of 25%. The WBP for the Kyte River watershed will include a comprehensive suite of best management practices (BMPs) for reducing loads from identified watershed sources.

4.5 Potential Pollutant Sources

To properly address the conditions within the Kyte River watershed, potential pollutant sources must be investigated for the pollutants where TMDLs will be developed. **Table 4-2** summarizes the potential sources associated with the listed impairments for the 303(d) listed segments in this watershed.

[3] https://www2.illinois.gov/sites/agr/Resources/NutrientLoss/Pages/default.aspx

Table 4-2 Impaired Water Bodies

Segment ID	Segment Name	Potential Causes of Impairment	Designated Use	Potential Sources (as identified by the 2016 303(d) list)
PL-03	Kyte River	**Fecal Coliform**	Primary Contact Recreation	Agriculture
PLB-C1	Beach Creek	**Dissolved Oxygen**	Aquatic Life	Municipal point source discharges
		Phosphorus (Total)	Aquatic Life	Municipal point source discharges

Bold Causes of Impairment have numeric water quality standards and TMDLs will be developed. *Reduction goals established by Illinois EPA will be applied to Italicized Causes of Impairment.*

This page intentionally left blank.

Section 5

Kyte River Watershed Data and Potential Pollution Sources

To further characterize the Kyte River watershed, a wide range of pertinent data were collected and reviewed. Water quality data for streams and lakes, as well as information on potential point and nonpoint sources within the watershed, were compiled from a variety of data sources. This information is presented and discussed in further detail in the remainder of this section.

5.1 Water Quality Data

Illinois EPA monitoring programs that contribute data to the assessment of streams include the Ambient Water Quality Monitoring Network, the Pesticide Monitoring Subnetwork, Facility-Related Stream Surveys, Intensive Basin Surveys, and the Fish Contaminant Monitoring Program[1]. Water quality data used for this report came from the Ambient Water Quality and Lake Monitoring Programs, Intensive Basin Survey Data, and Facility-Related Stream Surveys. The Ambient Water Quality Network and Ambient Lake Monitoring Programs include 146 fixed stream stations statewide that are sampled every 6 weeks. Additional data are collected during Intensive Basin Surveys, which are typically conducted on a 5-year cycle and focus on basins where intensive data are currently lacking or where historical data need updating. Facility-Related Stream Surveys were completed on Beach Creek in 1990 and 2002. Additional information on Illinois EPA's monitoring programs can be found in the "Illinois Water Monitoring Strategy[2]."

Data from historical water quality stations within the Kyte River watershed were located and reviewed for this report **Figure 5-1**. The impaired water body segments in the Kyte River watershed were presented in Section 1. Refer to **Table 1-1** for impairment information specific to each segment. Recent and historical data are included in this section and document historical trends and observations. Data are summarized by impairment and discussed in relation to the relevant Illinois water quality standard.

