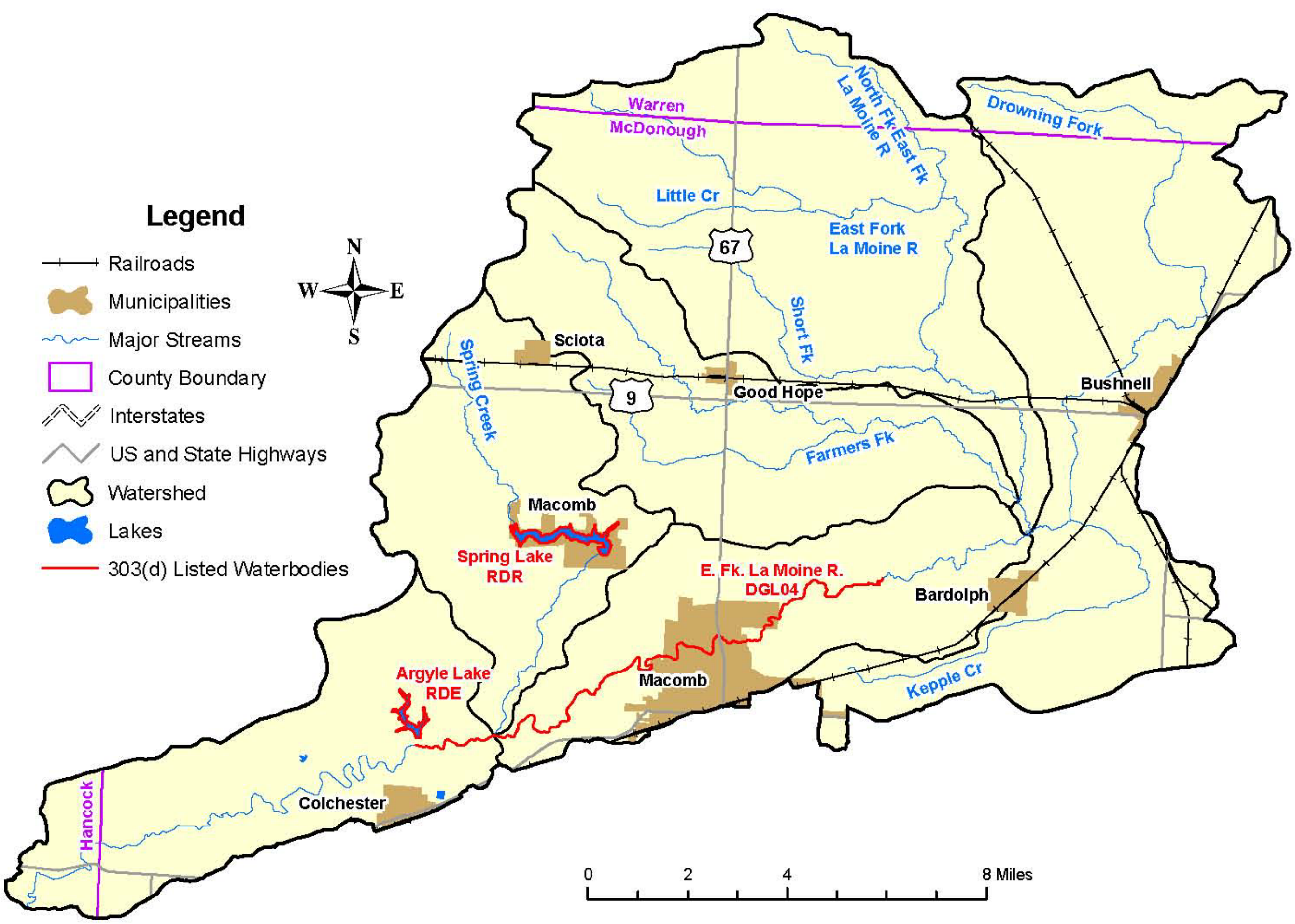
Illinois
Environmental
Protection Agency

Bureau of Water
P. O. Box 19276
Springfield, IL 62794-9276

August 2007

IEPA/BOW/07-016

East Fork LaMoine River Watershed TMDL Report



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EAST FORK LAMOINE RIVER TMDLS
(IL_DGL-04, IL_RDR, and IL_RDE)

Prepared Under Contract to

Illinois Environmental Protection Agency

and

Approved by US EPA

Prepared By

Baetis Environmental Services, Inc.

Chicago, Illinois

In Support Of

Limno-Tech, Inc.

