CDM

Illinois Environmental Protection Agency

Cahokia Canal/Horseshoe Lake Watershed TMDL
Stage One
Third Quarter Draft Report

April 2006

Draft Report

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Acronyms

°F	degrees Fahrenheit
BMP	best management practice
BOD	biochemical oxygen demand
$CBOD_5$	5-day carbonaceous biochemical oxygen demand
cfs	cubic feet per second
CRP	Conservation Reserve Program
cfu	Coliform forming units
CWA	Clean Water Act
DMR	Discharge Monitoring Reports
DO	dissolved oxygen
ft	Foot or feet
GIS	geographic information system
HUC	Hydrologic Unit Code
IDA	Illinois Department of Agriculture
IDNR	Illinois Department of Natural Resources
IL-GAP	Illinois Gap Analysis Project
ILLCP	Illinois Interagency Landscape Classification Project
Illinois EPA	Illinois Environmental Protection Agency
INHS	Illinois Natural History Survey
IPCB	Illinois Pollution Control Board
LA	load allocation
LC	loading capacity
lb/d	pounds per day
mgd	Million gallons per day
mg/L	milligrams per liter
MHP	mobile home park
mL	milliliter
MOS	margin of safety
NA	Not applicable
NASS	National Agricultural Statistics Service
NCDC	National Climatic Data Center
NED	National Elevation Dataset
NPDES	National Pollution Discharge Elimination System
NRCS	National Resource Conservation Service

PCBs	polychlorinated biphenyl
PCS	Permit Compliance System
SOD	sediment oxygen demand
SSURGO	Soil Survey Geographic Database
STORET	Storage and Retrieval
STP	Sanitary Treatment Plant
SWCD	Soil and Water Conservation District
TMDL	total maximum daily load
TSS	total suspended solids
ug/L	Micrograms per liter
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WLA	waste load allocation
WTP	Water Treatment Plant

Section 1
Goals and Objectives for Cahokia Canal/ Horseshoe Lake Watershed (0714010105, 0714010106, 0714010104)

1.1 Total Maximum Daily Load (TMDL) 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 lists water bodies not meeting water quality standards every two years. This list is called the 303(d) list and water bodies on the list are then targeted for TMDL development.

In general, a TMDL is a quantitative assessment of water quality problems, contributing sources, and pollution reductions needed to attain water quality standards. The TMDL specifies the amount of pollution or other stressor that needs to be reduced to meet water quality standards, allocates pollution 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
- 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:

- 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
- An antidegradation policy

Examples of designated uses are recreation and protection of aquatic life. 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 Cahokia Canal/ Horseshoe Lake 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)
- Stage 3 – Model Calibration, TMDL Scenarios, Implementation Plan

This report addresses Stage 1 TMDL development for the Cahokia Canal/Horseshoe Lake Watershed. Stage 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 is not required to establish the TMDL.

Following this process, the TMDL goals and objectives for the Cahokia Canal/ Horseshoe Lake Watershed will include developing TMDLs for all impaired water bodies within the watershed, describing all of the necessary elements of the TMDL, developing an implementation plan for each TMDL, and gaining public acceptance of the process. Following are the impaired water body segments in the Cahokia Canal/Horseshoe Lake Watershed for which a TMDL will be developed:

- Cahokia Canal (JN 02)
- Horseshoe Lake (Madison) (RJC)
- Prairie Du Pont Creek (JMAA01)
- Harding Ditch (JMCA02)
- Frank Holten Main Lake (RJK)
- Frank Holten Lake #2 (RJL)
- Frank Holten Lake #3 (RJM)
- Canteen Creek (JNA 01)

These impaired water body segments are shown on Figure 1-1. There are 8 impaired segments within the Cahokia Canal/Horseshoe Lake Watershed. Table 1-1 lists the water body segment, water body size, and potential causes of impairment for the water body.

Table 1-1 Impaired Water Bodies in Cahokia Canal/Horseshoe Lake Watershed

Water Body Segment ID	Water Body Name	Size	Causes of Impairment with Numeric Water Quality Standards	Causes of Impairment with Assessment Guidelines
JN 02	Cahokia Canal	11.87 miles	Dissolved oxygen	Total nitrogen, sedimentation/siltation, habitat alterations (streams), total phosphorus
RJC	Horseshoe Lake	2,107 acres	Total phosphorus, pH	Excess algal growth, non-native fish/animals, heptachlor, PCBs, zinc, total phosphorus, total suspended solids (TSS)
JMAA01	Prairie Du Pont Creek	14.34 miles	Dissolved oxygen[(1)]	Total phosphorus
JMAC02	Harding Ditch	10.48 miles	Total fecal coliform	
RJK	Frank Holten Main Lake	97 acres	Total phosphorus	TSS, excess algal growth, PCBs, total phosphorus
RJL	Frank Holten Lake #2	40 acres	Total phosphorus	TSS, excess algal growth, PCBs, total phosphorus
RJM	Frank Holten Lake #3	80 acres	Total phosphorus, dissolved oxygen	TSS, excess algal growth, non-native fish/animals, PCBs, total phosphorus
JNA 01	Canteen Creek	4.31 miles	Manganese	Total nitrogen, sedimentation/siltation, habitat alterations (streams), TSS, total phosphorus

[(1)]Data collected in 2005 indicates that Prairiie Du Pont Creek is no longer impaired for dissolved oxygen and the stream will no longer be on the State's 303(d) list. Therefore, a TMDL for dissolved oxygen is not being developed.

Illinois EPA are currently only developing TMDLs for parameters that have numeric water quality standards, and therefore the remaining sections of this report will focus on the manganese, dissolved oxygen, total phosphorus (numeric standard), pH, and total fecal coliform impairments in the Cahokia Canal/Horseshoe Lake Watershed. For potential causes that do not have numeric water quality standards as noted in Table 1-1, TMDLs will not be developed at this time. However, in the implementation plans completed during Stage 3 of the TMDL, many of these potential causes may be addressed by implementation of controls for the pollutants with water quality standards.

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

These elements are combined into the following equation:

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

The TMDL developed must also take into account the seasonal variability of pollutant loads so that water quality standards are met during all seasons of the year. Also, reasonable assurance that the TMDL will be achieved will be described in the implementation plan. The implementation plan for the Cahokia Canal/Horseshoe Lake Watershed will describe how water quality standards will be attained. This implementation plan will include recommendations for implementing best management practices (BMPs), cost estimates, institutional needs to implement BMPs and controls throughout the watershed, and timeframe for completion of implementation activities.

1.3 Report Overview

The remaining sections of this report contain:

- **Section 2 Cahokia Canal/Horseshoe Lake 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 occurred throughout the TMDL development

- **Section 4 Cahokia Canal/Horseshoe Lake Watershed Water Quality Standards** defines the water quality standards for the impaired water body

- **Section 5 Cahokia Canal/Horseshoe Lake Watershed Characterization** presents the available water quality data needed to develop TMDLs, discusses the characteristics of the impaired reservoirs in the watershed, and also describes the point and non-point 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 will be needed for TMDL development and also suggests segments for Stage 2 data collection.

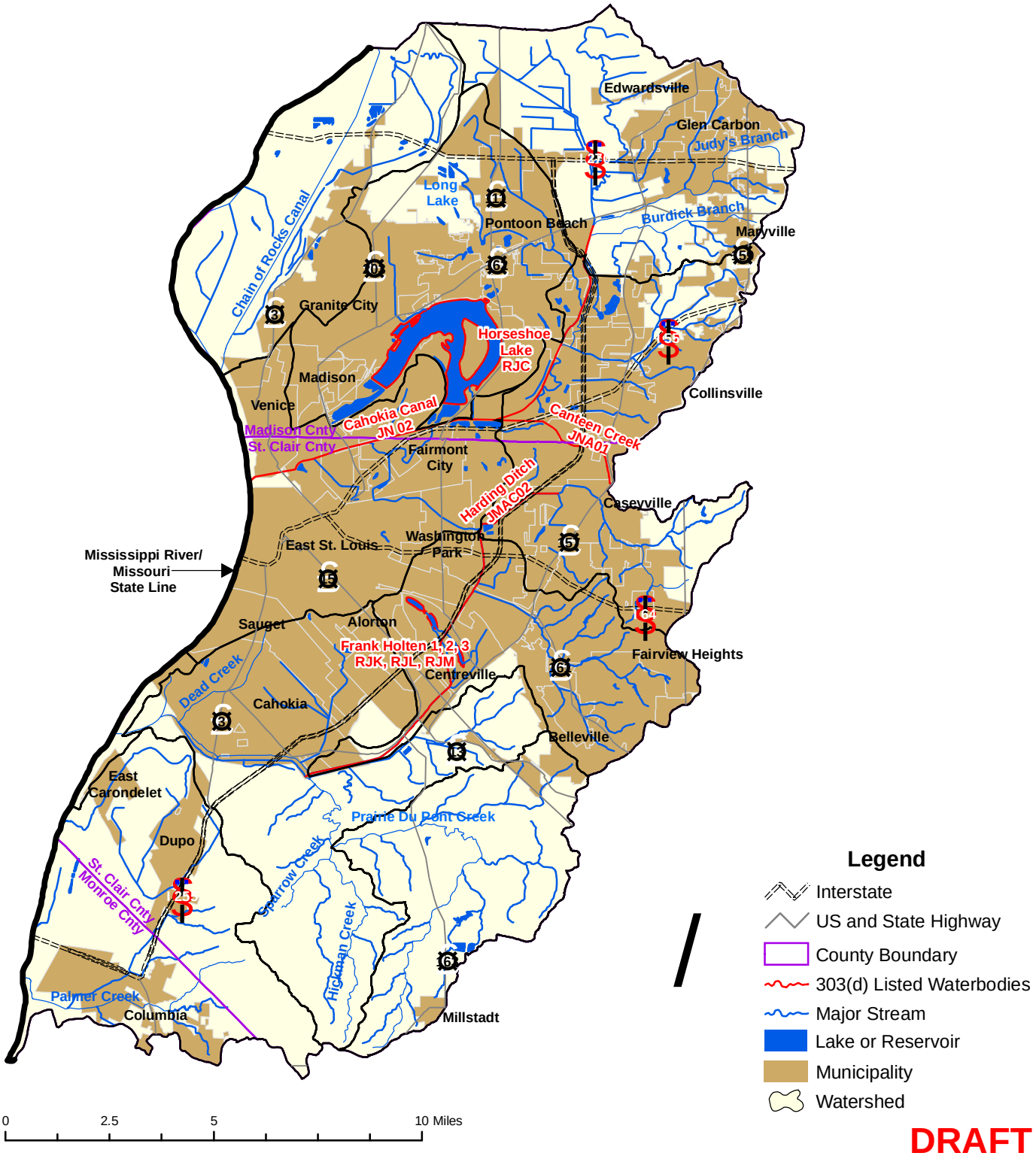

Figure 1-1
Cahokia Canal/Horseshoe Lake Watershed

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Section 2
Cahokia Canal/Horseshoe Lake Watershed Description

2.1 Cahokia Canal/Horseshoe Lake Watershed Location

The Cahokia Canal/Horseshoe Lake watershed (Figure 1-1) is located in southern Illinois, flows in a southwesterly direction, and drains approximately 181,673 acres within the state of Illinois. Approximately 75,472 acres lie in southwestern Madison County, 97,427 acres lie in western St. Clair County, and 8,775 acres lie in northern Monroe 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) coverages containing 30-meter grid resolution elevation data are available from the USGS for each 1:24,000-topographic quadrangle in the United States. Elevation data for the Cahokia Canal/Horseshoe Lake watershed was obtained by overlaying the NED grid onto the GIS-delineated watershed. Figure 2-1 shows the elevations found within the watershed.

Elevation in the Cahokia Canal/Horseshoe Lake watershed ranges from 702 feet above sea level in the headwaters of Cahokia Canal to 374 feet at its most downstream point at the Mississippi River. The absolute elevation change is 26 feet over the approximately 12-mile stream length of Cahokia Canal, which yields a stream gradient of approximately 2.2 feet per mile. Prairie DuPont Creek, located in the southern half of the watershed, yields an absolute elevation change of 262 feet over the approximately 20-mile stream length and a stream gradient of approximately 13.3 feet per mile.

2.3 Land Use

Land use data for the Cahokia Canal/Horseshoe Lake watershed were extracted from the Illinois Gap Analysis Project (IL-GAP) Land Cover data layer. IL-GAP was started at the Illinois Natural History Survey (INHS) in 1996, and the land cover layer was the first component of the project. The IL-GAP Land Cover data layer is a product of the Illinois Interagency Landscape Classification Project (IILCP), an initiative to produce statewide land cover information on a recurring basis cooperatively managed by the United States Department of Agriculture National Agricultural Statistics Service (NASS), the Illinois Department of Agriculture (IDA), and the Illinois Department of Natural Resources (IDNR). The land cover data was generated using 30-meter grid resolution satellite imagery taken during 1999 and 2000. The IL-GAP Land Cover data layer contains 23 land cover categories, including detailed classification in the vegetated areas of Illinois. Appendix A contains a complete listing of land cover

categories. (Source: IDNR, INHS, IDA, USDA NASS's 1:100,000 Scale Land Cover of Illinois 1999-2000, Raster Digital Data, Version 2.0, September 2003.)

The land use of the Cahokia Canal/Horseshoe Lake watershed was determined by overlaying the IL-GAP Land Cover data layer onto the GIS-delineated watershed. Table 2-1 contains the land uses contributing to the Cahokia Canal/Horseshoe Lake watershed, based on the IL-GAP land cover categories and also includes the area of each land cover category and percentage of the watershed area. Figure 2-2 illustrates the land uses of the watershed.