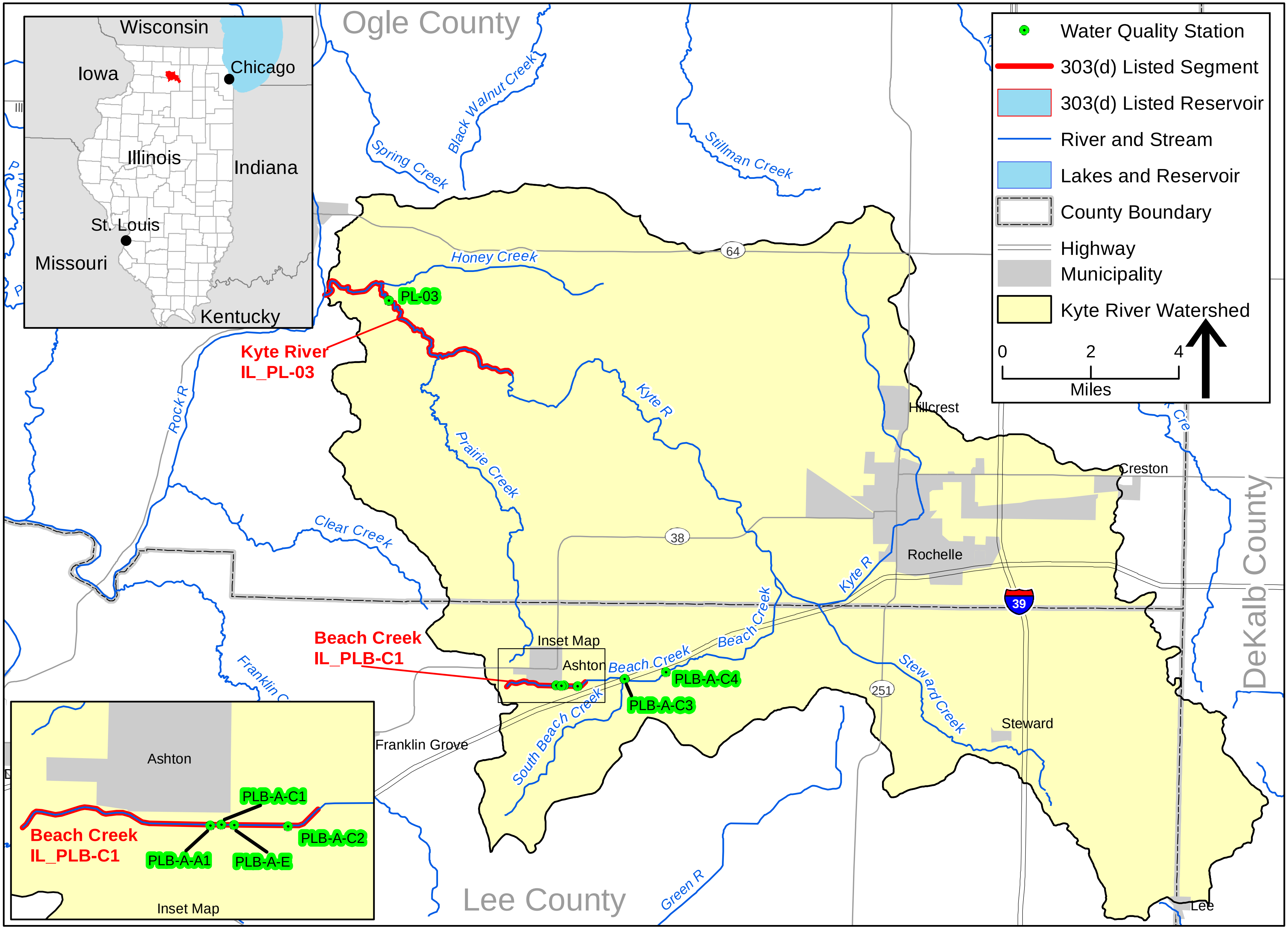
5.1.1 Stream Water Quality Data

Two impaired stream segments exist within the Kyte River watershed (Kyte River segment PL-03 and Beach Creek segment PLB-C1). Data presented below relate to the parameters of concern that currently have numeric criteria as well as those with water quality reduction goals designed to reduce nutrient enrichment in streams in Illinois. Historical water quality data for the impaired segments of the Kyte River watershed are available in Appendix D.

---

[1] https://www2.illinois.gov/epa/topics/water-quality/monitoring/Pages/river-and-stream.aspx
[2] https://www2.illinois.gov/epa/topics/water-quality/monitoring/Pages/strategy.aspx

This page intentionally left blank



DRAFT

CDM Smith

Figure 5-1: Kyte River Watershed, Water Quality Stations

This page intentionally left blank

5.1.1.1 Fecal Coliform

Kyte River segment PL-03 is listed for impairment of the primary contact recreation use caused by elevated fecal coliform concentrations. **Table 5-1** summarizes available historical fecal coliform data for this segment. The general use water quality standard for fecal coliform states that the standard of 200 colony forming units (cfu) per 100 milliliters (mL) shall not be exceeded by the geometric mean of at least five samples, nor can 10 percent of the samples collected exceed 400 cfu per 100 mL in protected waters, except as provided in 35 Ill. Adm. Code 302.209(b). Samples must be collected over a 30-day period or less during the months of May through October. Although the minimum sampling frequency requirements for assessing the 200 cfu/100 mL standard are not regularly achieved, single samples have been compared to the standards (200 cfu/100 mL and of the 400 cfu/100 mL) for general comparison purposes. The summary of data presented in **Table 5-1** reflects single samples compared to the standards during the appropriate months. **Figure 5-2** shows the fecal coliform samples collected over time on segment PL-03.

Table 5-1 Existing Fecal Coliform Data for Kyte River Collected at Site PL-03

Stream Segment ID	Period of Record and Number of Data Points	Geometric Mean (cfu/100mL)	Maximum (cfu/100mL)	Minimum (cfu/100mL)	Number of samples > 200(1)	Number of samples > 400(1)
Kyte River Segment PL-03	1998-2006; 30	330	4,000	23	18	13