Ann Arbor, Michigan

November 2007

Contents

Lamoine

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

RECEIVED
OCT 01 2007
Watershed Management Section
BUREAU OF WATER

SEP 25 2007

REPLY TO THE ATTENTION OF:

WW-16J

Marcia Willhite, Chief
Bureau of Water
Illinois Environmental Protection Agency
P.O. Box 19276
Springfield, IL 62794-9276

Dear Ms. Willhite:

The United States Environmental Protection Agency (U.S. EPA) has reviewed the final Total Maximum Daily Loads (TMDLs) from the Illinois Environmental Protection Agency (IEPA) for the East Fork LaMoine River (DGL-04), Spring Lake (RDR) and Argyle Lake (RDE) in Illinois. The TMDLs are for phosphorus and manganese, and address several impairments in these waterbodies.

Based on this review, U.S. EPA has determined that Illinois' TMDLs for phosphorus and manganese meet the requirements of Section 303(d) of the Clean Water Act and U.S. EPA's implementing regulations at 40 C.F.R. Part 130. Therefore, U.S. EPA hereby approves three TMDLs for six impairments for the East Fork LaMoine River (DGL-04), Spring Lake (RDR) and Argyle Lake (RDE) in Illinois. The statutory and regulatory requirements, and U.S. EPA's review of Illinois' compliance with each requirement, are described in the enclosed decision document.

We wish to acknowledge Illinois' effort in submitting this TMDL and look forward to future TMDL submissions by the State of Illinois. If you have any questions, please contact Dean Maraldo, TMDL Program Manager, at 312-353-2098.

Sincerely yours,

Kevin M. Pierard
Acting Director, Water Division

Enclosure

cc: Jennifer Clarke, IEPA

Part 1 – Stage One Report

CDM

Illinois Environmental
Protection Agency

East Fork LaMoine River/Spring Lake Watershed Total Maximum Daily Load Stage One Report

October 2006

Final Report

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Acronyms and Abbreviations

°F	degrees Fahrenheit
BMP	best management practice
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
MOS	margin of safety
MUID	Map Unit Identification
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
PCS	Permit Compliance System
SSURGO	Soil Survey Geographic Database
STATSGO	State Soil Geographic
STORET	Storage and Retrieval
STP	Sanitary Treatment Plant
TMDL	total maximum daily load

Acronyms and Abbreviations (continued)

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 East Fork La Moine River/Spring Lake Watershed (0713001003)

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 East Fork La Moine River/Spring 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, TMDLScenarios, Implementation Plan

This report addresses Stage 1 TMDL development for the East Fork La Moine River/Spring 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 East Fork La Moine River/Spring 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 East Fork La Moine River/Spring Lake watershed for which a TMDL will be developed:

- East Fork La Moine River (DGL 04)
- Argyle Lake (RDE)
- Spring Lake (McDonough) (RDR)

These impaired water body segments are shown on Figure 1-1. There are three impaired segments within the East Fork La Moine River/Spring 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 East Fork La Moine River/Spring Lake Watershed

Water Body Segment ID	Water Body Name	Size	Causes of Impairment with Numeric Water Quality Standards	Causes of Impairment with Assessment Guidelines
DGL 04	East Fork La Moine River	14.17 miles	Manganese	
RDE	Argyle Lake	95.1 acres	Total phosphorus	Total suspended solids (TSS), excess algal growth
RDR	Spring Lake (McDonough)	277 acres	Total phosphorus, dissolved oxygen[(1)]	TSS, excess algal growth, total nitrogen

(1) Data collected in 2003 indicates that Spring Lake is no longer impaired for dissolved oxygen and the lake will no longer be on the State's 303(d) list. Therefore, a TMDL for dissolved oxygen is not being developed.

Illinois EPA is currently developing TMDLs for parameters that have numeric water quality standards, and therefore the remaining sections of this report will focus on the manganese and total phosphorus (numeric standard) impairments in the East Fork La Moine River/Spring 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:

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

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 East Fork La Moine River/ Spring 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 East Fork La Moine River/Spring 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 East Fork La Moine River/Spring Lake Watershed Water Quality Standards** defines the water quality standards for the impaired water body.
- **Section 5 East Fork La Moine River/Spring 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.