The land cover data reveal that approximately 73,373 acres, representing nearly 40 percent of the total watershed area, are devoted to agricultural activities. Corn and soybean farming account for nearly 13 percent and 15 percent of the watershed area, respectively. Urban areas occupy approximately 33 percent of the watershed (about nine percent high density, 17 percent low/medium density, and eight percent urban open space). Upland forests occupy approximately 11 percent of the watershed, and urban open space and wetlands each occupy approximately eight percent. Other land cover categories represent five percent or less of the watershed area.

Table 2-1. Land Use in Cahokia Canal/Horseshoe Lake Watershed

Land Cover Category	Area (Acres)	Percentage
Corn	22,892	12.6%
Soybeans	27,284	15.0%
Winter Wheat	3,554	2.0%
Other Small Grains & Hay	552	0.3%
Winter Wheat/Soybeans	7,651	4.2%
Other Agriculture	2,440	1.3%
Rural Grassland	9,000	5.0%
Upland	19,385	10.7%
Forested Areas	5,283	2.9%
High Density	15,606	8.6%
Low/Medium Density	30,259	16.7%
Urban Open Space	14,126	7.8%
Wetlands	14,213	7.8%
Surface Water	8,591	4.7%
Barren & Exposed Land	837	0.4%
Total	**181,673**	**100%**

1. Forested areas includes partial canopy/savannah upland.
2. Wetlands includes shallow marsh/wet meadow, deep marsh, seasonally/temporally flooded, floodplain forest, and shallow water.

2.4 Soils

Detailed soils data and spatial coverages are available through the Soil Survey Geographic (SSURGO) database for a limited number of counties in Illinois. 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 NRCS soil mapping.

The Cahokia Canal/Horseshoe Lake Watershed falls within Madison, Monroe and St. Clare Counties. Figure 2-3 displays the SSURGO soil series in the Cahokia Canal/Horseshoe Lake watershed. Attributes of the spatial coverage can be linked to the SSURGO database which provides information on various chemical and physical soil characteristics for each map unit and soil series. Of particular interest for TMDL development are the hydrologic soil groups as well as the K-factor of the Universal Soil Loss Equation. The following sections describe and summarize the specified soil characteristics for the Cahokia Canal/Horseshoe Lake watershed.

2.4.1 Cahokia Canal/Horseshoe Lake Watershed Soil Characteristics

Appendix B contains the SSURGO soil series for the Cahokia Canal/Horseshoe Lake Watershed. The table also contains the area, dominant hydrologic soil group, and k-factor range. Each of these characterizations is described in more detail in the following paragraphs. The predominant soil type in the watershed is Darwin Silty Clay on zero to 2 percent slopes followed by Marine Silt Loam on zero to five percent slopes.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils are assigned to one of four groups. They are grouped according to their infiltration rates under saturated conditions during long duration storm events. All four hydrologic soil groups (A, B, C, and D) are found within the Cahokia Canal/Horseshoe Lake watershed with the majority of the watershed falling into category B. Category B soils are defined as "soils having a moderate infiltration rate when thoroughly wet". Category B soils "consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture". These soils have a moderate rate of water transmission. (NRCS, 2005)

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 Cahokia Canal/Horseshoe Lake watershed range from 0.02 to 0.55.

2.5 Population

Population data were retrieved from Census 2000 TIGER/Line Data from the US Bureau of the Census. Geographic shape files of census blocks were downloaded for every county containing any portion of the watersheds. The block files were clipped to each watershed so that only block populations associated with the watershed would be counted. The census block demographic text file (PL94) containing population data was downloaded and linked to each watershed and summed. City populations were taken from the US Bureau of the Census. For municipalities that are located across watershed borders, the population was estimated based on the percentage of area of municipality within the watershed boundary.

Approximately 226,747 people reside in the watershed. The major municipalities in the Cahokia Canal/Horseshoe Lake Watershed are shown in Figure 1-1. The cities of Granite City, East St. Louis, Collinsville and Cahokia are the largest population centers in the watershed and contribute an estimated 31,301, 22,638, 16,455, and 16,391 people, respectively, to total watershed population.

2.6 Climate and Streamflow

2.6.1 Climate

Southern Illinois has a temperate climate with hot summers and cold, snowy winters. Monthly precipitation and temperature data were available for the Cahokia station (id. 1160) in St. Clair County and were extracted from the NCDC database. Data were available from 1969-2002. Cahokia, IL is located within the basin and was chosen to be representative of meteorological conditions throughout the Cahokia Canal/Horseshoe Lake watershed.

Table 2-2 contains the average monthly precipitation along with average high and low temperatures for the period of record. The average annual precipitation is approximately 39 inches.

Table 2-2 Average Monthly Climate Data in Cahokia, IL

Month	Total Precipitation (inches)	Maximum Temperature (degrees F)	Minimum Temperature (degrees F)
January	2.1	39	20
February	2.3	45	25
March	3.6	56	34
April	4.0	68	45
May	4.0	76	54
June	3.8	85	63
July	3.8	89	67
August	3.6	87	65
September	3.1	80	57
October	2.7	70	45
November	3.5	56	35
December	2.7	44	26
Total	**39.2**		

2.6.2 Streamflow

Analysis of the Cahokia Canal/Horseshoe Lake watershed requires an understanding of flow throughout the drainage area. Unfortunately, there are no USGS gages within the watershed that have current, or even recent, streamflow data. Streamflow values can possibly be collected in the watershed if any Stage 2 data collection occurs or values can be estimated through the drainage area ratio method which assumes that the flow per unit area is equivalent in watersheds with similar characteristics. If new data becomes available, it will be incorporated into Stage 3 TMDL development. In the absence of new data, flows will be estimated from a gage in a neighboring watershed.

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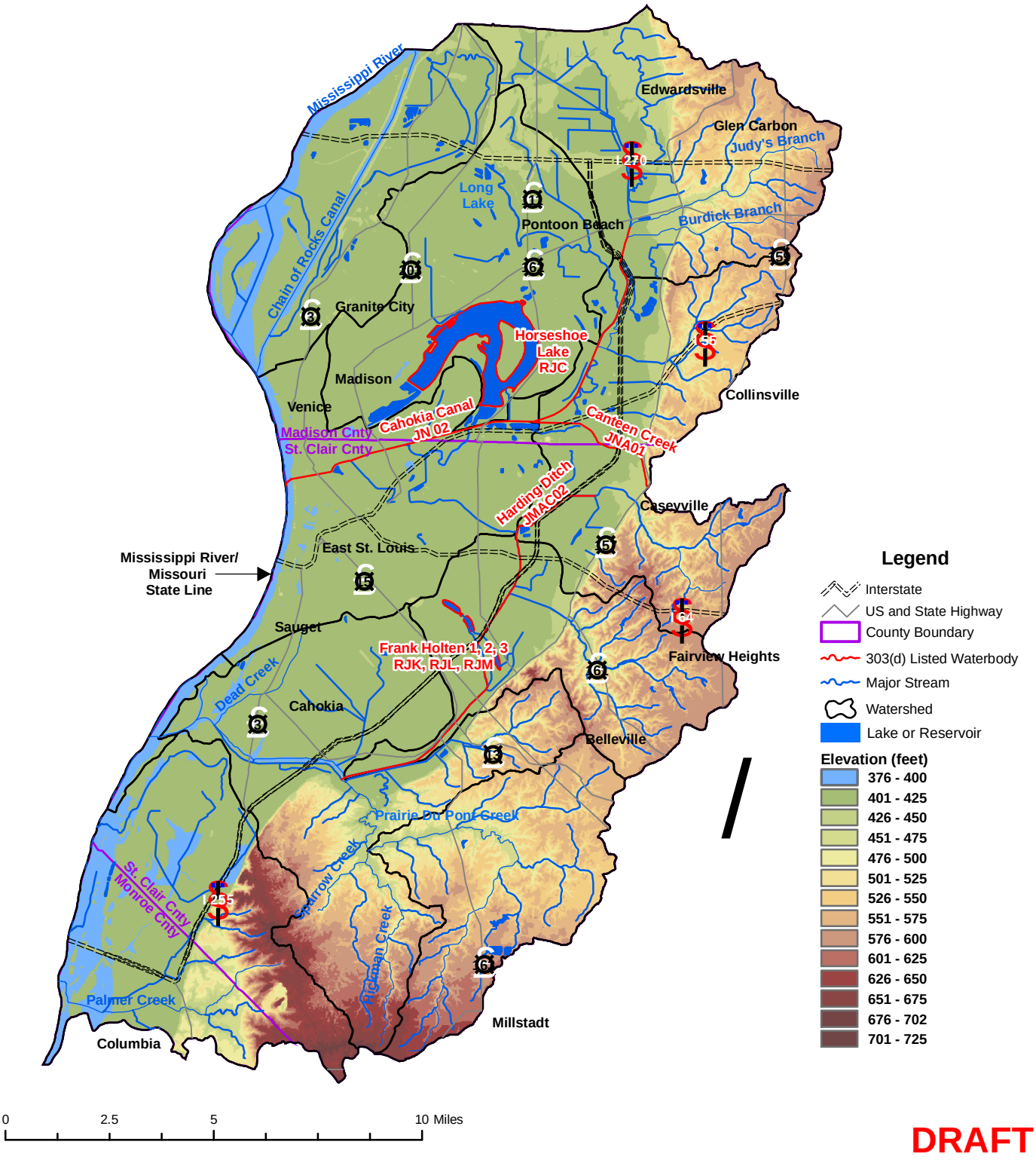

Figure 2-1
Cahokia Canal/Horseshoe Lake Watershed
Elevation

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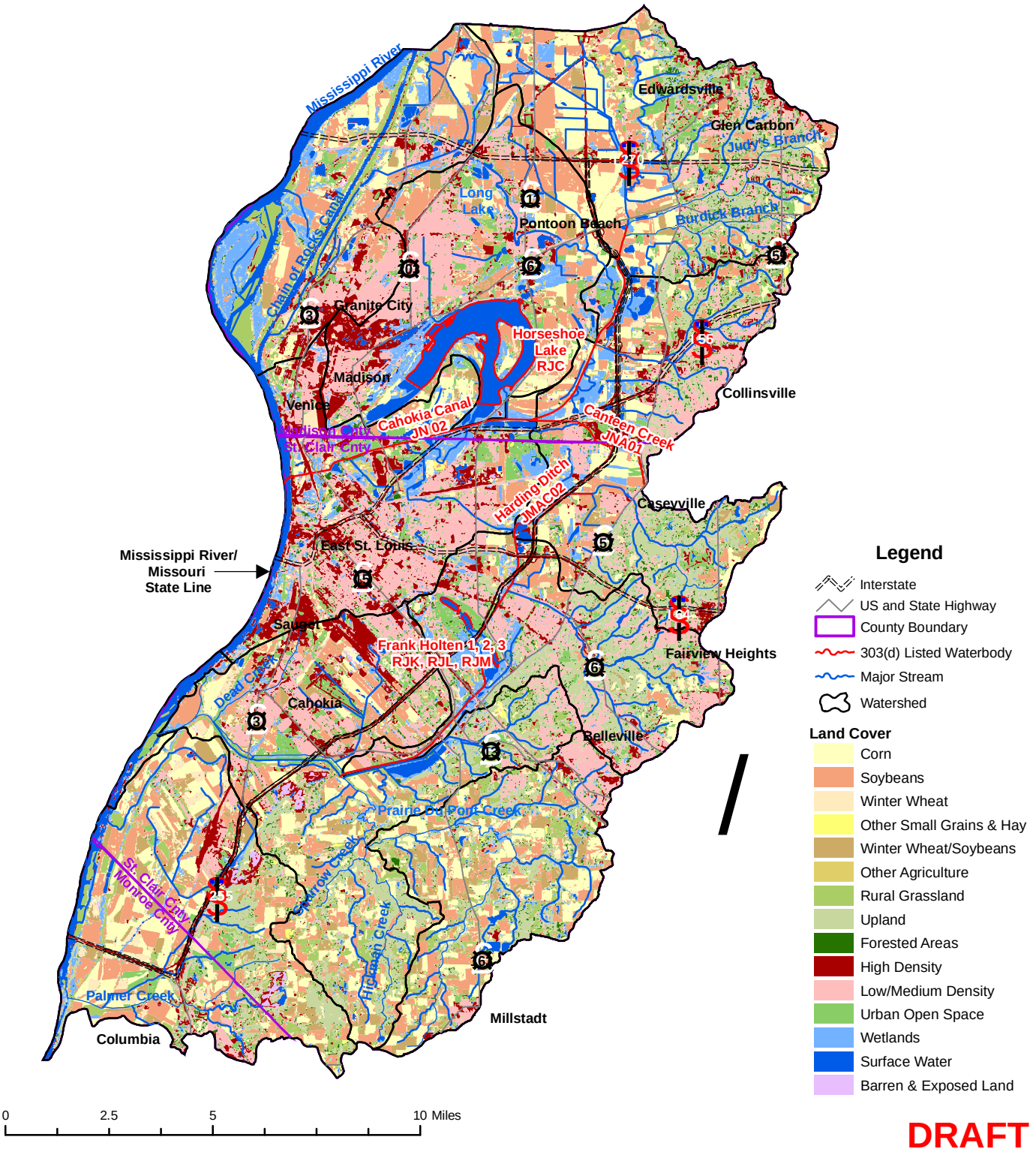