(1) Single samples collected during May through October

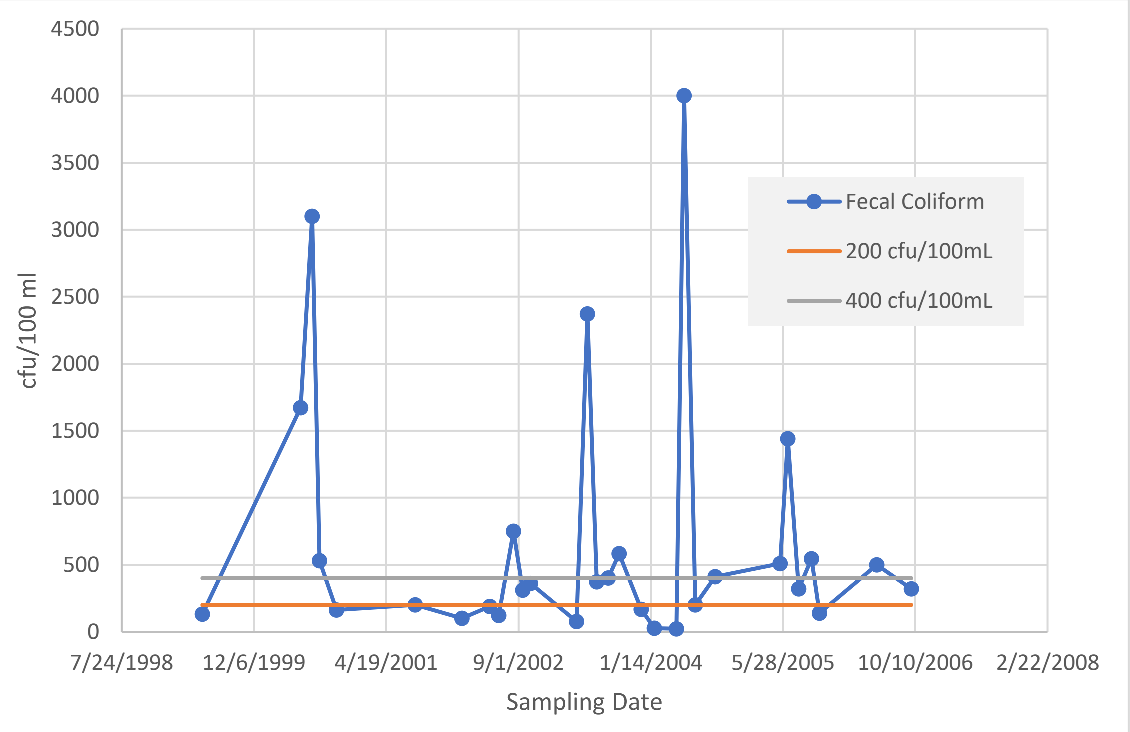


Figure 5-2: Historical Fecal Coliform data for Kyte River Segment PL-03

5.1.1.2 Dissolved Oxygen

Beach Creek segment PLB-C1 is listed for impairment of the aquatic life use caused by low dissolved oxygen concentrations. **Table 5-2,** along with **Figure 5-3,** summarize available historical dissolved oxygen data on this segment. The general use water quality standard provides seasonal instantaneous minimum and minimum weekly (7-day) average concentrations for dissolved oxygen in streams. Due to the limited dataset, only the instantaneous minimum standards of 5.0 mg/L for March through July and 3.5 mg/L for August through February were used to identify violations of the standard in this section of the report. The available datasets were not assessed for impairment of the weekly (7-day) minimum and monthly (30-day) mean DO limits; however, future data analysis may take the weekly standards into account. The data presented in **Table 5-2** reflect single measurements from the segment during two separate Facility Related Stream Surveys compared to the applicable seasonal standard at the time of the field measurement. The dataset is limited to data collected in 1990 (4 instream samples and one effluent sample) and 2002 (2 instream samples and one effluent sample). Data show that low dissolved oxygen was measured in the plant effluent (site E of Figure 5-3) and that instream DO below the effluent were also below the standard. Additional data collection is needed to confirm that impairment currently exists on this segment.

Table 5-2 Dissolved Oxygen Data for Impaired Stream Segments

Impaired Stream Segment Name & ID	Period of Record and Number of Data Points	Mean (mg/L)	Maximum (mg/L)	Minimum (mg/L)	Number of Violations
Beach Creek Segment PLB-C1	1990, 2002; 7	2.38	7.6	0.6	6

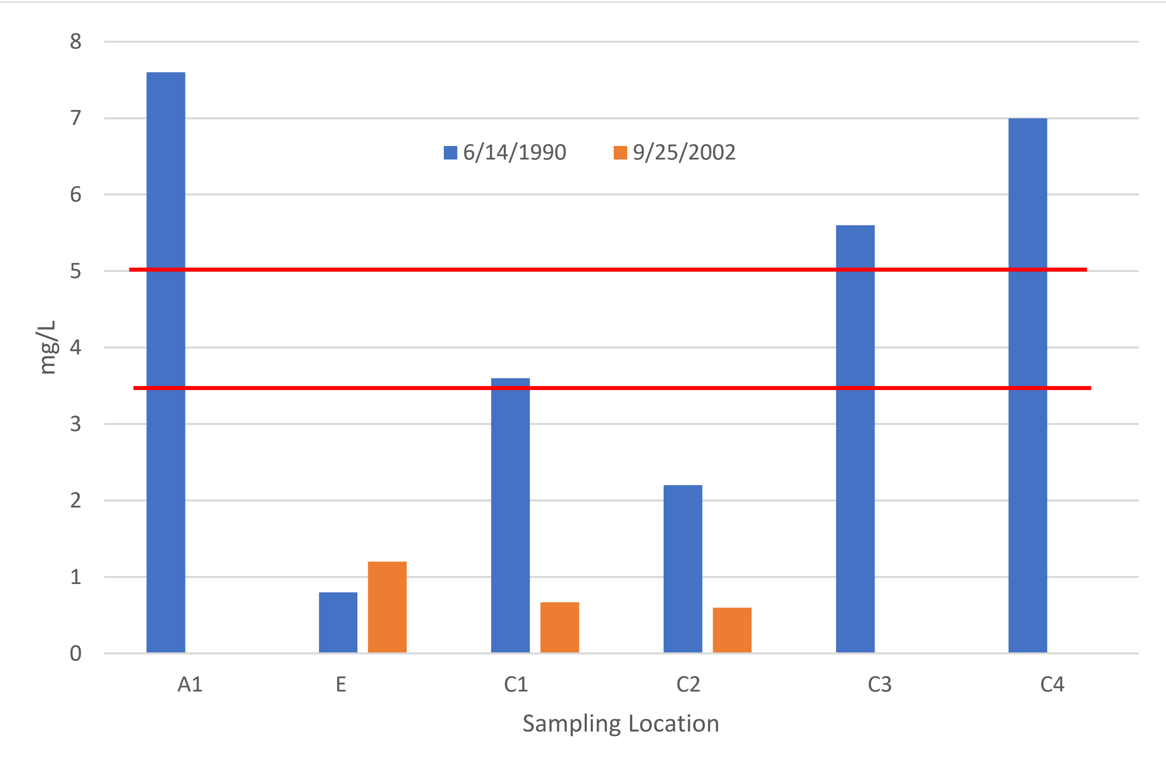


Figure 5-3: Historical Dissolved Oxygen data for Beach Creek Segment PLB-C1

5.1.1.3 Total Phosphorus

Beach Creek segment PLB-C1 is listed for impairment of the aquatic life use due to total phosphorus levels. **Table 5-3** summarizes historical phosphorus data collected on the impaired segment. **Figure 5-4** shows total phosphorus concentrations on Beach Creek during the Facility Related Stream Surveys conducted in 1990 and 2002. The FRSSs show that effluent (site E on Figure 5-4) concentrations at the time of the survey were causing increased TP concentrations in Beach Creek below the treatment plant (sites C-1 through C-4). Recent data have not been collected on this segment and the current conditions with relation to total phosphorus are unknown.