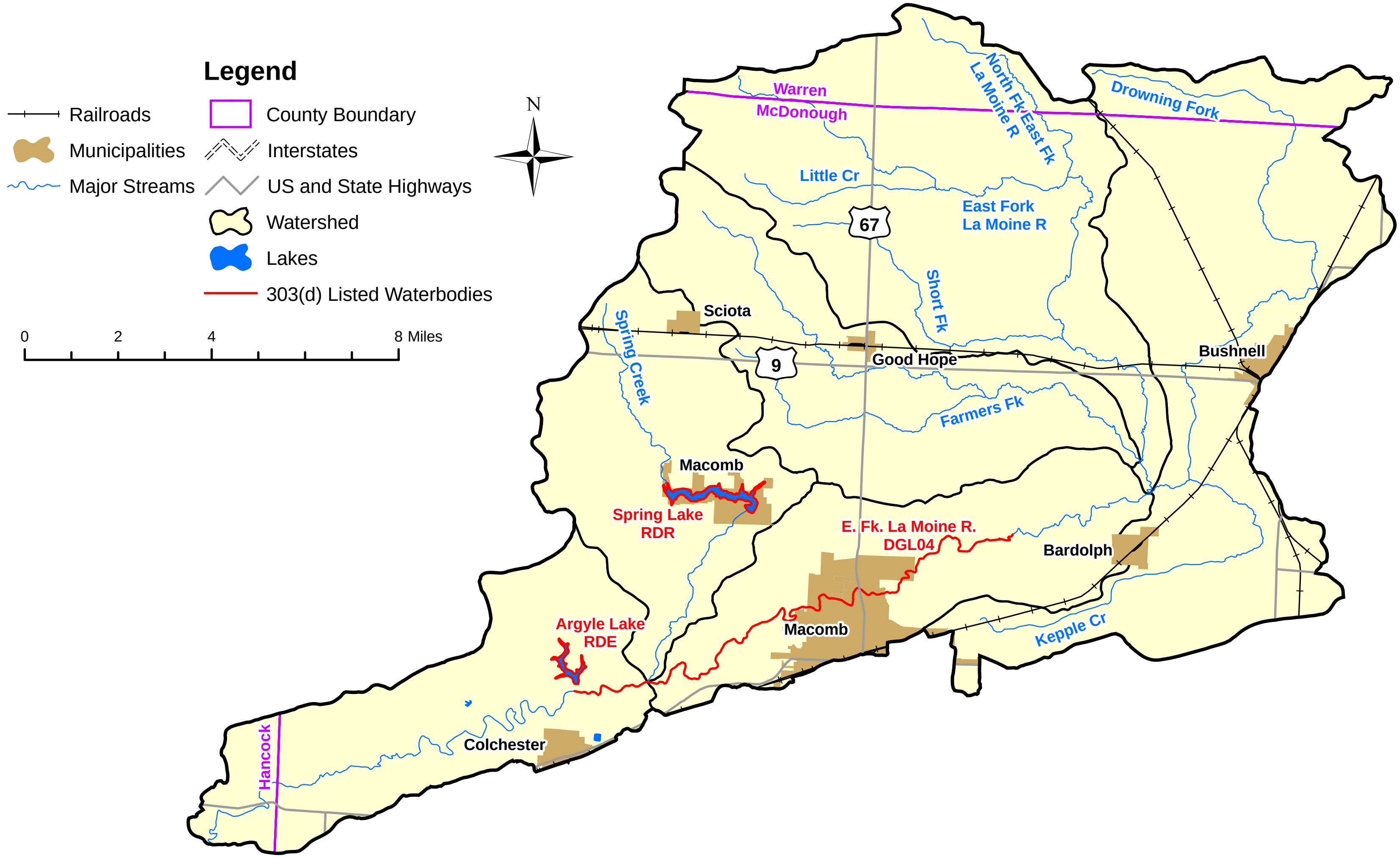

Figure 1-1
East Fork La Moine River - Spring Lake Watershed

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Section 2
East Fork La Moine River/Spring Lake Watershed Description

2.1 East Fork La Moine River/Spring Lake Watershed Location

The East Fork La Moine River/Spring Lake watershed (Figure 1-1) is located in western Illinois, trends in a southwesterly direction, and drains approximately 143,000 acres within the state of Illinois. The watershed covers land within Hancock, McDonough, and Warren Counties.

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 U.S. Geological Survey (USGS) for each 1:24,000-topographic quadrangle in the United States. Elevation data for the East Fork La Moine River/Spring 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 East Fork La Moine River/Spring Lake watershed ranges from 810 feet above sea level in the headwaters of East Fork La Moine River to 508 feet at its most downstream point in the southwest tip of the watershed. The absolute elevation change is 183 feet over the approximately 53-mile stream length of East Fork La Moine River, which yields a stream gradient of approximately 3.5 feet per mile.

2.3 Land Use

Land use data for the East Fork La Moine River/Spring 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 East Fork La Moine River/Spring 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 East Fork La Moine River/Spring 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 found in the watershed.

The land cover data reveal that approximately 121,172 acres, representing nearly 85 percent of the total watershed area, are devoted to agricultural activities. Corn and soybean farming account for about 39 percent and 37 percent of the watershed area, respectively and rural grassland accounts for approximately 8 percent. Upland forests occupy about 9 percent of the total watershed area. Other land cover categories represent less that 2 percent of the total watershed area.