Figure 2-2
Cahokia Canal/Horseshoe Lake Watershed
Land Use

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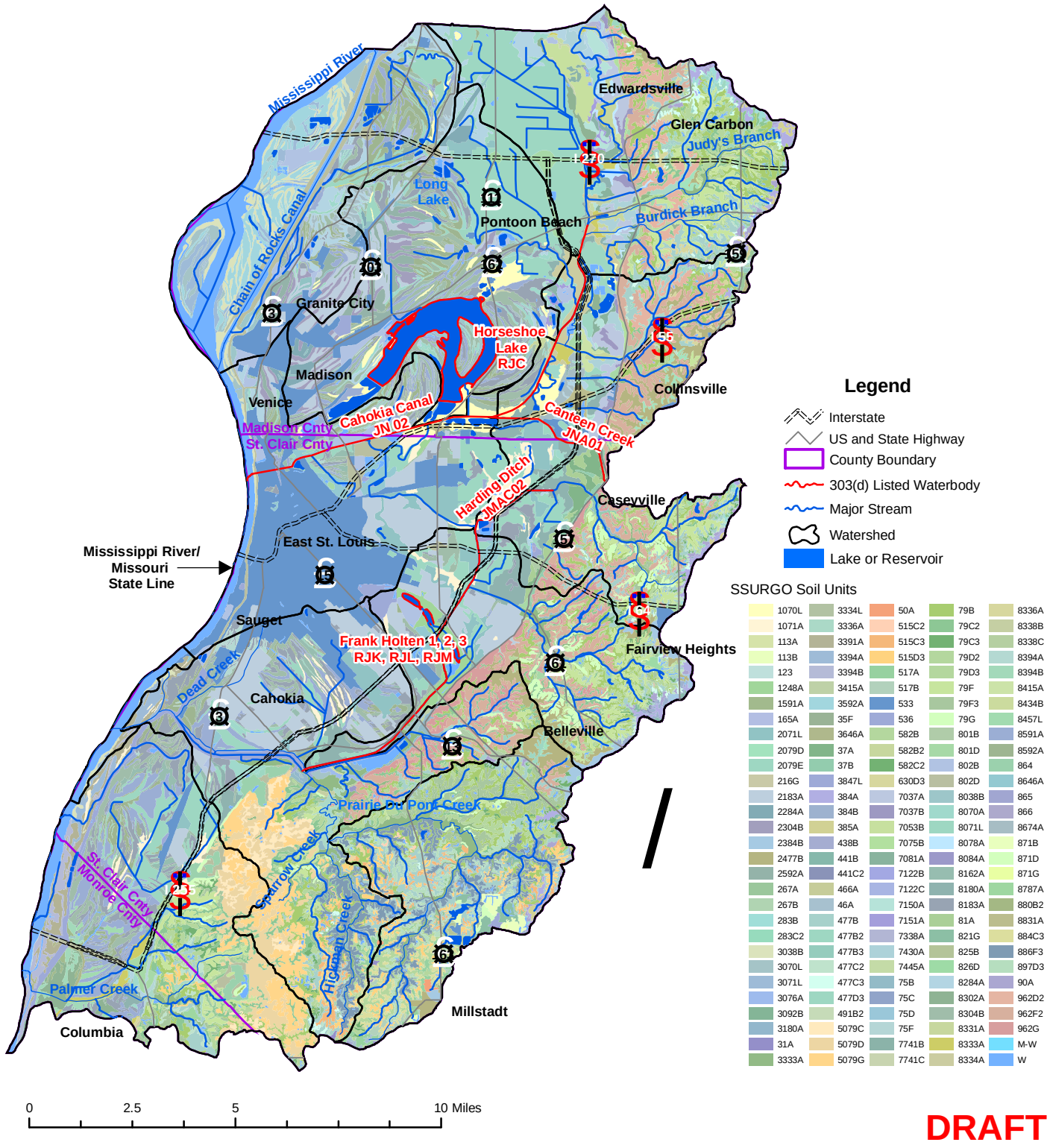

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Figure 2-3
Cahokia Canal/Horseshoe Lake Watershed
Soils

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Section 3
Public Participation and Involvement

3.1 Cahokia Canal/Horseshoe Lake Watershed Public Participation and Involvement

Public knowledge, acceptance, and follow through are necessary to implement a plan to meet recommended TMDLs. 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, will hold up to four public meetings within the watershed throughout the course of the TMDL development. This section will be updated once public meetings have occurred.

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Section 4
Cahokia Canal/Horseshoe Lake Watershed Water Quality Standards

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, setting the water quality standards is the responsibility of the Illinois Pollution Control Board (IPCB). Illinois is required to update water quality standards every three 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 three-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.

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, and Secondary Contact and Indigenous Aquatic Life Use (Illinois EPA 2005). The designated uses applicable to the Cahokia Canal/Horseshoe Lake Watershed are the General Use and Public and Food Processing Water Supplies Use.

4.2.1 General Use

The General Use classification is defined by IPCB as: The General Use standards 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 permits such use.

4.2.2 Public and Food Processing Water Supplies

The Public and Food Processing Water Supplies Use is defined by IPCB as: These are cumulative with the general use standards of Subpart B and must be met in all waters designated in Part 303 at any point at which water is withdrawn for treatment and distribution as a potable supply or for food processing.

4.3 Illinois Water Quality Standards

To make 303(d) listing determinations for aquatic life uses, Illinois EPA first collects biological data and if this data suggests that impairment to aquatic life is occurring, then a comparison of available water quality data with water quality standards occurs.

For public and food processing water supply waters, Illinois EPA compares available data with water quality standards to make impairment determinations. Tables 4-1 and 4-2 present the water quality standards of the potential causes of impairment for both lakes and streams within the Cahokia Canal/Horseshoe Lake Watershed. Only constituents with numeric water quality standards will have TMDLs developed at this time.

Table 4-1 Summary of Water Quality Standards for Potential Cahokia Canal/Horseshoe Lake Watershed Lake Impairments

Parameter	Units	General Use Water Quality Standard	Public and Food Processing Water Supplies
Excess Algal Growth	NA	No numeric standard	No numeric standard
Heptachlor	mg/L	No numeric standard	0.1
Non-Native Fish/animals	NA	No numeric standard	No numeric standard
PCBs - Statistical Guideline	NA	No numeric standard	No numeric standard
pH		6.5 minimum 9.0 maximum	No numeric standard
Total Phosphorus	mg/L	0.05(1)	No numeric standard
Total Phosphorus - Statistical Guideline	NA	No numeric standard	No numeric standard
Total Suspended Solids	NA	No numeric standard	No numeric standard
Zinc 9000	NA	No numeric standard	No numeric standard

µg/L = micrograms per liter mg/L = milligrams per liter NA = Not Applicable
1. Standard applies in particular inland lakes and reservoirs (greater than 20 acres) and in any stream at the point where it enters any such lake or reservoir.

Table 4-2 Summary of Water Quality Standards for Potential Cahokia Canal/Horseshoe Lake Watershed Stream Impairments

Parameter	Units	General Use Water Quality Standard	Public and Food Processing Water Supplies
Habitat Alterations (Streams)	NA	No numeric standard	No numeric standard
Manganese	µg/L	1000	150
Oxygen, Dissolved	mg/L	5.0 instantaneous minimum; 6.0 minimum during at least 16 hours of any 24 hour period	No numeric standard
Sedimentation/ Siltation	NA	No numeric standard	No numeric standard

Table 4-2 Summary of Water Quality Standards for Potential Cahokia Canal/Horseshoe Lake Watershed Stream Impairments (continued)

Parameter	Units	General Use Water Quality Standard	Public and Food Processing Water Supplies
Total Fecal Coliform	Count/ 100 mL	May through Oct – 200(1), 400(2) Nov though Apr – no numeric standard	2000(1)
Total Nitrogen as N	NA	No numeric standard	No numeric standard
Total Phosphorus - Statistical Guideline	NA	No numeric standard	No numeric standard
Total Suspended Solids	NA	No numeric standard	No numeric standard

µg/L = micrograms per liter exp(x) = base natural logarithms raised to the x- power
mg/L = milligrams per liter ln(H) = natural logarithm of hardness of the receiving water in mg/L
NA = Not Applicable * = conversion factor for multiplier for dissolved metals
1. Geometric mean based on a minimum of 5 samples taken over not more than a 30 day period.
2. Standard shall not be exceeded by more than 10% of the samples collected during any 30 day period

4.4 Potential Pollutant Sources

In order to properly address the conditions within the Cahokia Canal/Horseshoe Lake Watershed, potential pollution sources must be investigated for the pollutants where TMDLs will be developed. The following is a summary of the potential sources associated with the listed causes for the 303(d) listed segments in this watershed. They are summarized in Table 4-3.

Table 4-3 Summary of Potential Sources for Cahokia Canal/Horseshoe Lake Watershed

Segment ID	Segment Name	Potential Causes	Potential Sources
JN 02	Cahokia Canal	Total nitrogen as N, sedimentation/siltation, dissolved oxygen, habitat alterations (streams), total phosphorus	Agriculture, crop-related sources, nonirrigated crop production, construction, land development, urban runoff/storm sewers, hydromodification, channelization, source unknown
RJC	Horseshoe Lake	Total phosphorus, pH, total suspended solids, excess algal growth, non-native fish/animals, heptachlor, PCBs, zinc, total phosphorus	Industrial point sources, agriculture, crop-related sources, nonirrigated crop production, urban runoff/storm sewers, contaminated sediments, other, source unknown
JMAA01	Prairie Du Pont Creek	Dissolved oxygen, total phosphorus	Municipal point sources, agriculture, crop-related sources, nonirrigated crop production, intensive animal feeding operations, urban runoff/storm sewers
JMAC02	Harding Ditch	Total fecal coliform	Source unknown
RJK	Frank Holten Main Lake	Total phosphorus, total suspended solids, excess algal growth, PCBs, total phosphorus	Urban runoff/storm sewers, land disposal, onsite wastewater systems (septic tanks), recreation and tourism activities (other than boating), source unknown
RJL	Frank Holten Lake #2	Total phosphorus, total suspended solids, excess algal growth, PCBs, total phosphorus	Urban runoff/storm sewers, land disposal, onsite wastewater systems (septic tanks), recreation and tourism activities (other than boating), source unknown
RJM	Frank Holten Lake #3	Total phosphorus, dissolved oxygen, total suspended solids, excess algal growth, non-native fish/animals, PCBs, total phosphorus	Urban runoff/storm sewers, land disposal, onsite wastewater systems (septic tanks), other, source unknown
JNA 01	Canteen Creek	Manganese, total nitrogen as N, sedimentation/siltation, habitat alterations (streams), total suspended solids, total phosphorus	Municipal point sources, agriculture, crop-related sources, nonirrigated crop production, construction, land development, urban runoff/storm sewers, hydromodification, channelization, source unknown

Section 5
Cahokia Canal/Horseshoe Lake Watershed Characterization

Data was collected and reviewed from many sources in order to further characterize the Cahokia Canal/Horseshoe Lake Watershed. Data has been collected for water quality, reservoirs, and both point and nonpoint sources. This information is presented and discussed in further detail in the remainder of this section.

5.1 Water Quality Data

There are 14 historic water quality stations within the Cahokia Canal/Horseshoe Lake Watershed that were used for this report. Figure 5-1 shows the water quality data stations within the watershed that contain data relevant to the impaired segments.

The impaired water body segments in the Cahokia Canal/Horseshoe Lake Watershed were presented in Section 1. Refer to Table 1-1 for impairment information specific to each segment. The following sections address both stream and lake impairments. Data is summarized by impairment and discussed in relation to the relevant Illinois numeric water quality standard. Data analysis is focused on all available data collected since 1990. The information presented in this section is a combination of USEPA Storage and Retrieval (STORET) database and Illinois EPA database data. STORET data is available for stations sampled prior to January 1, 1999 while Illinois EPA data (electronic and hard copy) are available for stations sampled after that date. The following sections will first discuss Cahokia Canal/Horseshoe Lake Watershed stream data followed by Cahokia Canal/Horseshoe Lake Watershed lake/reservoir data.

5.1.1 Stream Water Quality Data

The Cahokia Canal/Horseshoe Lake Watershed has four impaired streams within its drainage area that are addressed in this report. There are five active water quality stations on impaired segments (see Figure 5-1). The data summarized in this section include water quality data for impaired constituents as well as parameters that could be useful in future modeling and analysis efforts. All historic data is available in Appendix C.

5.1.1.1 Fecal Coliform

Segment JMAC02 of Harding Ditch is listed as impaired for total fecal coliform. Table 5-1 summarizes available historic fecal coliform data on the segment. The general use water quality standard for fecal coliform states that the standard of 200 per 100 mL not be exceeded by the geometric mean of at least five samples, nor can 10 percent of the samples collected exceed 400 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 peak fecal coliform application periods (May through October).

There are no instances since 1990 where at least five samples have been collected during a 30-day period. 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 total fecal coliform samples collected over time on the impaired segment. Data is limited on the segment because samples collected between 1997 and 2003 were omitted due to exceeding the holding time.

Table 5-1 Existing Fecal Coliform Data

Sample Location and Parameter	Period of Record and Number of Data Points	Geometric mean of all samples	Maximum	Minimum	Number of samples > 200 (1)	Number of samples > 400 (1)
Harding Ditch Segment JMAC02; Sample Location JMAC02						
Total Fecal Coliform (cfu/100 mL)	1990-2004; 73	2,028	20,000	165	37	34

(1) Samples collected during the months of May through October
(2) Only two samples were available during the months of May through October

5.1.1.2 Dissolved Oxygen

Segment JN02 of Cahokia Canal and JMAA01 of Prairie Du Pont Creek are currently listed as impaired for dissolved oxygen (DO). Recent data collected on segment JMAA01 show that a DO impairment no longer exists. In the summer of 2005 3-day continuous DO monitoring data was taken at half-hour intervals on three different locations on the stream segment. There were no violations in this data, and therefore, this segment will be delisted for DO in the future when new assessments are made. Table 5-2 summarizes the available historic DO data since 1990 for Segment JN02 of Cahokia Canal (raw data contained in Appendix C). The table also shows the number of violations recorded on the segment. A sample was considered a violation if it was below 5.0 mg/L. Figure 5-3 shows the instantaneous DO concentrations over time on the Cahokia Canal.