Table 5-3 Historical Phosphorus Data Collected for Impaired Stream Segments

Impaired Stream Segment Name & ID	Period of Record and Number of Data Points	Mean (mg/L)	Maximum (mg/L)	Minimum (mg/L)
Beach Creek Segment PLB-C1	1990 and 2002; 7	0.8	1.9	0.05

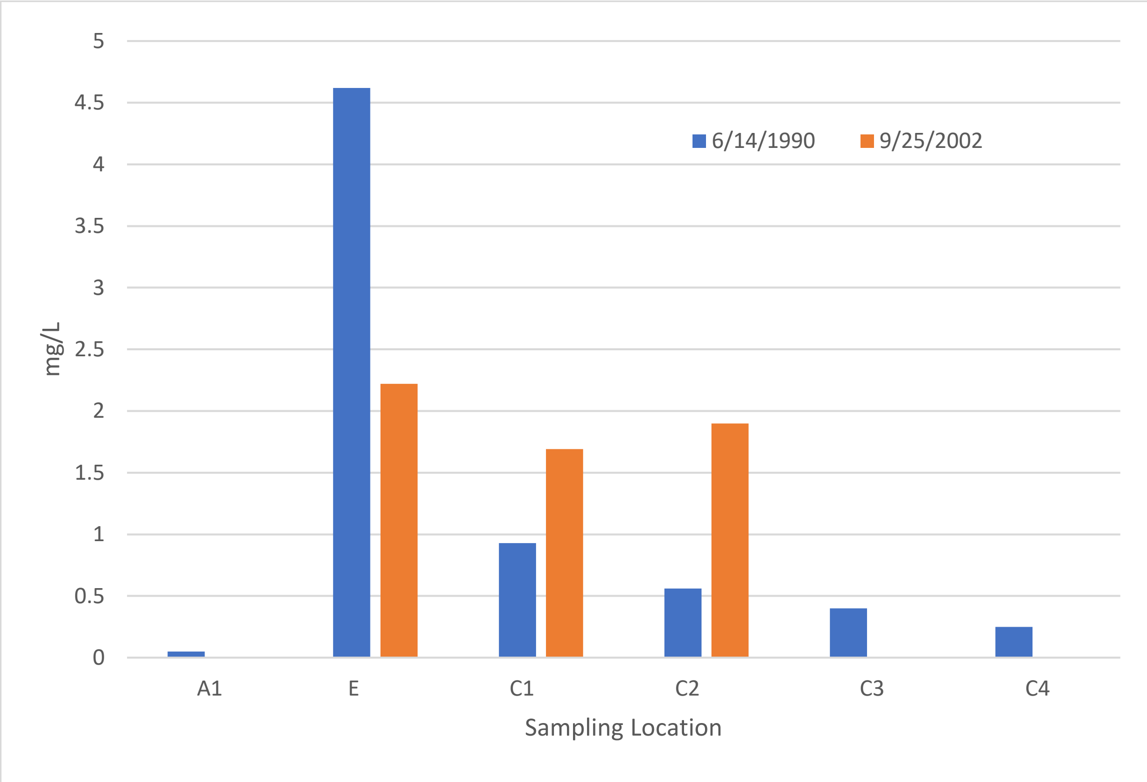


Figure 5-4: Historical Total Phosphorus data for Beach Creek Segment PLB-C1

5.2 Point Sources

Table 5-4 shows the permit information for facilities that discharge to the impaired segments in the Kyte River watershed while **Figure 5-5** shows the locations of each facility. In general, facilities discharging treated domestic wastewater have the potential to affect dissolved oxygen concentrations (through the discharge of nutrients and other oxygen-demanding materials), fecal coliform, and nutrient levels in their receiving waters. Potential pollutants discharged from industrial facilities vary and may include metals and/or sediments. National Pollutant Discharge Elimination System (NPDES) facilities with permit limits are required to submit discharge monitoring reports (DMRs) to Illinois EPA. Stage 3 will include a summary of relevant DMR data from discharges with the potential to impact impaired streams.

Table 5-4 Permitted Facilities Discharging within the Kyte River Watershed

Facility ID	Facility Name	Design Average/ Maximum Flow (mgd)	Receiving Water
ILG582015	Ashton STP, Village of	0.33/1.34	Beach Creek
IL0003336	Kinder Morgan Terminals, LLC	Intermittent discharge	Unnamed Tributary to Kyte River
IL0003638	Rochelle Foods, LLC	Intermittent discharge	Storm Sewer Tributary to Kyte River
IL0030741	City of Rochelle Water Reclamation	4.87/8.76	Kyte River
IL0075451	Rochelle Waste Disposal, LLC	Intermittent discharge	Unnamed Tributary to Kyte River
IL0076554	CHS - Rochelle	0.207[1]	Unnamed tributary to Steward Creek