Table 2-1 Land Use in East Fork La Moine River/Spring Lake Watershed

Land Cover Category	Area (Acres)	Percentage
Corn	56,077	39.2%
Soybeans	52,210	36.5%
Winter Wheat	1,193	0.8%
Other Agriculture	1,009	0.7%
Rural Grassland	10,682	7.5%
Upland	13,260	9.3%
Forested Area	873	0.6%
High Density	1,270	0.9%
Low/Medium Density	1,017	0.7%
Urban Open Space	2,003	1.4%
Wetlands	2,740	1.9%
Surface Water	576	0.4%
Barren & Exposed Land	186	0.1%
Total	**143,096**	**100%**

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

2.4 Soils

Two types of soil data are available for use within the state of Illinois through the National Resource Conservation Service (NRCS). General soils data and map unit delineations for the entire state are provided as part of the State Soil Geographic (STATSGO) database. Soil maps for the database are produced by generalizing detailed soil survey data. The mapping scale for STATSGO is 1:250,000. More detailed soils data and spatial coverages are available through the Soil Survey Geographic (SSURGO) database for a limited number of counties. 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 NRCS.

The East Fork La Moine River/Spring Lake watershed falls within Hancock, McDonough, and Warren Counties. At this time, SSURGO data is available for

Warren and McDonough Counties. STATSGO data has been used in lieu of SSURGO data for the portion of the watershed that lies within Hancock County. Figure 2-3 displays the STATSGO soil map units as well as the SSURGO soil series in the East Fork La Moine River/Spring Lake watershed. Attributes of the spatial coverage can be linked to the STATSGO and SSURGO databases, which provide 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 East Fork La Moine River/Spring Lake watershed.

2.4.1 East Fork La Moine River/Spring Lake Watershed Soil Characteristics

Appendix B contains the STATSGO Map Unit IDs (MUIDs) for the East Fork La Moine River/Spring Lake watershed as well as the SSURGO soil series. The table 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. The predominant soil type in the watershed is Ipava silt loam on 0 to 5 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 the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms. Hydrologic soil groups B, C, and D are found within the East Fork La Moine River/ Spring 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." 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 East Fork La Moine River/Spring Lake watershed range from 0.02 to 0.55.

2.5 Population

Population data were retrieved from Census 2000 TIGER/Line Data from the U.S. 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 U.S. 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 17,895 people reside in the watershed. The major municipalities in the East Fork La Moine River watershed are shown in Figure 1-1. The city of Macomb is the largest population center in the watershed and contributes an estimated 15,000 people to the total watershed population.

2.6 Climate and Streamflow

2.6.1 Climate

Western Illinois has a temperate climate with hot summers and cold, snowy winters. Monthly precipitation data from Macomb (station id. 5280) in McDonough County were extracted from the NCDC database for the years of 1948 through 2004. The data station in Macomb, Illinois was chosen to be representative of precipitation throughout the East Fork La Moine River watershed.

Temperature data was not available for any station within the watershed. Data from La Harpe, Illinois (station id 4823) in Hancock County was chosen to supplement precipitation data collected in Macomb, Illinois. La Harpe, Illinois is approximately 16 miles northwest of Macomb. Monthly temperature data were extracted for the years of 1901 to 2004.

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 36 inches.

Table 2-2 Average Monthly Climate Data in the East Fork La Moine River Watershed

Month	Total Precipitation (inches)	Maximum Temperature (degrees F)	Minimum Temperature (degrees F)
January	1.6	34	15
February	1.5	38	19
March	2.7	50	29
April	3.6	63	40
May	4.1	74	50
June	4.3	83	60
July	4.1	88	64
August	3.4	86	62
September	3.5	78	54
October	2.8	67	43
November	2.3	51	31
December	1.9	38	20
Total	**35.8**		

2.6.2 Streamflow

Analysis of the East Fork La Moine/Spring 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. For Stage 3 TMDL development, data from a neighboring gage would be used to estimate flows in the East Fork La Moine/Spring Lake watershed.

2.7 Watershed Photographs

The photographs shown here are of the East Fork La Moine/Spring Lake watershed that were taken in the summer of 2006. Appendix D contains additional photographs of the watershed.