Table 5-2 Existing Dissolved Oxygen Data for Cahokia Canal/Horseshoe Lake Watershed Impaired Stream Segments

Sample Location and Parameter	Illinois WQ Standard (mg/L)	Period of Record and Number of Data Points	Mean	Maximum	Minimum	Number of Violations
Cahokia Canal Segment JN02; Sample Location JN02						
DO	5.0(1)	1990-2003; 126	8.2	13.9	2.3	16

(1) Instantaneous Minimum

Table 5-3 contains information on data availability for other parameters that may be useful in data needs analysis and future modeling efforts for DO. Where available, all nutrient, biological oxygen demand (BOD), and total organic carbon data has been collected for possible use in future analysis.

Table 5-3 Data Availability for DO Data Needs Analysis and Future Modeling Efforts

Sample Location and Parameter	Available Period of Record Post 1990	Number of Samples
Cahokia Canal Segment JN02; Sample Location JN02		
Ammonia, Unionized (Calc Fr Temp-pH-NH4) (mg/L)	1990-1998	82
Ammonia, Unionized (mg/L as N)	1990-1998	82
BOD, 5-Day, 20 Deg C (mg/L)	1990	1
Carbon, Total Organic (mg/L as C)	1998	2
COD, .025N K2CR2O7 (mg/L)	1990-1993	36
Nitrite plus Nitrate, Total 1 Det. (mg/L as N)	1990-2002	115
Nitrogen, Ammonia, Total (mg/L as N)	1990-2002	115
Nitrogen, Kjeldahl, Total (mg/L as N)	1998-2002	26
Phosphorus, Dissolved (mg/L as P)	1990-2002	115
Phosphorus, Total (mg/L as P)	1990-2002	115

5.1.1.3 Manganese

Segment JNA01 of Canteen Creek is impaired for manganese. The applicable water quality standard is a maximum total manganese concentration of 1,000 µg/L. Table 5-4 summarizes the available historic manganese data since 1990 for the impaired stream. The table also shows the number of violations recorded on the segment. Figure 5-4 shows total manganese values recorded over time for Canteen Creek.

Table 5-4 Existing Manganese Data

Sample Location and Parameter	Illinois WQ Standard (µg/L)	Period of Record and Number of Data Points	Mean	Maximum	Minimum	Number of Violations
Canteen Creek Segment JNA01; Sample Locations JNA01 and JNA02						
Total Manganese (µg/L)	General Use: 1000	1990-1998; 83	423	3,800	68	2

5.1.2 Lake and Reservoir Water Quality Data

The Cahokia Canal/Horseshoe Lake Watershed has four impaired lakes within its drainage area that are addressed in this report. There are nine active water quality stations on or tributary to the impaired water bodies (see Figure 5-1). The data summarized in this section include water quality data for impaired constituents as well as parameters that could be useful in future modeling and analysis efforts. All historic data is available in Appendix C.

5.1.2.1 Horseshoe Lake

There are four active stations on Horseshoe Lake. The reservoir is impaired for total phosphorus and pH. An inventory of all available phosphorus and pH data at all depths is presented in Table 5-5.

Table 5-5 Horseshoe Lake Data Inventory for Impairments

Horseshoe Lake Segment RJC; Sample Locations RJC-1, RJC-2, RJC-3 and RJC-4		
RJC-1	**Period of Record**	**Number of Samples**
Total Phosphorus	1993-2002	48
Dissolved Phosphorus	1993-1996	19
Total Phosphorus in Bottom Deposits	1993-1996	3
pH	1993-1996	3

Table 5-5 Horseshoe Lake Data Inventory for Impairments (continued)

Horseshoe Lake Segment RJC; Sample Locations RJC-1, RJC-2, RJC-3 and RJC-4		
RJC-2	**Period of Record**	**Number of Samples**
Total Phosphorus	1993-2002	20
Dissolved Phosphorus	1993-1996	10
pH	1993-2002	19
RJC-3		
Total Phosphorus	1993-2002	21
Dissolved Phosphorus	1993-1996	11
Total Phosphorus in Bottom Deposits	1993-1996	3
pH	1993-2002	20
RJC-4		
Total Phosphorus	1993-2002	19
Dissolved Phosphorus	1993-1996	10
pH	1993-2002	19

Table 5-6 contains information on data availability for other parameters that may be useful in data needs analysis and future modeling efforts for total phosphorus. DO at varying depths as well as chlorophyll-a data has been collected where available.

Table 5-6 Horseshoe Lake Data Availability for Data Needs Analysis and Future Modeling Efforts

Horseshoe Lake Segment RJC; Sample Locations RJC-1, RJC-2, RJC-3 and RJC-4		
RJC-1	**Period of Record**	**Number of Samples**
Chlorophyll-a Corrected	1993-2002	28
Chlorophyll-a Uncorrected	1993-2002	28
Total Depth	1993-2002	679
Dissolved Oxygen	1993-2002	598
Temperature	1993-2002	598
RJC-2		
Chlorophyll-a Corrected	1993-2002	18
Chlorophyll-a Uncorrected	1993-2002	18
Total Depth	1993-2002	120
Dissolved Oxygen	1993-2002	48
Temperature	1993-2002	19
RJC-3		
Chlorophyll-a Corrected	1993-2002	18
Chlorophyll-a Uncorrected	1993-2002	18
Total Depth	1993-2002	135
Dissolved Oxygen	1993-2002	60
Temperature	1993-2002	20
RJC-4		
Chlorophyll-a Corrected	1993-2002	18
Chlorophyll-a Uncorrected	1993-2002	18
Total Depth	1993-2005	114
Dissolved Oxygen	1993-2005	41
Temperature	1993-2002	19

5.1.2.1.1 Total Phosphorus

Compliance with the total phosphorus standard is based on samples collected at a one-foot depth from the lake surface. The average total phosphorus concentrations at a one-foot depth for each year of available data at each monitoring site in Horseshoe Lake are presented in Table 5-7. The water quality standard for total phosphorus is a concentration less than or equal to 0.05 mg/L.

Table 5-7 Average Total Phosphorus Concentrations (mg/L) in Horseshoe Lake at One-Foot Depth

	RJC-1		RJC-2		RJC-3		RJC-4		Lake Average	
Year	Data Count; Number of Violations	Average	Data Count; Number of Violations	Average	Data Count; Number of Violations	Average	Data Count; Number of Violations	Average	Data Count; Number of Violations	Average
1993	5;4	0.11	5;4	0.14	5;4	0.09	5;4	0.16	20;16	0.13
1996	5;5	0.15	5;5	0.22	5;5	0.14	5;5	0.22	20;20	0.18
1997	5;5	0.18	NA	NA	NA	NA	NA	NA	5;5	0.18
1998	5;5	0.14	NA	NA	NA	NA	NA	NA	5;5	0.14
1999	5;5	0.25	5;5	0.10	5;4	0.25	5;5	0.29	20;19	0.22
2002	4;4	0.15	4;4	0.40	4;4	0.17	4;4	0.26	16;16	0.25

The annual averages for total phosphorus at all four sites where data was available as well as the lake average have been greater than the 0.05 mg/L standard. The majority of the samples taken at all sites have been above the standard. Figure 5-5 shows the average values by year.

5.1.2.1.2 pH

Table 5-8 summarizes the available historic pH data since 1990 for the lake. The table also shows the number of violations for each segment. A sample was considered a violation if the value was not within the 6.5-9.0 pH range.

Table 5-8 Average pH in Horseshoe Lake

	RJC-1		RJC-2		RJC-3		RJC-4		Lake Average	
Year	Data Count; Number of Violations	Average	Data Count; Number of Violations	Average	Data Count; Number of Violations	Average	Data Count; Number of Violations	Average	Data Count; Number of Violations	Average
1993	9;0	7.87	5;0	8.18	6;0	8.25	5;1	8.36	25;1	8.16
1996	10;0	7.90	5;0	8.82	5;1	8.90	5;0	8.82	20;1	8.61
1999	10;0	7.75	5;0	8.62	5;1	8.84	5;0	8.72	20;1	8.48
2002	8;1	7.43	4;0	8.70	4;1	8.78	4;0	8.85	20;2	8.44

The average pH concentration was within the standard range at all locations. One violation occurred when pH values where sampled below 6.5. That sample was collected in 2002 at RJC-1. The remaining violations occurred when samples were above 9.0. Figure 5-6 shows the average annual pH values.

5.1.2.2 Frank Holten Lakes 1, 2, and 3

There are five active stations on the Frank Holten Lakes. The lakes are impaired for total phosphorus and Lake 3 is also impaired for DO. An inventory of all available phosphorus data for each lake as well as DO data for Lake 3 at all depths is presented in Table 5-9.

Table 5-9 Frank Holten Lakes - Data Inventory for Impairments

Frank Holten Lakes 1, 2, and 3 – Segments RJK, RJL, and RJM		
RJK-1	Period of Record	Number of Samples
Total Phosphorus	1990-2002	89
Dissolved Phosphorus	1990-2002	21

Table 5-9 Frank Holten Lakes - Data Inventory for Impairments (continued)

Frank Holten Lakes 1, 2, and 3 – Segments RJK, RJL, and RJM		
RJL-1	**Period of Record**	**Number of Samples**
Total Phosphorus	1990-2002	104
Dissolved Phosphorus	1990-2002	88
Total Phosphorus in Bottom Deposits	1992-1996	3
RJM-1		
Total Phosphorus	1990-2002	201
Dissolved Phosphorus	1990-2002	113
Total Phosphorus in Bottom Deposits	1992-1996	6
Dissolved Oxygen	1990-2002	388
RJM-2		
Total Phosphorus	1990-2002	84
Dissolved Phosphorus	1990-2002	76
Dissolved Oxygen	1990-2002	378
RJM-3		
Total Phosphorus	1990-2002	100
Dissolved Phosphorus	1990-2002	76
Total Phosphorus in Bottom Deposits	1992-1996	4
Dissolved Oxygen	1990-2002	332

Table 5-10 contains information on data availability for other parameters that may be useful in data needs analysis and future modeling efforts for total phosphorus and DO. DO and chlorophyll-a data has been collected where available for phosphorus impairments while nutrient data has been collected for the DO impairment.

Table 5-10 Frank Holten Lakes -Data Availability for Data Needs Analysis and Future Modeling Efforts

Frank Holten Lakes 1, 2, and 3 – Segments RJK, RJL, and RJM		
RJK-1	**Period of Record**	**Number of Samples**
Chlorophyll-a Corrected	1996-2002	29
Chlorophyll-a Uncorrected	1996-2002	29
Total Depth	1990-2002	290
Dissolved Oxygen	1999-2002	80
Temperature	1990-2002	21
RJL-1		
Chlorophyll-a Corrected	1990-2002	42
Chlorophyll-a Uncorrected	1990-2002	42
Depth of Pond or Reservoir in Feet	1990-2002	369
Oxygen, Dissolved, Analysis by Probe (mg/L)	1999-2002	115
Temperature	1990-2002	88
RJM-1		
Ammonia, Unionized (Calc Fr Temp-pH-NH4) (mg/L)	1990-1996	80
Ammonia, Unionized (mg/L as N)	1990-1996	80
Chlorophyll-a Corrected	1990-2002	74
Chlorophyll-a Uncorrected	1990-2002	74
COD, .025N K2CR2O7 (mg/L)	1990-1992	100
Depth of Pond or Reservoir in Feet	1990-2002	312
Nitrite plus Nitrate, Total 1 Det. (mg/L as N)	1990-1996	184
Nitrogen, Ammonia, Total (mg/L as N)	1990-1996	182
Nitrogen, Kjeldahl, Total (mg/L as N)	1990-1996	146
Dissolved Oxygen, % of Saturation	1990-1996	344
Temperature	1990-2002	388

Table 5-10 Frank Holten Lakes -Data Availability for Data Needs Analysis and Future Modeling Efforts (continued)

Frank Holten Lakes 1, 2, and 3 – Segments RJK, RJL, and RJM		
RJM-2		
Ammonia, Unionized (Calc Fr Temp-pH-NH4) (mg/L)	1990-1996	66
Ammonia, Unionized (mg/L as N)	1990-1996	66
Chlorophyll-a Corrected	1990-2002	78
Chlorophyll-a Uncorrected	1990-2002	78
COD, .025N K2CR2O7 (mg/L)	1990-1992	56
Depth of Pond or Reservoir in Feet	1990-2002	264
Nitrite plus Nitrate, Total 1 Det. (mg/L as N)	1990-1996	74
Nitrogen, Ammonia, Total (mg/L as N)	1990-1996	74
Nitrogen, Kjeldahl, Total (mg/L as N)	1990-1996	66
Dissolved Oxygen, % of Saturation	1990-1996	338
Temperature	1990-2002	378
RJM-3		
Ammonia, Unionized (Calc Fr Temp-pH-NH4) (mg/L)	1990-1996	66
Ammonia, Unionized (mg/L as N)	1990-1996	66
Chlorophyll-a Corrected	1990-2002	74
Chlorophyll-a Uncorrected	1990-2002	74
COD, .025N K2CR2O7 (mg/L)	1990-1992	56
Depth of Pond or Reservoir in Feet	1990-2002	236
Nitrite plus Nitrate, Total 1 Det. (mg/L as N)	1990-1996	90
TKN Bottom Deposits	1992-1996	4
Nitrogen, Ammonia, Total (mg/L as N)	1990-1996	90
Nitrogen, Kjeldahl, Total (mg/L as N)	1990-1996	66
Temperature	1990-2002	332

5.1.2.2.1 Total Phosphorus

The average total phosphorus concentrations at a one-foot depth for each year of available data at each monitoring site in the Frank Holten Lakes are presented in Table 5-11. The water quality standard for total phosphorus is a concentration less than or equal to 0.05 mg/L and compliance is assessed at a one-foot depth from the lake surface.