ND = No Data
1- Design Average Flow

5.3 Nonpoint Sources

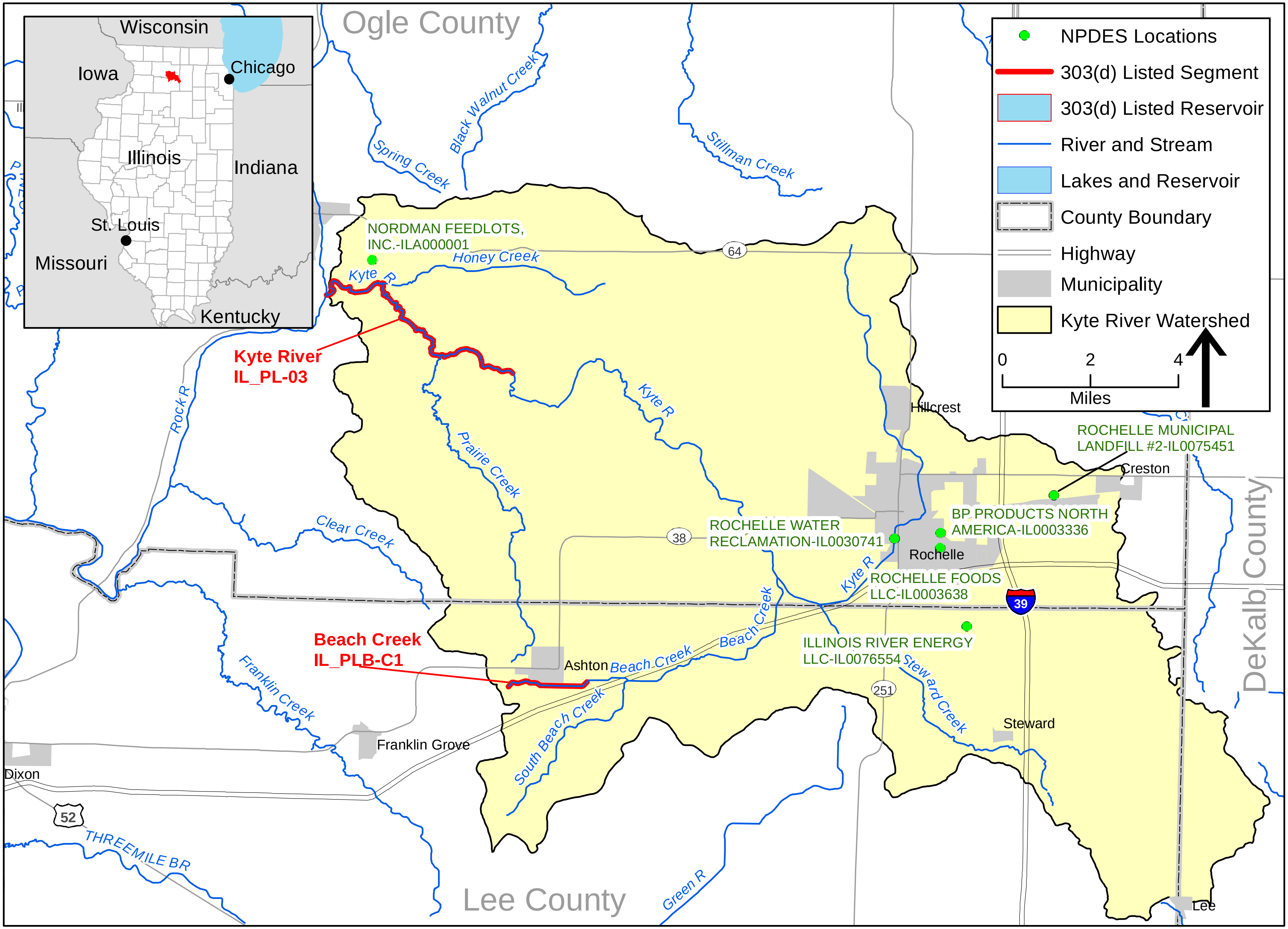
There are many potential nonpoint sources of pollutant loading to the impaired segments in the Kyte River watershed. This section will discuss site-specific cropping practices, animal operations, and area septic systems. Available data were collected through communications with the local NRCS, Illinois Soil and Water Conservation Districts (SWCDs), and public health departments.

5.3.1 Crop Information

Approximately 78 percent of the land within the Kyte River watershed is devoted to agriculture[3]. Because much of the watershed is under cultivation, soil loss from fields is likely the primary source of sediment and any pollutant attached to the sediment (nutrients, oxygen-demanding materials, and potentially fecal coliform). Tillage practices for crops such as corn, soybeans, and grains can be categorized as conventional till, reduced till, mulch till, and no till. The percentage of each tillage practice for corn, soybeans, and small grains by county are generated from County Transect Surveys by the Illinois Department of Agriculture (IDA)[4]. Data from the 2015 and 2018 survey are presented in **Tables 5-5** through **5-7** for DeKalb, Lee, and Ogle Counties, respectively.

According to the County Transect Survey summary report, fields planted conventionally leave less than 15% of the soil surface covered with crop residue after planting while mulch-till leaves at least 30% of the residue from the previous crop on the soil surface after being tilled and planted. Reduced-till falls between conventional and mulch (greater than 15% but less than 30%) and no-till practices leave the soil virtually undisturbed from harvest through planting. Residue is important because it shields the ground from the eroding effects of rain and helps retain moisture for crops. Data indicates a transition towards mulch tilling in most counties over the past decade with reductions in conventional till practices.

[3] https://www.nass.usda.gov/Research_and_Science/Cropland/Release/index.php
[4] IDA. 2015. Illinois Soil Conservation Transect Survey Reports. Retrieved from https://www2.illinois.gov/sites/agr/Resources/LandWater/Pages/Illinois-Soil-Conservation-Transect-Survey-Reports.aspx.