East Fork La Moine River Segment DGL04 at 1400 East Road Looking East

Spring Lake

*Spring Lake Dam 2
Discharging into Spring Creek*

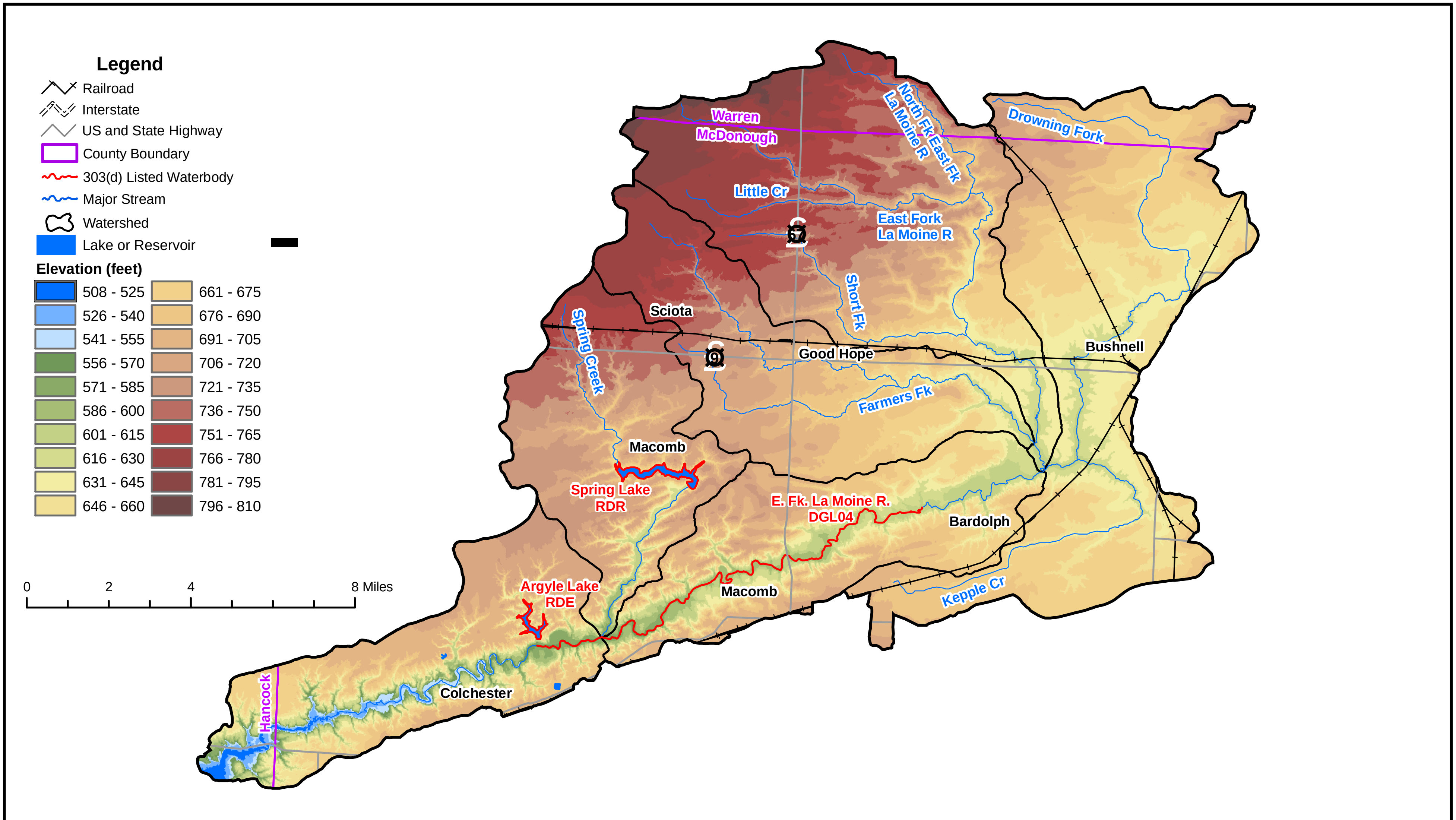
*Spring Creek at 1700 North Road Looking
Northwest North of Spring Lake*

Spring Creek Watershed

*Farmers Fork (East Fork La Moine River
Tributary) Stream Restoration*

*Kepple Creek (East Fork La Moine River
Tributary) at 2000 East Road Looking West*