Table 5-11 Average Total Phosphorus Concentrations (mg/L) in the Frank Holten Lakes at One-Foot Depth

	RJK-1		RJL-1		RJM-1		RJM-2		RJM-3	
Year	Data Count; Number of Violations	Average	Data Count; Number of Violations	Average	Data Count; Number of Violations	Average	Data Count; Number of Violations	Average	Data Count; Number of Violations	Average
1990	21; 21	0.44	16; 15	0.14	64; 64	0.15	24; 24	0.15	24; 24	0.17
1991	7; 7	0.20	23; 23	0.16	50; 50	0.17	22; 22	0.15	46; 46	0.19
1992	24; 24	0.37	8; 8	0.15	38; 38	0.16	16; 16	0.11	10; 10	0.16
1996	6; 5	0.11	5; 5	0.15	10; 10	0.16	12; 12	0.17	10; 10	0.22
1997	6; 6	0.16	NA	NA	NA	NA	NA	NA	NA	NA
1998	5; 5	0.15	NA	NA	NA	NA	NA	NA	NA	NA
1999	5; 5	0.06	5; 5	0.06	5; 5	0.10	5; 5	0.11	5; 5	0.12
2002	5; 5	0.14	5; 5	0.15	5; 5	0.21	5; 5	0.23	5; 5	0.26

Only one sample collected was below the phosphorus standard on both Frank Holten Lake 1 (RJK) and 2 (RJL). No samples have been below the 0.05 mg/L total phosphorus standard on Frank Holten Lake 3 (RJM). Figure 5-7 shows the annual

average total phosphorus concentrations for each sampling location on each lake. Average concentrations were highest at all sites in 1991.

5.1.2.2.2 DO

The average DO concentrations at a one-foot depth for each year of available data at each monitoring site on Frank Holten Lake #3 are presented in Table 5-12. The water quality standard for DO is an instantaneous minimum concentration of 5.0 mg/L. Compliance is determined at a one-foot depth from the lake surface.

Table 5-12 Average Dissolved Oxygen Concentrations (mg/L) in Frank Holten Lake #3 at One-Foot Depth

	RJM-1		RJM-2		RJM-3		Lake Average	
Year	Data Count; Number of Violations	Average	Data Count; Number of Violations	Average	Data Count; Number of Violations	Average	Data Count; Number of Violations	Average
1990	24;0	9.9	24;0	10.0	24;0	9.9	72;0	9.9
1991	22;0	11.2	22;0	11.0	22;0	11.3	66;0	11.2
1992	10;0	10.8	10;0	10.8	10;0	11.3	30;0	11.0
1996	10;0	7.5	10;0	8.3	10;0	9.1	30;0	8.3
1999	6;1	9.0	5;0	8.7	4;0	10.0	15;1	9.2
2002	5;1	8.0	5;0	8.5	5;0	9.7	15;1	8.7

The annual averages for DO at all three sites as well as the lake average are not in violation of the DO standard at one foot depth during any sampling year. Figure 5-8 shows DO sampling results at one-foot depth over time. Only two violations have occurred on the lake. Both violations were sampled at RJM-1; one in 1999, and one in 2002. Lake averages were calculated using data from each sampling location.

5.2 Reservoir Characteristic

There are four impaired reservoirs in the Cahokia Canal/Horseshoe Lake watershed. Reservoir information that can be used for future modeling efforts was collected from GIS analysis, the Army Corps of Engineers, the Illinois EPA, and USEPA water quality data. The following sections will discuss the available data for each reservoir.

5.2.1 Horseshoe Lake

Horseshoe Lake is located near East St. Louis in Madison County east of the Mississippi River and has a surface area of approximately 2,430 acres. The lake is part of Horseshoe Lake State Park which is maintained by the Illinois Department of Natural Resources. During heavy spring floods, the Mississippi River would overflow its banks and flood into the low floodplain to the east of the river. A system of levies was constructed on the Mississippi to prevent the overflow, therefore creating Horseshoe Lake. Table 5-13 contains depth information for each sampling location on the lake. The average maximum depth in Horseshoe Lake is 54.5 feet.

Table 5-13 Average Depths (ft) for Horseshoe Lake Segment RJC (Illinois EPA 2002 and USEPA 2002a)

Year	RJC-1	RJC-2	RJC-3	RJC-4
1993	54.5	3.8	9.4	2.1
1996	53.0	3.4	4.5	2.9
1997	10.9	3.5	3.6	8.1
1998	14.5	4.2	4.8	4.0
1999	60.0	3.5	4.0	2.5
2002	59.1	3.7	4.8	2.9
2005	–	–	–	2.0
Average	**54.5**	**3.8**	**9.4**	**2.1**

5.2.2 Frank Holten Lakes 1, 2, and 3

The Frank Holten Lakes are located in East St. Louis in St. Clair County. All three lakes are located within the Frank Holten State Park, which is maintained by the Illinois Department of Natural Resources. Table 5-14 contains lake information for each lake.

Table 5-14 Frank Holten Lakes

	Lake No. 1	Lake No. 2	Lake No. 3
Surface Area (acres)	97	40	80
Capacity (acre-feet)	500	NA	92.4
Shoreline (miles)	2.5	NA	2

Tables 5-15, -16, and -17 contain depth information for each sampling location on the lakes. The maximum water depths for Frank Holten Lakes No. 1, No. 2, and No. 3 are 13.0 feet, 21.1 feet, and 7.8 feet respectively.

Table 5-15 Average Depths (ft) for Frank Holten Lake No. 1 (Illinois EPA 2002 and USEPA 2002a)

Year	RJK-1
1990	13.7
1991	15.5
1992	13.2
1996	11.3
1997	6.7
1998	8.6
1999	17.1
2002	17.5
Average	**13.0**

Table 5-16 Average Depths (ft) for Frank Holten Lake No. 2 (Illinois EPA 2002 and USEPA 2002a)

Year	RJL-1
1990	23.5
1991	23.6
1992	23.1
1996	15.8
1999	19.7
2002	21.4
Average	**21.2**

Table 5-17 Average Depths (ft) for Frank Holten Lake No. 3 (Illinois EPA 2002 and USEPA 2002a)

Year	RJM-1	RJM-2	RJM-3
1990	9.3	9.3	8.0
1991	8.9	8.9	7.4
1992	9.0	8.9	8.0
1996	7.9	7.8	5.9
1997	5.9	7.0	5.7
1998	8.5	7.9	5.4
1999	6.6	6.3	4.1
2002	6.6	6.5	4.4
Average	**7.8**	**7.8**	**6.1**

5.3 Point Sources

Point sources for the Cahokia Canal/Horseshoe Lake Watershed have been separated into municipal/industrial sources and mining discharges. Available data has been summarized and presented in the following sections.

5.3.1 Municipal and Industrial Point Sources

Permitted facilities must provide Discharge Monitoring Reports (DMRs) to Illinois EPA as part of their NPDES permit compliance. DMRs contain effluent discharge sampling results, which are then maintained in a database by the state. Figure 5-9 shows all permitted facilities whose discharge potentially reaches impaired segments. In order to assess point source contributions to the watershed, the data has been examined by receiving water and then by the downstream impaired segment that has the potential to receive the discharge. Receiving waters were determined through information contained in the USEPA Permit Compliance System (PCS) database. Maps were used to determine downstream impaired receiving water information when PCS data was not available. Many of the point sources in this watershed discharge directly to the Mississippi River. These point sources have not been used for watershed assessment. The impairments for each segment or downstream segment were considered when reviewing DMR data. Data has been summarized for any sampled parameter that is associated with a downstream impairment (i.e., all available nutrient and biological oxygen demand data was reviewed for segments that are impaired for dissolved oxygen). This will help in future model selection as well as source assessment and load allocation.

5.3.1.1 Cahokia Canal Segment JN 02

There are seven point sources with the potential to contribute discharge to Cahokia Canal Segment JN 02. Segment JN 02 is listed as impaired for dissolved oxygen. Table 5-18 contains a summary of available and pertinent DMR data for these point sources. Dissolved oxygen data is not required by all permits and was available for only three point sources.

Table 5-18 Effluent Data from Point Sources Discharging Upstream of or Directly to Cahokia Canal Segment JN 02 (Illinois EPA 2005)

Facility Name Period of Record Permit Number	Receiving Water/ Downstream Impaired Waterbody	Constituent	Average Value	Average Loading (lb/d)
Elementis Pigments, Inc. 1995-2005 IL0038709	Schoenberger Creek/Cahokia Canal Segment JN 02	Average Daily Flow	0.655 mgd	NA
		Nitrogen, Ammonia	1.12 mg/L	5.64
General Chemical LLC 2003-2004 IL0000647	Rose Creek/Cahokia Canal Segment JN 02	Average Daily Flow	0.0037 mgd	NA
Dot-Dist 8 Bowman Ave Pump Station 1997-2005 IL0070955	Cahokia Canal/Cahokia Canal Segment JN 02	Average Daily Flow	19 mgd	NA
		Nitrogen, Ammonia	0.722 mg/L	83.1
Maryville WTP 1996-2003 ILG640139	NA/Cahokia Canal Segment JN 02	Average Daily Flow	0.01 mgd	NA
Stone Meadows MHP 1994-2004 IL0046914	Cahokia Canal/Cahokia Canal Segment JN 02	Average Daily Flow	0.07 mgd	NA
		BOD, 5-Day	157.9 mg/L	
		CBOD, 5-Day	5.58 mg/L	2.05
		Oxygen, Dissolved	7.2 mg/L	
		Nitrogen, Ammonia	1.23 mg/L	0.36
Wheel Ranch MHP-Collinsville 1996-2003 IL0044598	NA/Cahokia Canal Segment JN 02	Average Daily Flow	0.015 mgd	NA
		BOD, 5-Day	431.8 mg/L	–
		CBOD, 5-Day	6.22 mg/L	0.258
		Nitrogen, Ammonia	2.94 mg/L	0.122
Holiday MHP 1995-2004 IL0038288	Unnamed Tributary to Cahokia Canal/Cahokia Canal Segment JN 02	Average Daily Flow	0.05 mgd	NA
		BOD, 5-Day	181.4 mg/L	71.9
		CBOD, 5-Day	7.01 mg/L	1.99
		Nitrogen, Ammonia	2.69 mg/L	0.39

5.3.1.2 Horseshoe Lake Segment RJC

There is one permitted facility that discharges to Horseshoe Lake Segment RJC. Horseshoe Lake is listed for total phosphorus and pH impairments. Table 5-19 contains a summary of available DMR data for this point source. Phosphorus sampling is not required by the US Steel-Granite City permit.

Table 5-19 Effluent Data from Point Sources Discharging to Horseshoe Lake Segment RJC (Illinois EPA 2005)

Facility Name Period of Record Permit Number	Receiving Water/ Downstream Impaired Waterbody	Constituent	Average Value	Average Loading (lb/d)
United States Steel-Granite C 1989-2005 IL0000329	Horseshoe Lake/ Horseshoe Lake Segment RJC	Average Daily Flow	26.3 mgd	NA
		pH	7.80 su	

5.3.1.3 Harding Ditch Segment JMAC02

There is one point source with the potential to contribute discharge to Harding Ditch Segment JMAC02. Segment JMAC02 is impaired for total fecal coliform. Table 5-20 contains a summary of available DMR data.

Table 5-20 Effluent Data from Point Sources Discharging to Harding Ditch Segment JMAC02 (Illinois EPA 2005)

Facility Name Period of Record Permit Number	Receiving Water/ Downstream Impaired Waterbody	Constituent	Average Value	Average Loading (lb/d)
Caseyville Township West STP 1993-2004 IL0023043	Clare Creek/Harding Ditch Segment JMAC02	Average Daily Flow	0.786 mgd	NA
		Total fecal coliform	138.0 mg/L	–

5.3.1.4 Canteen Creek Segment JNA 01

There is one point source with the potential to contribute discharge to Canteen Creek Segment JNA 01. Segment JNA 01 is impaired for manganese. Table 5-21 contains a summary of available DMR data.

Table 5-21 Effluent Data from Point Sources Discharging to Canteen Creek Segment JNA 01 (Illinois EPA 2005)

Facility Name Period of Record Permit Number	Receiving Water/ Downstream Impaired Waterbody	Constituent	Average Value	Average Loading (lb/d)
Collinsville STP 1989-2005 IL0028215	Canteen Creek/Canteen Creek Segment JNA01	Average Daily Flow	4.41 mgd	NA
		Manganese	0.017 mg/L	–

5.3.1.5 Other

There are no permitted facilities that discharge directly to any of the Frank Holten Lakes.

5.3.2 Mining Discharges

There are no permitted mine sites or recently abandoned mines within the Cahokia Canal/Horseshoe Lake Watershed. If additional information becomes available, it will be reviewed and considered during Stage 3 of TMDL development.

5.4 Nonpoint Sources

There are many potential nonpoint sources of pollutant loading to the impaired segments in the Cahokia Canal/Horseshoe Lake Watershed. This section will discuss site-specific cropping practices, animal operations, and area septic systems. Data was collected through communication with local NRCS, Soil and Water Conservation District (SWCD), Public Health Department, and County Tax Department officials.

5.4.1 Crop Information

A portion of the land found within the Cahokia Canal/Horseshoe Lake watershed is devoted to crops. Corn and soybean farming account for approximately 13 percent and 15 percent of the watershed respectively. Tillage practices 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 by the Illinois Department of Agriculture from County Transect Surveys. The most recent survey was conducted in 2004. Data specific to the Cahokia Canal/Horseshoe Lake Watershed

were not available; however, the Madison, St. Clair, and Monroe County practices were available and are shown in the following tables.