DRAFT

Figure 5-5: Kyte River Watershed, NPDES Locations

This page intentionally left blank

Table 5-5 Tillage Practices in DeKalb County, Illinois

Tillage System	Corn		Soybean		Small Grain	
	2015	2018	2015	2018	2015	2018
Conventional	37.7%	47.5%	5%	4.1%	0%	0.0%
Reduced - Till	23.8%	30.2%	18%	24.3%	90%	66.7%
Mulch – Till	34.9%	16.7%	62%	49.3%	0%	0.0%
No - Till	3.6%	5.6%	15%	22.3%	10%	33.3%

NA (Not available) = zero survey data points, however, the 2017 survey indicates that only no-till practices were applied for small grain.

Table 5-6 Tillage Practices in Lee County, Illinois

Tillage System	Corn		Soybean		Small Grain	
	2015	2018	2015	2018	2015	2018
Conventional	2.2%	16.0%	2.0%	3.6%	100%	0%
Reduced - Till	18.8%	28.8%	12.2%	12.0%	0%	0%
Mulch – Till	77.4%	49.0%	69.4%	61.4%	0%	50%
No - Till	1.6%	6.2%	16.3%	22.9%	0%	0%

Data as reported by agency and some columns do not add up to 100%.

Table 5-7 Tillage Practices in Ogle County, Illinois

Tillage System	Corn		Soybean		Small Grain	
	2015	2018	2015	2018	2015	2018
Conventional	21.0%	36.0%	4.3%	5.6%	0.0%	44.4%
Reduced - Till	45.9%	34.9%	20.2%	26.4%	16.7%	0.0%
Mulch – Till	27.9%	19.1%	40.5%	39.3%	72.2%	11.1%
No - Till	5.2%	10.0%	34.4%	28.7%	11.1%	33.3%

Data as reported by agency and some columns do not add up to 100%.

Information on field tiling practices was also sought as field drains can influence the timing and amounts of water delivered to area streams as well as deliver dissolved nutrients from fields to receiving waters. The current status of field tiling in the watershed is unknown.

5.3.2 Animal Operations

Information on commercial animal operations is available from the NASS. Knowing the number of animal units in a watershed is useful in TMDL development as grazing animals have the potential to increase erosion and contribute nutrients through manure. Although watershed-specific data are not available, countywide data for DeKalb, Lee, and Ogle Counties are presented in **Tables 5-8** through **5-10**, respectively. Data from 2012 and 2017 have been published on the USDA website[5][6][7][8].

Table 5-8 DeKalb County Animal Population (2012 and 2017 Census of Agriculture)

Livestock Type	2012	2017	Percent Change
Cattle and Calves	31,286	18,599	-40.6%
Beef	1,668	1,729	3.7%
Dairy	726	827	13.9%
Hogs and Pigs	239,648	276,185	15.2%
Poultry(1)	3,164(2)	1,710(2)	-46.0%
Sheep and Lambs	2,588	1,057	-59.2%
Horses and Ponies	550	459	-16.5%

(1) Poultry census data inclusive of broilers, layers, pullets, roosters and turkeys
(2) No data available for pullets, broilers, or turkeys; therefore, percent change may not be accurate

Table 5-9 Lee County Animal Population (2012 and 2017 Census of Agriculture)

Livestock Type	2012	2017	Percent Change
Cattle and Calves	10,215	11,076	8.4%
Beef	ND	2,560	ND
Dairy	ND	52	ND
Hogs and Pigs	42,235	59,763	41.5%
Poultry(1)	1,719	67,038	3,800%
Sheep and Lambs	313	399	27.5%
Horses and Ponies	324	288	-11.1%

(1) Poultry census data inclusive of broilers, layers, pullets, roosters and turkeys
ND= No data

Table 5-10 Ogle County Animal Population (2012 and 2017 Census of Agriculture)

Livestock Type	2012	2017	Percent Change
Cattle and Calves	30,913	26,463	-14.4%
Beef	7,618	6,572	-13.7%
Dairy	1,260	1,358	7.8%
Hogs and Pigs	95,639	95,495	-0.2%
Poultry(1)	218(2) (3)	2,903(2)	1231.7%
Sheep and Lambs	932	807	-13.4%
Horses and Ponies	871	858	-1.5%

(1) Poultry census data inclusive of broilers, layers, pullets, roosters and turkeys
(2) No data available for pullets; therefore, percent change may not be accurate
(3) No data available for layers; therefore, percent change may not be accurate

[5] https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Illinois/
[6] https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Wisconsin/
[7] https://www.nass.usda.gov/Publications/AgCensus/2012/Full_Report/Volume_1,_Chapter_2_County_Level/Illinois/
[8] https://www.nass.usda.gov/Publications/AgCensus/2012/Full_Report/Volume_1,_Chapter_2_County_Level/Wisconsin/

The tables above show significant cattle, hog and pig populations within the watershed counties. Animal operations have the potential to contribute nutrients and fecal coliform to area waterways. No concentrated animal feeding operations (CAFOs) were listed for the DeKalb, Lee, or Ogle counties under the general NPDES permit for CAFOs in Illinois (NPDES Permit No. ILA01)[9] and there are no known CAFOs within the watershed.

5.3.3 Septic Systems

Most households in rural areas of Illinois that are not connected to municipal sewers make use of onsite sewage disposal systems or septic systems. There are several types of septic systems, but the most common septic system is composed of a septic tank draining to a septic field, where nutrient removal occurs. However, the degree of nutrient removal is limited by local soils and the extent of system upkeep and maintenance. Across the U.S., septic systems have been found to be a significant source of phosphorus pollution. Faulty septic systems or illegal discharges can also be a source of fecal coliform.