*Kepple Creek (East Fork La Moine River
Tributary) Watershed*



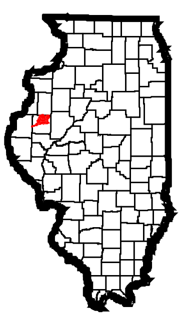


Figure 2-1
East Fork La Moine River - Spring Lake Watershed
Elevation

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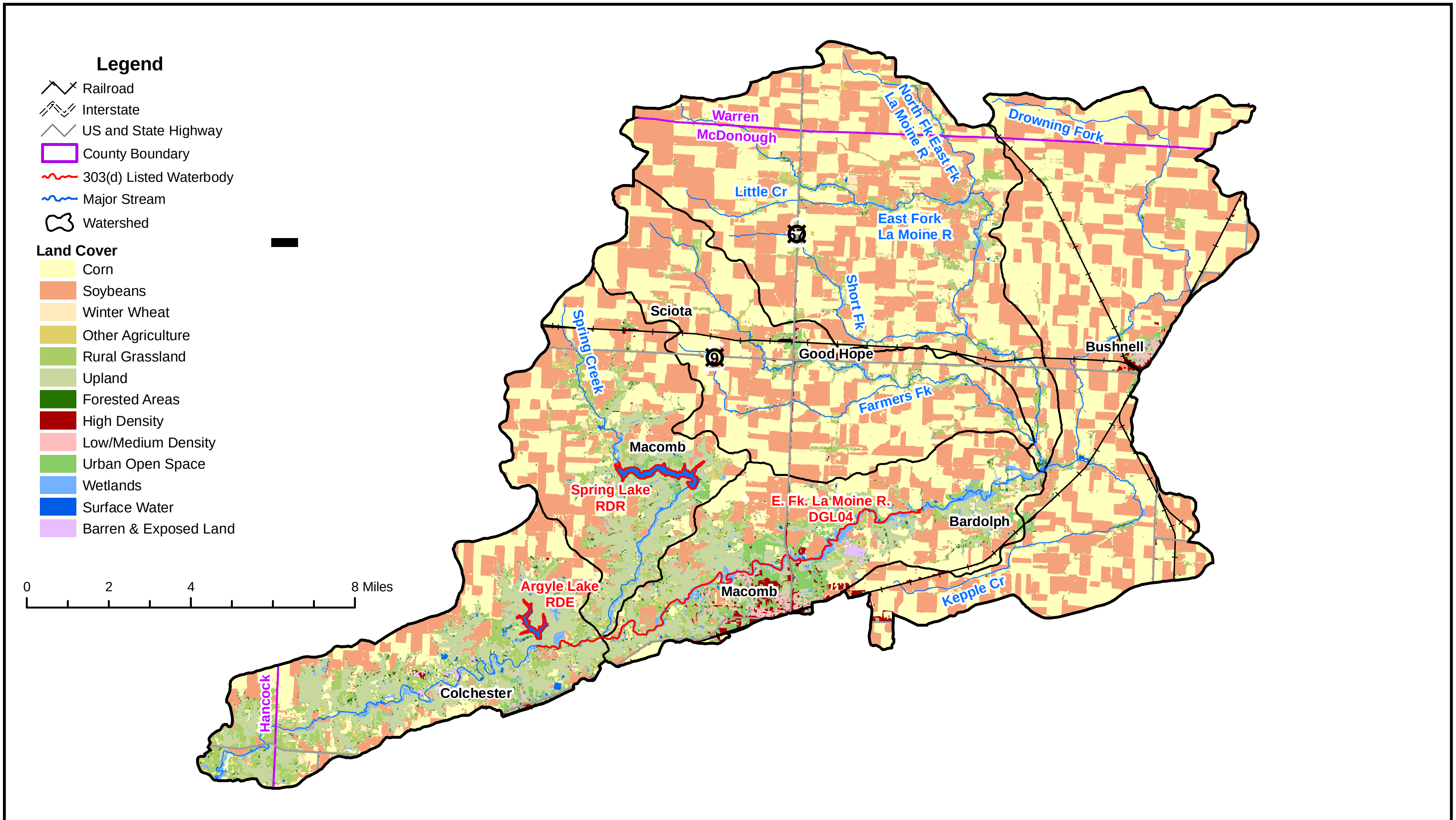