Table 5-22 Tillage Practices in Madison County

Tillage System	Corn	Soybean	Small Grain
Conventional	68%	8%	6%
Reduced - Till	21%	35%	21%
Mulch - Till	7%	22%	23%
No - Till	4%	35%	49%

Table 5-23 Tillage Practices in St. Clair County

Tillage System	Corn	Soybean	Small Grain
Conventional	96%	27%	0%
Reduced - Till	1%	22%	0%
Mulch - Till	1%	10%	0%
No - Till	1%	41%	0%

Table 5-24 Tillage Practices in Monroe County

Tillage System	Corn	Soybean	Small Grain
Conventional	60%	10%	6%
Reduced - Till	32%	37%	21%
Mulch - Till	2%	19%	23%
No - Till	6%	33%	49%

The Cahokia Canal/Horseshoe Lake Watershed is situated in a predominately urban area. Much of the watershed in Madison County is situated in the Mississippi River flood plain and is protected by a US Army Corps of Engineers levee system. Communications with local NRCS offices indicate that soils are favorable for subsurface tile drainage systems although no specific watershed data is available. It is estimated that approximately 5,000 acres are tiled in the Madison county portion of this watershed. Tile drainage estimates from other watershed counties were not available. Site-specific data will be incorporated if it becomes available. Without local information, soils data will be reviewed for information on hydrologic soil group in order to provide a basis for tile drain estimates.

5.4.2 Animal Operations

Watershed specific animal numbers were not available for the Cahokia Canal/Horseshoe Lake Watershed. Data from the National Agricultural Statistics Service was reviewed and is presented below to show countywide livestock numbers.

Table 5-25 Madison County Animal Population (2002 Census of Agriculture)

	1997	2002	Percent Change
Cattle and Calves	17,690	15,809	-11%
Beef	5,890	5,931	1%
Dairy	1,774	1,683	-5%
Hogs and Pigs	46,331	29,844	-36%
Poultry	1,517	NA	NA
Sheep and Lambs	1,047	1,013	-3%
Horses and Ponies	NA	1,226	NA

Table 5-26 St. Clair County Animal Population (2002 Census of Agriculture)

	1997	2002	Percent Change
Cattle and Calves	8,362	6,985	-16%
Beef	1,888	1,656	-12%
Dairy	1,096	1,039	-5%
Hogs and Pigs	39,433	30,188	-23%
Poultry	1,426	790	-45%
Sheep and Lambs	449	374	-17%
Horses and Ponies	NA	879	NA

Table 5-27 Monroe County Animal Population (2002 Census of Agriculture)

	1997	2002	Percent Change
Cattle and Calves	10,200	9,846	-3%
Beef	3,525	3,451	-2%
Dairy	950	1,351	42%
Hogs and Pigs	52,235	42,551	-19%
Poultry	444	560	26%
Sheep and Lambs	973	667	-31%
Horses and Ponies	NA	446	NA

Again, the Cahokia Canal/Horseshoe Lake Watershed is situated in a predominately urban area. It is estimated that there are very few livestock operations, although it is thought that there are a small number of horse stables located in the watershed. Any additional site-specific information that becomes available will be incorporated.

5.4.3 Septic Systems

Many households in rural areas of Illinois, which are not connected to municipal sewers, make use of onsite sewage disposal systems, or septic systems. There are a variety of 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 soils and system upkeep and maintenance.

Information on septic systems has been obtained for St. Clair and Monroe Counties. Septic system information for Madison County is not available. Table 5-28 is a summary of the available septic system data in the Cahokia Canal/Horseshoe Lake Watershed.

Table 5-28 Estimated Septic Systems in the Cahokia Canal/Horseshoe Lake Watershed

County	Estimated No. of Septic Systems	Source of Septic Areas/ No. of Septic Systems
Madison	N/A	
St. Clair	5,000	County Health Department, East Side Health District, City of Fairview Heights
Monroe	45	Health Department
Total	**5,045**	

There are approximately 5,000 septic systems in the Cahokia Canal/Horseshoe Lake watershed. The area within St. Clair County falls under three separate jurisdictions: St. Clair County, Fairview Heights, and East Side Health District. Estimates of the number of septic systems in the watersheds were obtained for each of the three entities and summed for the county total. There are 700 septic systems within St. Clair County's jurisdiction, 4,000 in Fairview Heights, and 300 within the East Side Health District's jurisdiction. All of the area in Monroe County within the watershed is served by septic systems. Most of the

municipalities surrounding Long Lake, Horseshoe Lake, and Frank Holten 1, 2, and 3 are sewered.

5.5 Watershed Studies and Other Watershed Information

Previous planning efforts have been conducted in the Cahokia Canal/Horseshoe Lake Watershed. In the summer of 1998, and intensive survey of the Mississippi South Central Basin was conducted. A Phase III, Post-Restoration Monitoring Report was also completed for the Frank Holten Lakes in 1994. Data from these studies will be used as a reference during Stage 3 of TMDL development. Further investigation will be conducted on other watershed planning efforts and local watershed groups. Any available and relevant information will be collected and incorporated during Stage 3 of TMDL development.

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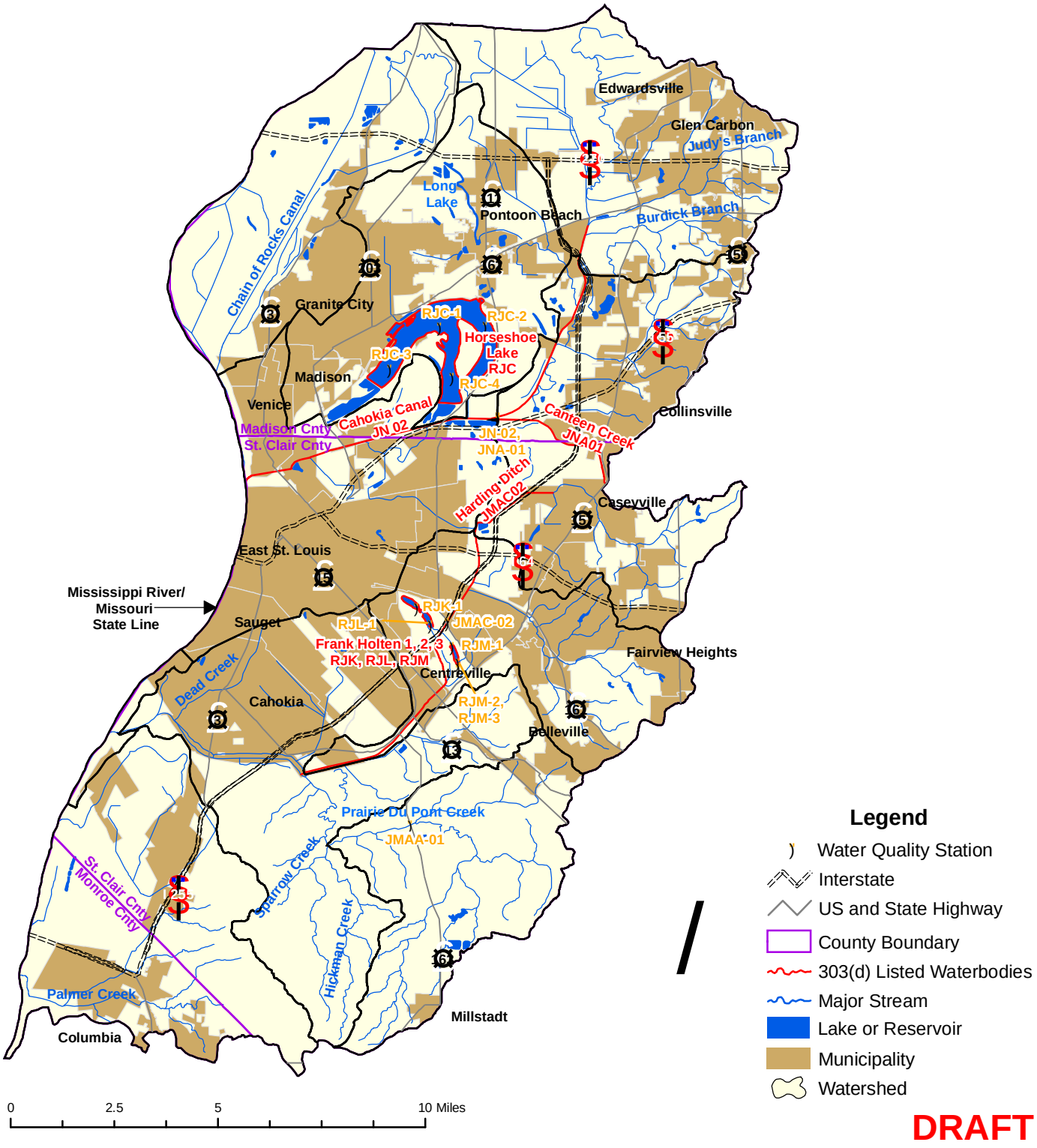

Figure 5-1
Cahokia Canal/Horseshoe Lake Watershed
Water Quality Stations

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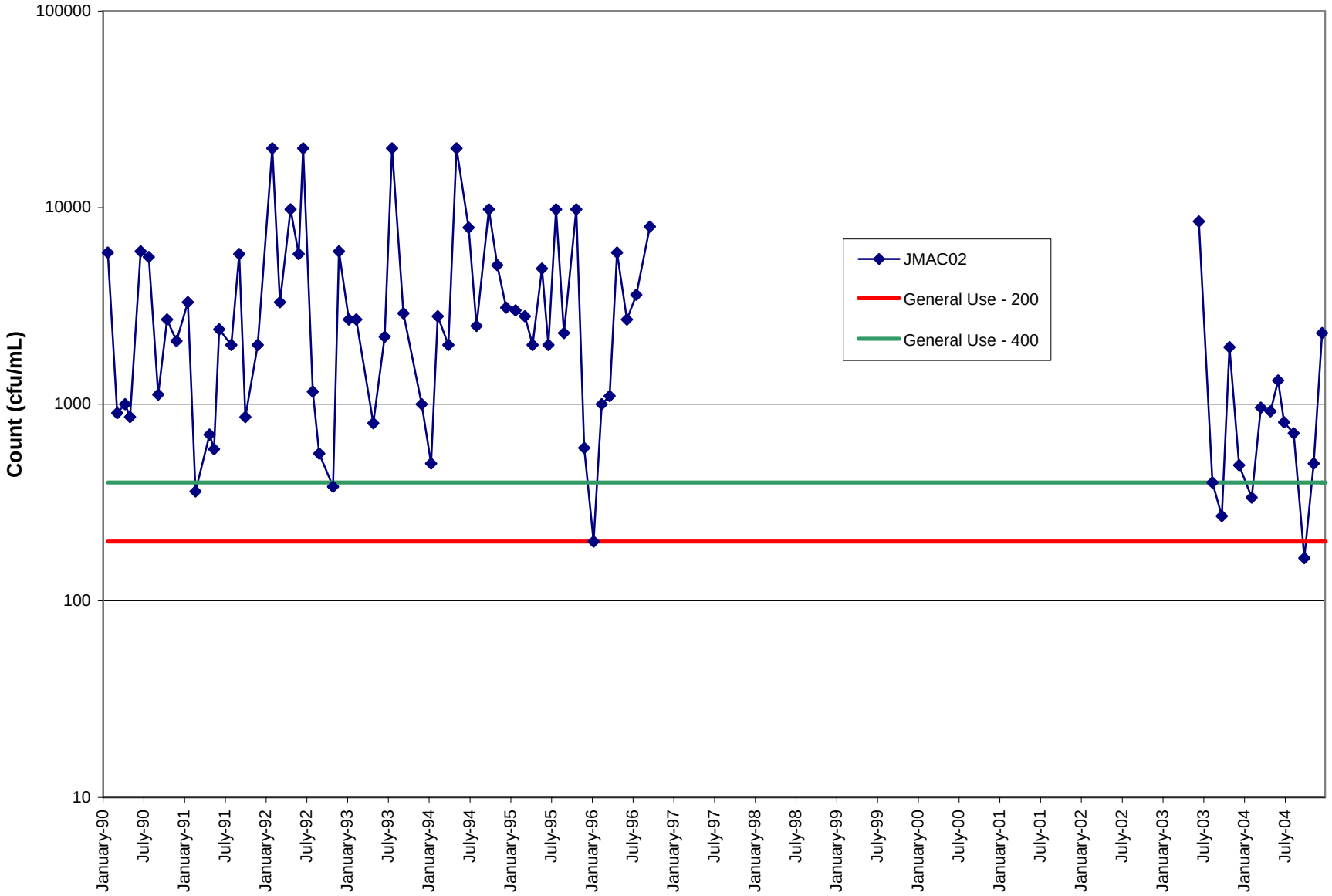