Information on the extent of municipalities in the Kyte River watershed with or without sewers was obtained from the county health departments. Health department officials in Lee County stated that the town of Ashton is served by sewer, but most county residents within the watershed rely on private septic systems, specifically the villages of Steward and Scarboro[10]. Additionally, health department officials in Ogle County reported that approximately 1,560 residences and about 132 barns within the watershed and county rely on septic systems[11]. DeKalb County health department officials indicated that most of the watershed area within the county, although relatively small, would rely on septic systems[12].

5.4 Watershed Studies and Other Watershed Information

Previous efforts completed within the watershed are listed below. Reports will be reviewed, and data will be incorporated into Stage 3 where appropriate and relevant.

1990 – Biological and Water Quality Survey of Beach Creek (PLB) and South Branch Beach Creek (PLBA) in the Vicinity of the Ashton Sewage Treatment Plant (NPDES IL0023361) Lee County, IL, June 14, 1990 – Report finds poor to very poor stream conditions within the 0.5-mile reach downstream from where the Ashton STP discharges to Beach Creek. The report also concluded that the Ashton STP was responsible for the creek's low dissolved oxygen and higher fecal coliform concentrations just downstream of its discharge location.

---

[9] http://www.epa.state.il.us/water/permits/cafo/

[10] Halberg, K. 2019, December 6. Lee County Health Department, Director of Environmental Health. Email correspondence.

[11] Glenn, A. 2019, December 10. Ogle County Health Department, Environmental Health Inspector. Email correspondence.

[12] Carlson, L. 2019, December 6. DeKalb County Health Department, Environmental Health Practitioner. Email correspondence.

This page intentionally left blank

Section 6

Approach to Developing TMDL and Identification of Data Needs

The range of analyses used for developing TMDLs varies from simple to complex. Examples of a simple approach include mass-balance, load-duration, and simple watershed and receiving water models. Detailed approaches incorporate the use of complex watershed and receiving water models. Simplistic approaches typically require less data than detailed approaches and therefore these are the analyses recommended for the Kyte River watershed. Establishing a link between pollutant loads and resulting water quality is one of the most important steps in developing a TMDL. As discussed above, this link can be established through a variety of techniques. The objective of the remainder of this section is to recommend approaches for establishing these links for the constituents of concern in the Kyte River watershed.

6.1 Additional Data Needs for TMDL Development in the Kyte River Watershed

Table 6-1 contains summary information regarding data availability for all impairments in the Kyte River watershed. Although there are a reasonable number of fecal coliform sample data points available for the Kyte River to support TMDL calculation, the segment was last sampled for fecal coliform in 2006. In order to better assess the current fecal coliform concentration, additional sample collection is recommended. Sample collection at various times of year and over a range of flow conditions would be most beneficial for assessing the entire range of conditions that may occur within the river and would provide for a more accurate depiction of potential factors influencing the fecal coliform impairments in the Kyte River. Additional data collection is recommended for impairments on Beach Creek due to a lack of recent data and data needed to support model development.

Table 6-1 Data Availability and Data Needs for TMDL/LRS Development in the Kyte River watershed

Impaired Segment	Impairment Parameter	Period of Record	Data Count	Additional Data Needs
Kyte River (PL-03)	Fecal Coliform	1998-2006	30	Recommend additional fecal coliform data to confirm impairment, to help with source identification (samples over a range of flows), and to meet assessment requirements stipulating a minimum of five samples within 30 days
Beach Creek (PLB- C1)	Dissolved Oxygen	1990, 2002	7	Recommend additional DO data for impairment assessment; Synoptic data for flow, hydraulics, DO, temperature, nutrients, CBOD, and SOD to support model development
	Phosphorus (Total)	1990, 2002	7	Recommend additional phosphorus data to provide recent stream data

6.2 Approaches for Developing TMDLs in the Kyte River Watershed

6.2.1 Recommended Approach for Fecal Coliform TMDLs in the Kyte River

The recommended approach for developing a TMDL for fecal coliform in the Kyte River is the load-duration curve method. The load-duration method uses the cumulative frequency distribution of stream flow and pollutant concentration data to estimate the allowable loads for a waterbody. Due to the somewhat limited availability of recent fecal coliform data on the Kyte River, further data collection may be beneficial and would provide greater validity to the model output.

6.2.2 Recommended Approach for Dissolved Oxygen TMDL in Beach Creek

The recommended approach to TMDL development for DO impairments in streams is the development and parameterization of the QUAL2K model. QUAL2K is an updated spreadsheet-based version of the well-known and USEPA-supported QUAL2E model[1]. The model simulates DO dynamics as a function of nitrogenous and CBOD, atmospheric re-aeration, SOD, and phytoplankton photosynthesis and respiration. The model also simulates the fate and transport of nutrients and BOD and the presence and abundance of phytoplankton (as chlorophyll-a). Stream hydrodynamics and temperature are important controlling parameters in the model. The model is suited to steady-state simulations. As discussed in Section 6.1, outdated data currently exists to support model development for Beach Creek. Specific data requirements for development of a QUAL2K model include a synoptic (snapshot in time) water quality survey of the reach to include measurements of flow, hydraulics, DO, temperature, nutrients, SOD, and CBOD. The collected data will be used to support the model development and parameterization and will lend significant confidence to the TMDL conclusions. It is not anticipated that an additional watershed model will be needed to develop the DO TMDL for this stream.

6.2.3 Recommended Approach for Total Phosphorus LRS Development

The recommended approach for establishing a water quality goal for total phosphorus in Beach Creek is a modified load duration curve method. The load duration methodology uses the cumulative frequency distribution of stream flow and pollutant concentration data to estimate the allowable loads for a waterbody. CDM Smith will work closely with Illinois EPA to determine the target load to use based on the Illinois NLRS interim goal of 25% load reduction.