Figure 2-2
East Fork La Moine River - Spring Lake Watershed
Land Use

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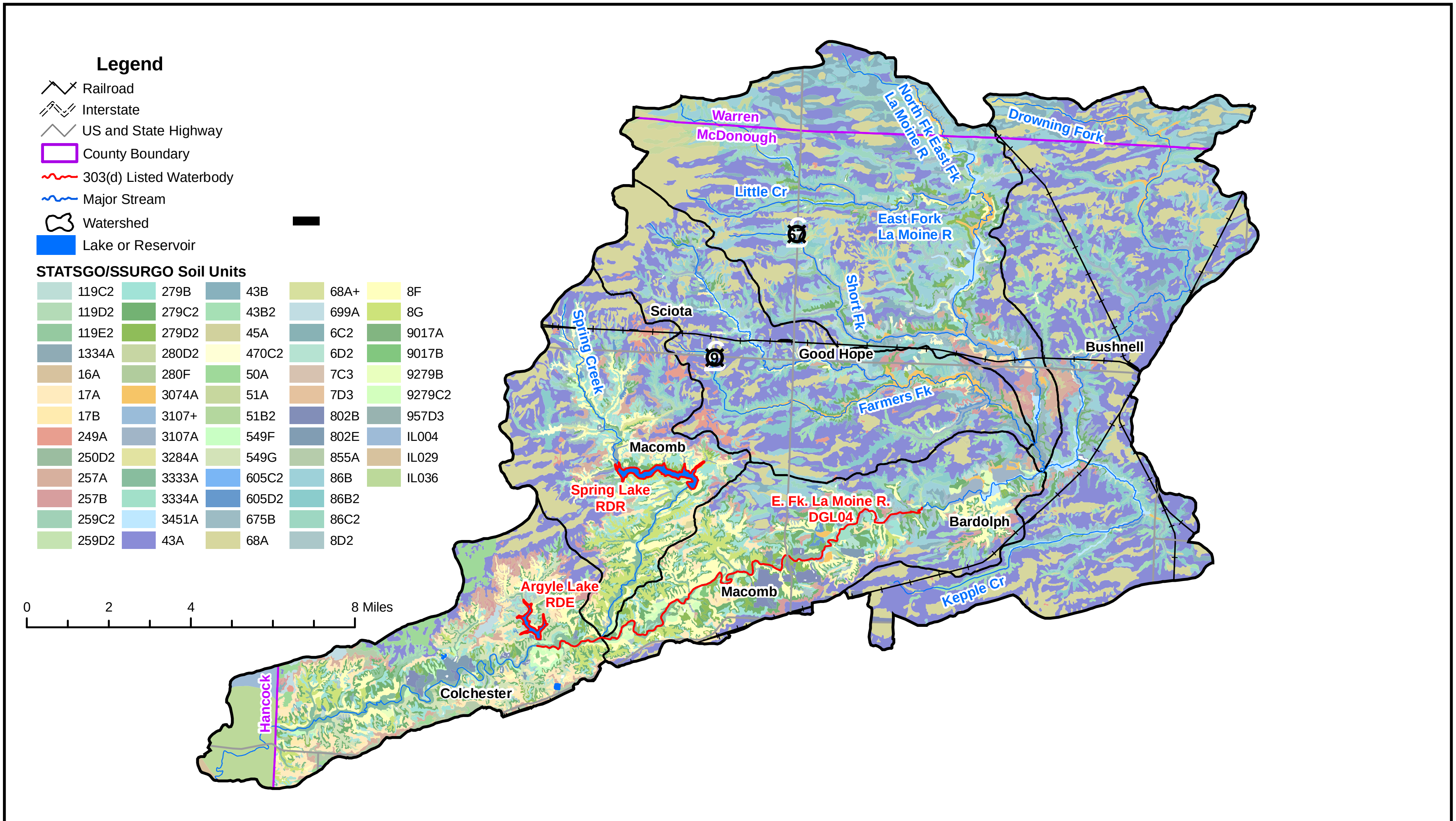

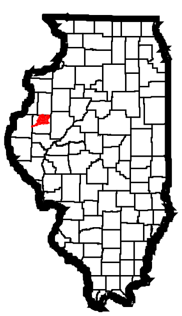

Figure 2-3
East Fork La Moine River - Spring Lake Watershed
Soils

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Section 3
Public Participation and Involvement

3.1 East Fork La Moine River/Spring 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. A public meeting was held on May 30, 2006 at Macomb City Hall in Macomb, Illinois to present Stage 1 of TMDL development for the East Fork La Moine River/Spring Lake watershed.

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Section 4
East Fork La Moine River/Spring 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 East Fork La Moine River/Spring 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 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 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 standards that "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 an impairment to aquatic life exists, a comparison of available water quality data with water quality standards will then occur. 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 East Fork La Moine River/Spring 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 East Fork La Moine River/Spring 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
Total Nitrogen as N	mg/L	No numeric standard	No numeric standard
Total Phosphorus	mg/L	0.05[1]	No numeric standard
Total Suspended Solids	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 East Fork La Moine River/Spring Lake Watershed Stream Impairments

Parameter	Units	General Use Water Quality Standard	Public and Food Processing Water Supplies
Manganese (total)	µg/L	1000	150

µg/L = micrograms per liter mg/L = milligrams per liter NA = Not Applicable

4.4 Potential Pollutant Sources

In order to properly address the conditions within the East Fork La Moine River/Spring 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 East Fork La Moine River/Spring Lake Watershed