CDM

V:\6 Cahokia Canal_Horseshoe Lake\Data\Stream-Fecal.xlsCahokia Canal Fecal

Figure 5-2:
Harding Ditch JMAC02
Total Fecal Coliform

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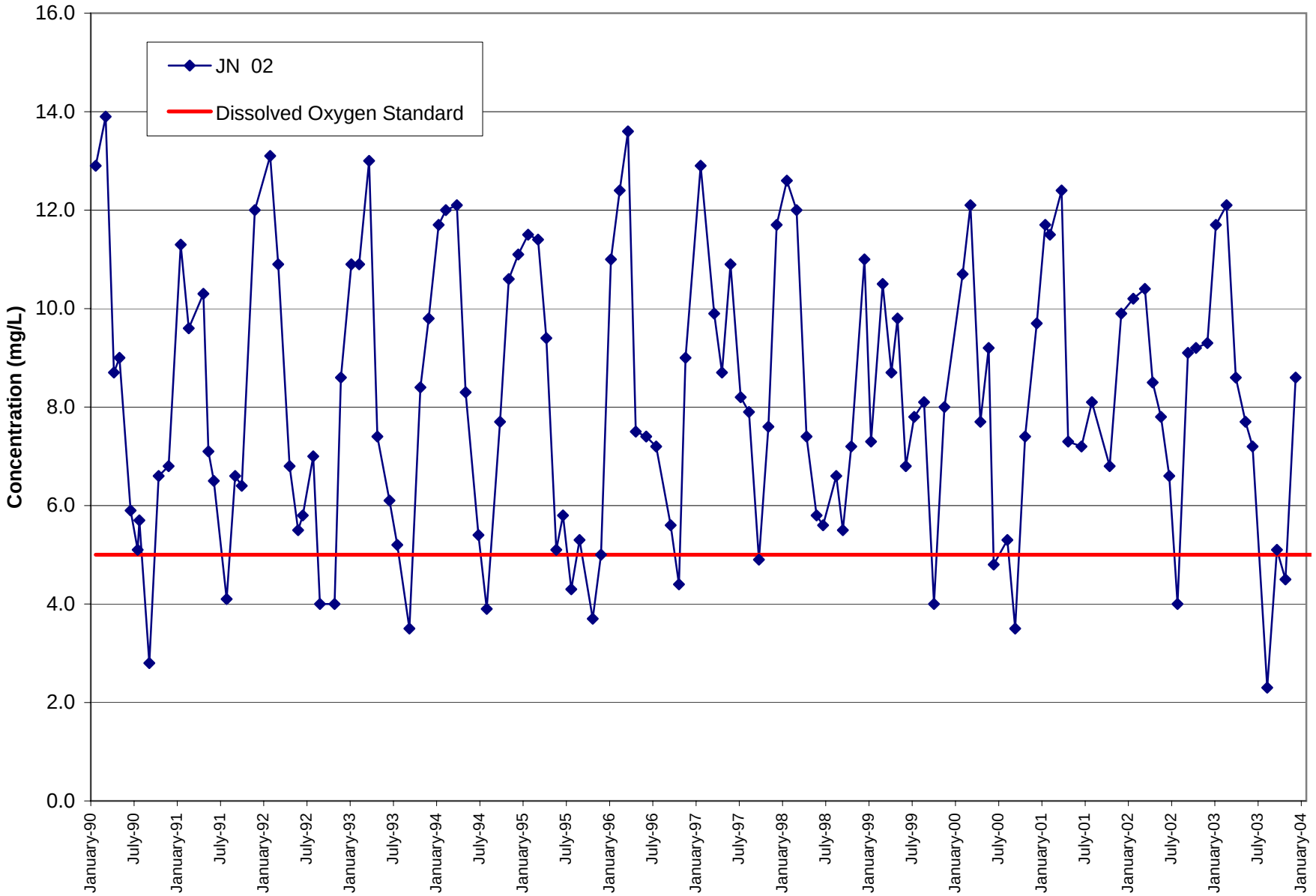

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Figure 5-3:
Cahokia Canal Segment JN02
Dissolved Oxygen Concentrations

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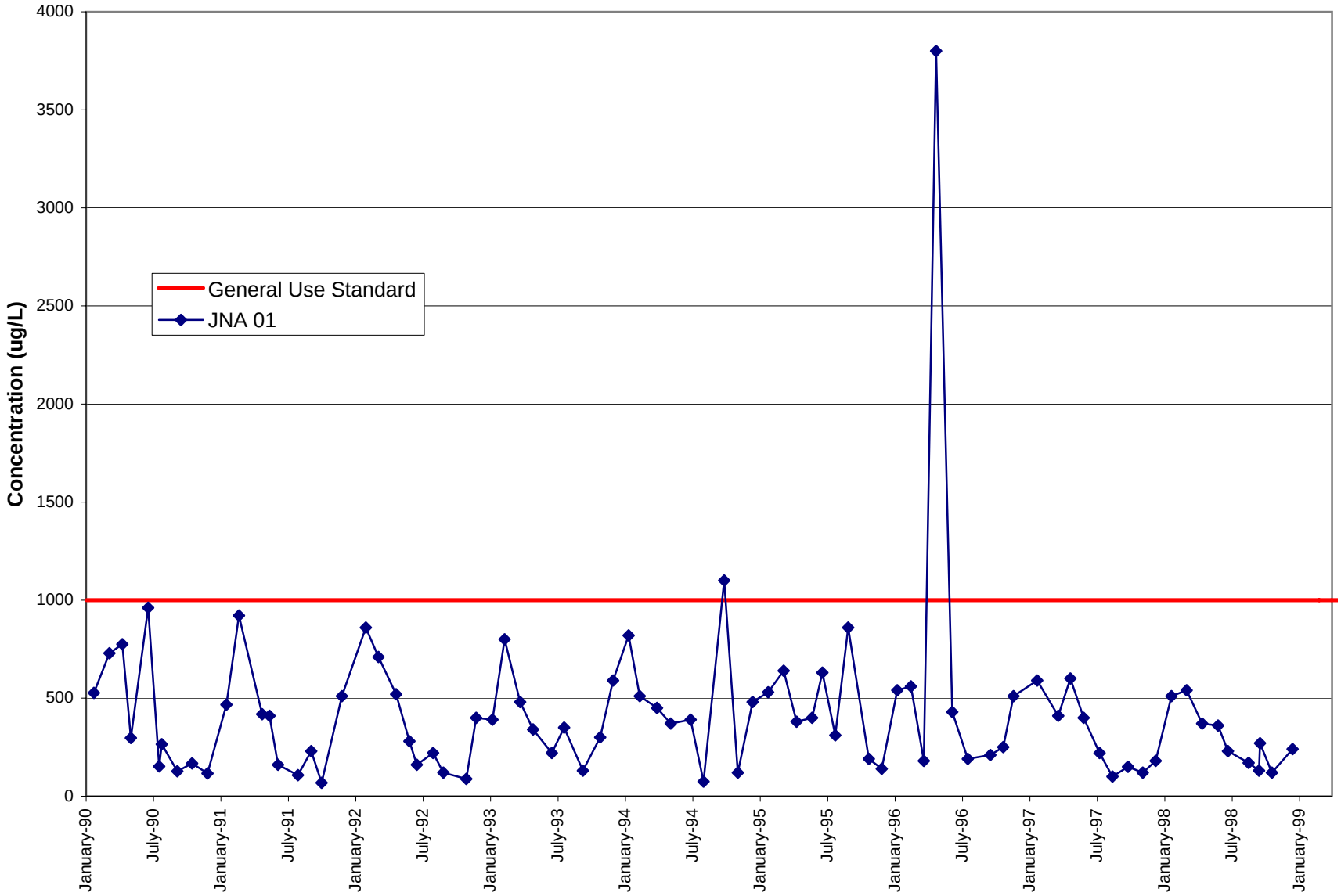

CDM

V:\6 Cahokia Canal_Horseshoe Lake\Data\Stream-Other.xlsManganese

Figure 5-4:
Canteen Creekk JNA01
Total Manganese Concentrations

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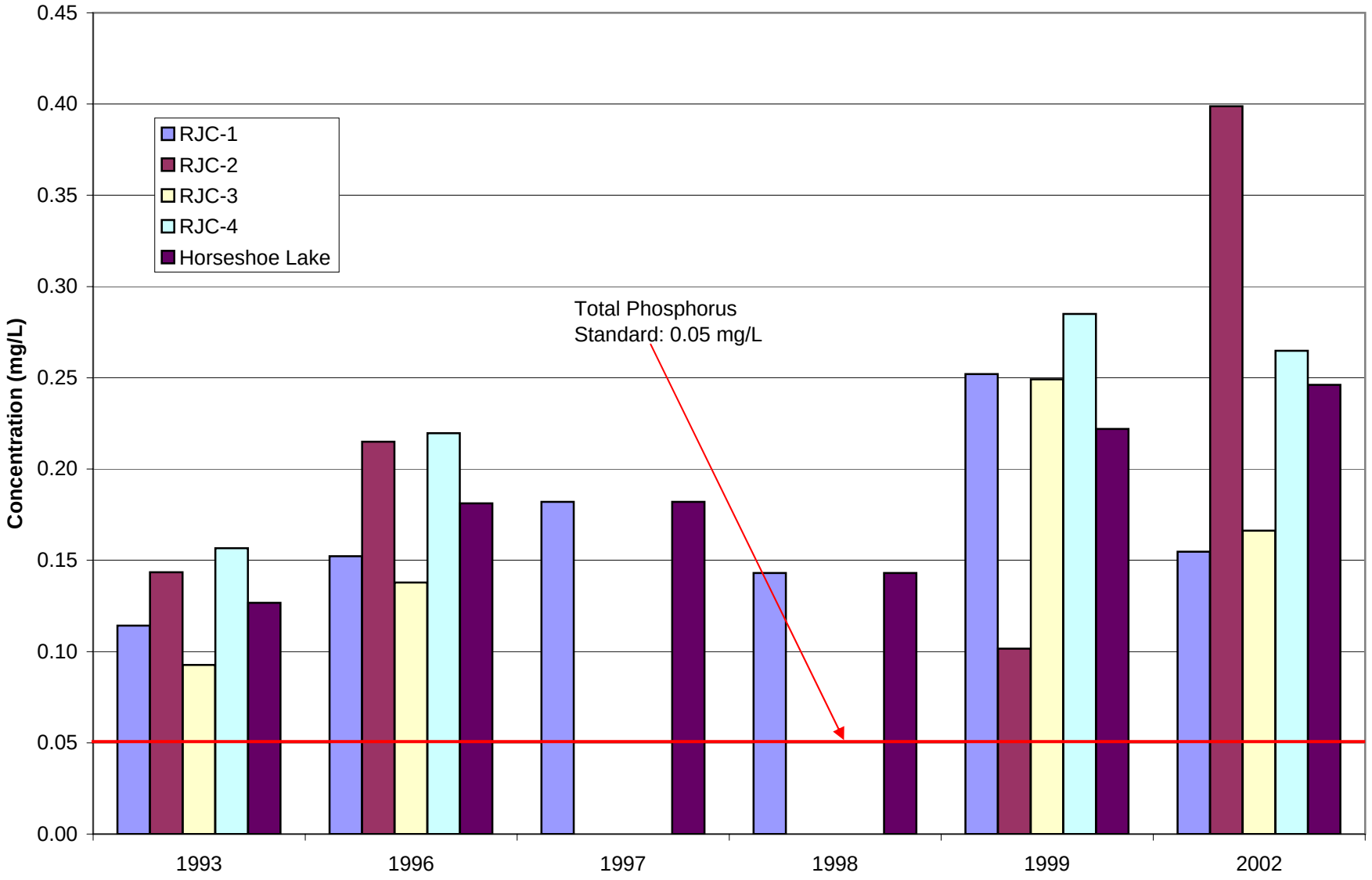

Figure 5-5:
Horseshoe Lake
Average Annual Phosphorus Concentrations
at One-Foot Depth

CDM

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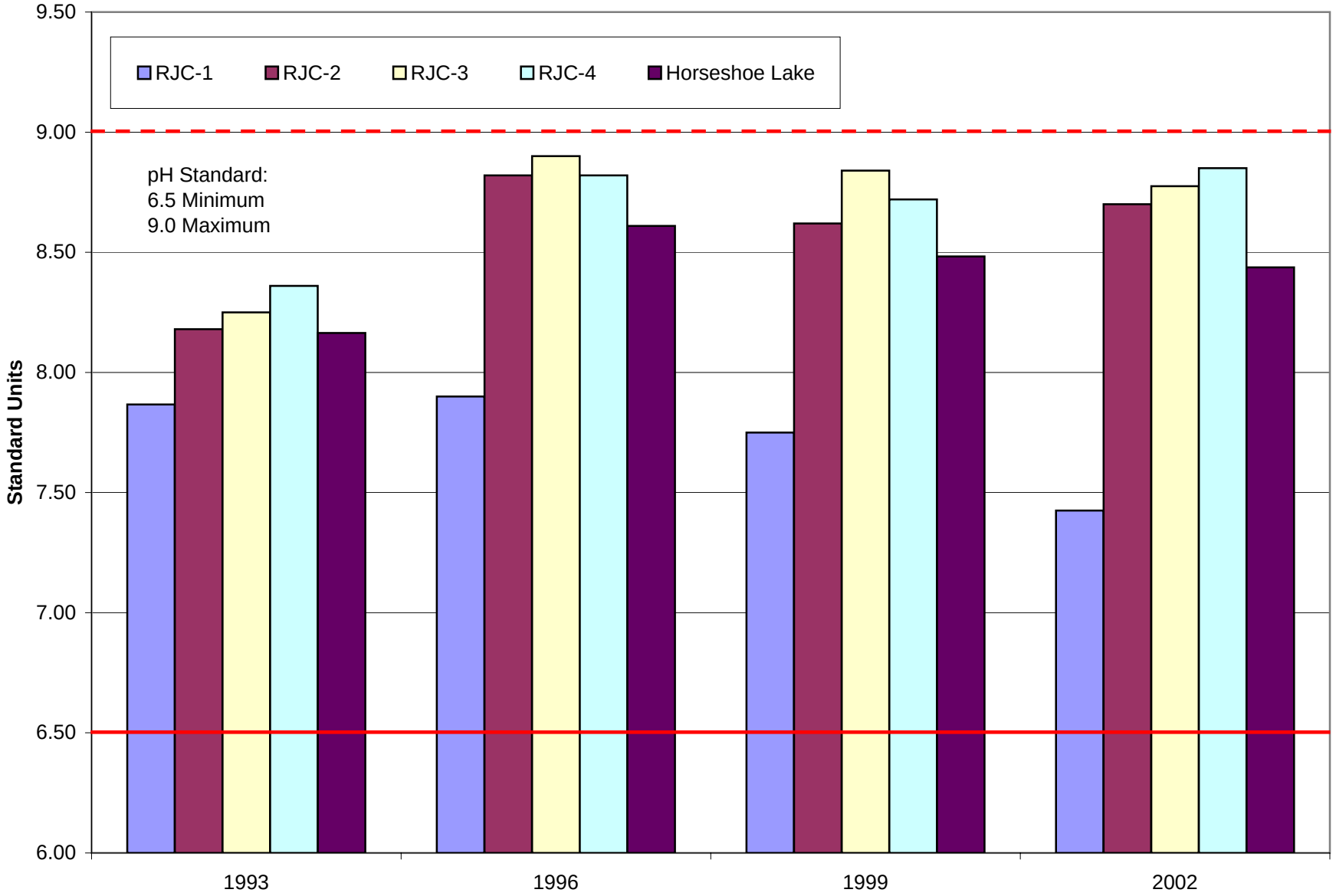