[1] http://www.qual2k.com/

Section 7
References

Carlson, L. 2019, December 6. DeKalb County Health Department, Environmental Health Practitioner. Email correspondence.

Glenn, A. 2019, December 10. Ogle County Health Department, Environmental Health Inspector. Email correspondence.

Halberg, K. 2019, December 6. Lee County Health Department, Director of Environmental Health. Email correspondence.

IDA (Illinois Department of Agriculture). 2018. Illinois Soil Conservation Transect Survey Reports. Retrieved from https://www2.illinois.gov/sites/agr/Resources/LandWater/Pages/Illinois-Soil-Conservation-Transect-Survey-Reports.aspx.

IDA. 2015. Illinois Soil Conservation Transect Survey Reports. Retrieved from https://www2.illinois.gov/sites/agr/Resources/LandWater/Pages/Illinois-Soil-Conservation-Transect-Survey-Reports.aspx.

IEPA (Illinois Environmental Protection Agency). 2019. River and Stream. Retrieved from https://www2.illinois.gov/epa/topics/water-quality/monitoring/Pages/river-and-stream.aspx.

IEPA (Illinois Environmental Protection Agency). 2018. Illinois Integrated Water Quality Report and Section 303(d) List, 2018. Retrieved from https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Documents/Draft-2018-Integrated-Report-11-14-2018.pdf.

IEPA (Illinois Environmental Protection Agency). 2016. Illinois Integrated Water Quality Report and Section 303(d) List, 2016. Retrieved from https://www2.illinois.gov/epa/Documents/iepa/water-quality/watershed-management/tmdls/2016/303-d-list/iwq-report-surface-water.pdf.

IEPA (Illinois Environmental Protection Agency). 2014. Illinois Water Monitoring Strategy 2015 - 2020. Retrieved from https://www2.illinois.gov/epa/Documents/epa.state.il.us/water/water-quality/monitoring-strategy/monitoring-strategy-2015-2020.pdf.

IDPA (Illinois Environmental Protection Agency). General NPDES Permit for Concentrated Animal Feeding Operations. Retrieved from: http://www.epa.state.il.us/water/permits/cafo/

IPCB (Illinois Pollution Control Board). Title 35 Procedural and Environmental Rules. Retrieved from: https://pcb.illinois.gov/SLR/IPCBandIEPAEnvironmentalRegulationsTitle35

IPCB (Illinois Pollution Control Board). Title 35: Environmental Protection, Subtitle C: Water Pollution, Chapter I: Pollution Control Board, Part 303 Water Use Designations and Site

Specific Water Quality Standards. Retrieved from: https://pcb.illinois.gov/documents/dsweb/Get/Document-16952/

NOAA (National Oceanic and Atmosphere Administration) National Centers for Environmental Information. Land Based Station Data. Retrieved from https://www.ncdc.noaa.gov/data-access/land-based-station-data

NRCS. 2007. Part 630 Hydrology National Engineering Handbook: Hydrologic Soil Groups. United States Department of Agriculture. Retrieved from http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba.

QUAL2K. Modeling Framework for Simulating River, Stream, and Lake Water Quality. Retrieved from: http://www.qual2k.com/

U.S. Census Bureau (Census). 2007-Present. TIGER/Line Shapefiles. Retrieved from: https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html

U.S. Census Bureau (Census). 2010 Census – Block Maps. Retrieved from: https://www.census.gov/geographies/reference-maps/2010/geo/2010-census-block-maps.html

USDA (U.S. Department of Agriculture). 2018. National Agricultural Statistics Service: CropScape and Copland Data Layer. Last Modified 9/12/2019. https://www.nass.usda.gov/Research_and_Science/Cropland/Release/index.php

USDA (U.S. Department of Agriculture). Illinois Nutrient Loss Reduction Strategy. Retrieved from: https://www2.illinois.gov/sites/agr/Resources/NutrientLoss/Pages/default.aspx

USDA (U.S. Department of Agriculture). 2017. Census of Agriculture: 2017 Census Volume 1, Chapter 2: County Level Data, Illinois. Retrieved from https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Illinois/.

USDA (U.S. Department of Agriculture). 2017. Census of Agriculture: 2017 Census Volume 1, Chapter 2: County Level Data, Wisconsin. Retrieved from https://www.nass.usda.gov/Publications/AgCensus/2012/Full_Report/Volume_1,_Chapter_2_County_Level/Wisconsin/

USDA (U.S. Department of Agriculture). 2012. Census of Agriculture: 2012 Census Volume 1, Chapter 2: County Level Data, Wisconsin. Retrieved from https://www.nass.usda.gov/Publications/AgCensus/2012/Full_Report/Volume_1,_Chapter_2_County_Level/Illinois/.

USDA (U.S. Department of Agriculture). 2012. Census of Agriculture: 2012 Census Volume 1, Chapter 2: County Level Data, Illinois. Retrieved from https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_2_County_Level/Wisconsin/

USDA. Published Soil Survey for Illinois. Retrieved from: https://www.nrcs.usda.gov/wps/portal/nrcs/surveylist/soils/survey/state/?stateId=IL

USGS (U.S. Geological Survey). 2019. Daily Data for Illinois: Streamflow. Retrieved from https://waterdata.usgs.gov/IL/nwis/current/?type=dailydischarge&group_key=basin_cd

USGS (U.S. Geological Survey) National Elevation Dataset (NED). 2019. Retrieved from: https://catalog.data.gov/dataset/usgs-national-elevation-dataset-ned

This page intentionally left blank.

This page intentionally left blank

cdmsmith.com