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Figure 5-6:
Horseshoe Lake
Average Annual pH Values

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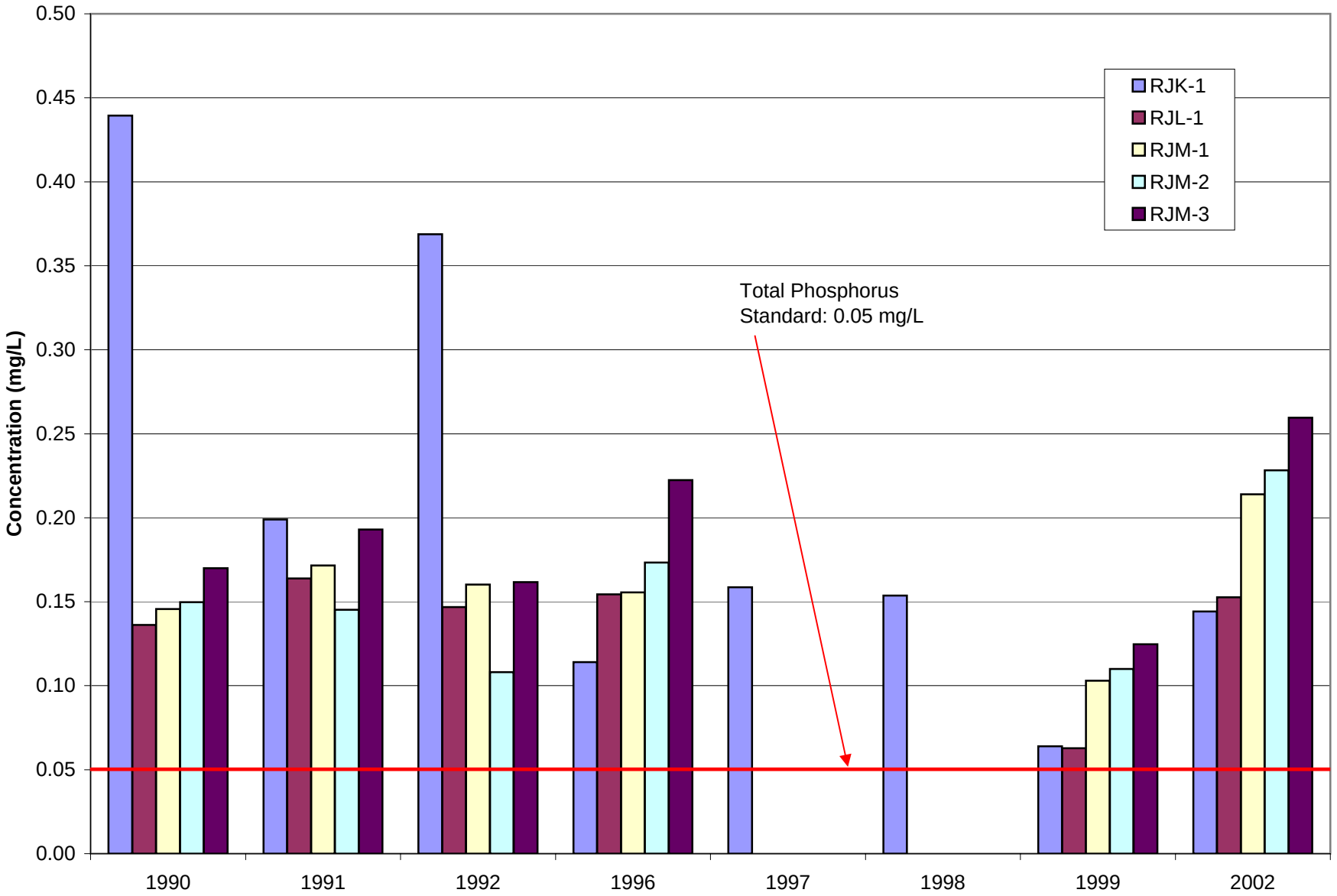

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Figure 5-7:
Frank Holten Lakes
Annual Average Total Phosphorus Concentrations

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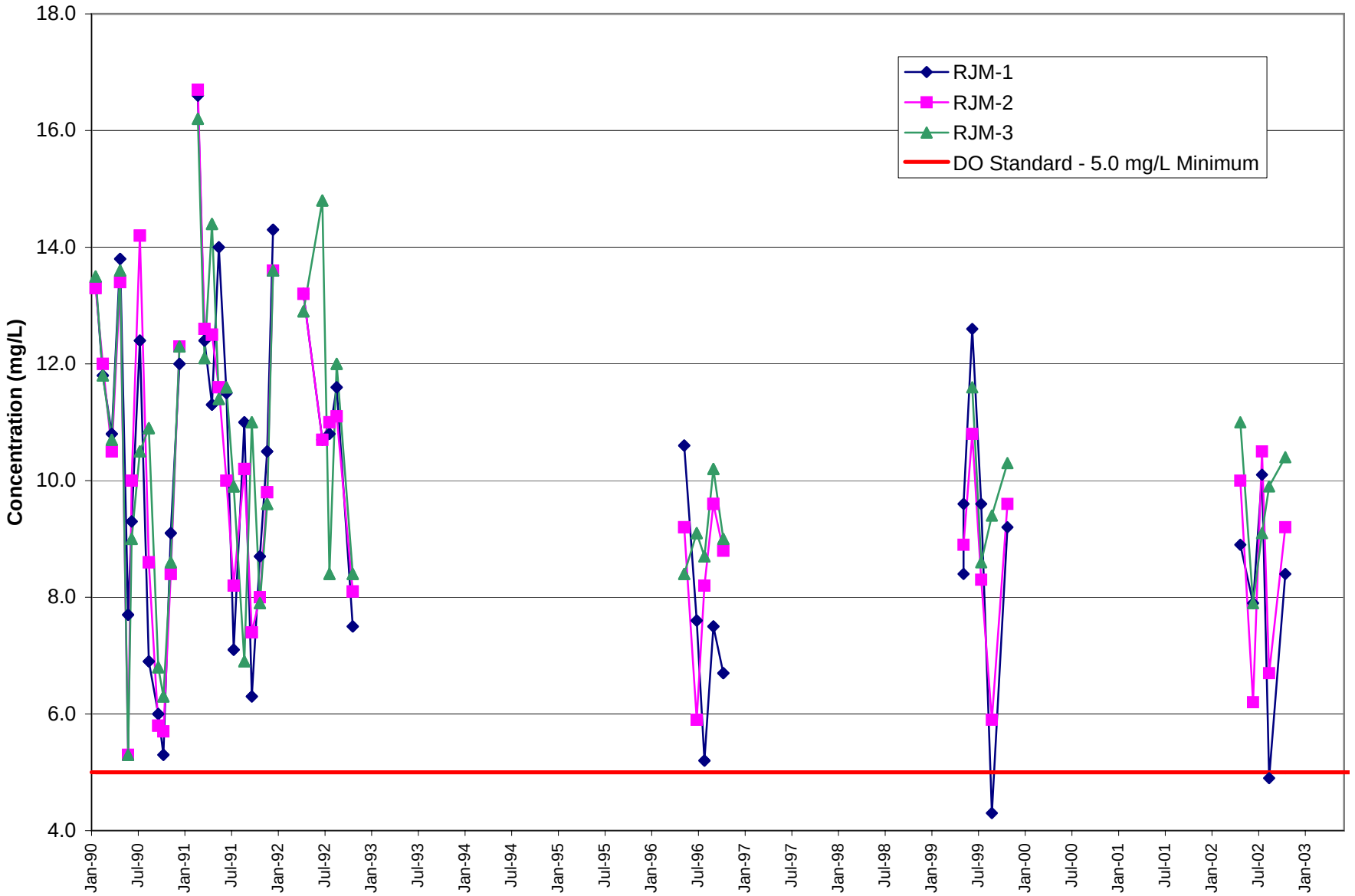

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Figure 5-8:
Frank Holten Lake #3
Dissolved Oxygen Concentrations

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Figure 5-9
Cahokia Canal/Horseshoe Lake Watershed
NPDES Permits

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Section 6
Approach to Developing TMDL and Identification of Data Needs

Illinois EPA is currently developing TMDLs for pollutants that have numeric water quality standards. Of the pollutants impairing stream segments in the Cahokia Canal/ Horseshoe Lake Watershed, manganese, DO, and fecal coliform are the parameters with numeric water quality standards. For the impaired lakes in the watershed, phosphorus, DO, and pH are the parameters with numeric water quality standards. Illinois EPA believes that addressing these impairments should lead to an overall improvement in water quality due to the interrelated nature of the other listed pollutants. Recommended technical approaches for developing TMDLs for streams and lakes are presented in this section. Additional data needs are also discussed.

6.1 Simple and Detailed Approaches for Developing TMDLs

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. Simple approaches typically require less data than detailed approaches and therefore these are the analyses recommended for the Cahokia Canal/Horseshoe Lake Watershed except for stream segments where major point sources whose NDPES permit may be affected by the TMDL's WLA. 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 Cahokia Canal/Horseshoe Lake Watershed.

6.2 Approaches for Developing TMDLs for Stream Segments in the Cahokia Canal/Horseshoe Lake Watershed

All of the impaired stream segments with the watershed have major point sources discharging to them. Approaches for developing TMDLs for parameters that are possibly affected by point sources as well as TMDLs for parameters not likely influenced by point sources are described below.

6.2.1 Recommended Approach for DO TMDLs for Segments with Major Point Sources

Cahokia Canal Segment JN02 has point sources discharging directly to or upstream of it. For this segment a more complicated approach that would also incorporate the impacts of stream plant activity, and possibly sediment oxygen demand (SOD), and would require a more sophisticated numerical model and an adequate level of measured data to aide in model parameterization is recommended.

Available instream water quality data for the impaired stream segment is limited, particularly spatial data. Therefore additional data collection is recommended for this segment. Specific data requirements include a synoptic (snapshot in time) water quality survey of this reach with careful attention to the location of the point source dischargers. This survey should include measurements of flow, hydraulics, DO, temperature, nutrients, and CBOD. The collected data will be used to support the model development and parameterization and will lend significant confidence to the TMDL conclusions.

This newly collected data could then be used to support the development and parameterization of a more sophisticated DO model for this stream and therefore, the use of the QUAL2E model (Brown and Barnwell 1985) could be utilized to accomplish the TMDL analysis for Cahokia Canal. QUAL2E is well-known and USEPA-supported. It simulates DO dynamics as a function of nitrogenous and carbonaceous oxygen demand, atmospheric reaeration, 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 essentially only suited to steady-state simulations.

In addition to the QUAL2E model, a simple watershed model such as PLOAD, Unit Area Loads or the Watershed Management Model is recommended to estimated BOD and nutrient loads from non-point sources in the watershed. This model will allow for allocation between point and nonpoint source loads and provide an understanding of percentage of loadings from point sources and nonpoint sources in the watershed.

6.2.2 Recommended Approach for Fecal Coliform TMDLs

Segment JMAC02 of Harding Ditch is impaired for fecal coliform. The general use water quality standard for total fecal coliform is:

- 200 cfu/100 mL geometric mean based on a minimum of five samples taken over not more than a 30 day period during the months of May through October
- 400 cfu/100 mL shall not be exceeded by more than 10 percent of the samples collected during any 30 day period during the months of May through October

As discussed in Section 5.1.1.1, there have been no instances when five or more samples have been taken within a 30 day period. More data is required in order to properly assess compliance with the standard.

If it is confirmed that the segment is impaired for total fecal coliform, the recommended approach for developing a TMDL for the segment would be to use the load-duration curve method. The load-duration methodology uses the cumulative frequency distribution of streamflow and pollutant concentration data to estimate the allowable loads for a waterbody.

6.2.3 Recommended Approach for Manganese TMDL

Segment JNA01 of Canteen Creek is impaired for manganese. No apparent source of manganese has been identified to date and therefore, an empirical loading and spreadsheet analysis will be utilized to calculate this TMDL.

6.3 Approaches for Developing TMDLs for Lakes and Reservoirs in the Cahokia Canal/Horseshoe Lake Watershed

Recommended TMDL approaches for Horseshoe Lake and the Frank Holten Lakes will be discussed in this section. It is assumed that enough data exists to develop a simple model for use in TMDL development.

6.3.1 Recommended Approach for Total Phosphorus, DO and pH TMDLs

Horseshoe Lake and each of the Frank Holten Lakes are impaired for total phosphorus. Horseshoe Lake is also impaired for pH while Frank Holten Lake #3 is additionally impaired for DO. The BATHTUB model is recommended for all lake phosphorus and DO assessments in this watershed. The BATHTUB model performs steady-state water and nutrient balance calculations in a spatially segmented hydraulic network that accounts for advective and diffusive transport, and nutrient sedimentation. The model relies on empirical relationships to predict lake trophic conditions and subsequent DO conditions as functions of total phosphorus and nitrogen loads, residence time, and mean depth (USEPA 1997). Oxygen conditions in the model are simulated as meta and hypolimnetic depletion rates, rather than explicit concentrations.

Watershed loadings to the lakes will be based on empirical data or tributary data available in the lake watersheds. In addition, pH will be addressed empirically. Most likely, control of phosphorus concentrations will address pH impairments within Horseshoe Lake.

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