Segment ID	Segment Name	Potential Causes	Potential Sources
DGL 04	East Fork La Moine River	Manganese	Source unknown
RDE	Argyle Lake	Total phosphorus, total suspended solids, excess algal growth	Agriculture, crop-related sources, nonirrigated crop production, habitat modification (other than hydromodificaiton), bank or shoreline modification/destabilization, recreation and tourism activities (other than boating), forest/grassland/parkland
RDR	Spring Lake (McDonough)	Total phosphorus, total suspended solids, excess algal growth, total nitrogen as N	Agriculture, crop-related sources, nonirrigated crop production, hydromodification, flow regulation/modification, habitat modification (other than hydromodificaiton), bank or shoreline modification/destabilization, recreation and tourism activities (other than boating), forest/grassland/parkland, source unknown

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Section 5
East Fork La Moine River/Spring Lake Watershed Characterization

Data were collected and reviewed from many sources in order to further characterize the East Fork La Moine River/Spring Lake watershed. Data has been collected in regards to 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 eight historic water quality stations within the East Fork La Moine River/ Spring 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 East Fork La Moine River/Spring 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 East Fork La Moine River/Spring Lake watershed stream data followed by Spring and Argyle Lake reservoir data.

5.1.1 Stream Water Quality Data

The East Fork La Moine River/Spring Lake watershed has one impaired stream segment within its drainage area that is addressed in this report. There are two active water quality stations on segment DGL04 of the East Fork La Moine River (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 Manganese

The applicable water quality standard is a maximum total manganese concentration of 1,000 µg/L for general use and 150 µg/L for public water supply. Segment DGL04 is designated for public water use and therefore, both standards are applicable. Table 5-1 summarizes the available historic manganese data since 1990 for the segment. The table also shows the number of violations recorded. There have been two violations of the public water supply standard on segment DGL 04 of the East Fork La Moine River.

Both occurred at sample location DGL 04 in 1998. No violations were recorded in 2002.

Table 5-1 Historic Manganese Data for Segment DGL04 of East Fork La Moine River

<table>
<tr><th>Sample Location and Parameter</th><th>Applicable Illinois WQ Standard (µg/L)</th><th>Period of Record and Number of Data Points</th><th>Mean</th><th>Maximum</th><th>Minimum</th><th>Number of Violations</th></tr>
<tr><td colspan="7">East Fork La Moine River Segment DGL04; Sampling Locations DGL04 and DGL07</td></tr>
<tr><td rowspan="2">Total Manganese</td><td>General Use: 1000</td><td rowspan="2">1998-2002; 6</td><td rowspan="2">223</td><td rowspan="2">340</td><td rowspan="2">85</td><td>0</td></tr>
<tr><td>Public Water Supply: 150</td><td>2</td></tr>
<tr><td>Dissolved Manganese</td><td>NA</td><td>2002; 4</td><td>93</td><td>160</td><td>15</td><td>NA</td></tr>
<tr><td>Total Manganese in Bottom Deposits</td><td>NA</td><td>1998-2002; 2</td><td>650</td><td>790</td><td>510</td><td>NA</td></tr>
</table>

5.1.2 Lake and Reservoir Water Quality Data

Spring Lake and Argyle Lake are the impaired lakes within the watershed that are addressed in this report. The data summarized in this section include water quality data for the constituent of impairments 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 Spring Lake

Spring Lake is listed as impaired for total phosphorus. There are three active stations on Spring Lake (see Figure 5-1). An inventory of all available phosphorus data at all sample depths is presented in Table 5-2.

Table 5-2 Inventory of Impairment Data for Spring Lake

Spring Lake; Sample Locations RDR-1, RDR-2, and RDR-3		
RDR-1	**Period of Record**	**Number of Samples**
Total Phosphorus	1991-1998	43
Dissolved Phosphorus	1992-1993	12
Phosphorus in Bottom Deposits	1992-1993	12
RDR-2		
Total Phosphorus	1991-1994	21
Dissolved Phosphorus	1993	3
RDR-3		
Total Phosphorus	1991-1994	25
Dissolved Phosphorus	1993	5
Phosphorus in Bottom Deposits	1993	1

Table 5-3 contains information on data availability for other parameters that may be useful in data needs analysis and future modeling efforts. DO at varying depths as well as chlorophyll-a data have been collected where available.

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

Spring Lake; Sample Locations RDR-1, RDR-2, and RDR-3		
RDR-1	**Period of Record**	**Number of Samples**
Chlorophyll-a Corrected	1992-1998	13
Chlorophyll-a Uncorrected	1992-1998	13
Dissolved Oxygen	1992-1993	96
RDR-2		
Chlorophyll-a Corrected	1993	6
Chlorophyll-a Uncorrected	1993	6
Dissolved Oxygen	1993	30
RDR-3		
Chlorophyll-a Corrected	1993	4
Chlorophyll-a Uncorrected	1993	4
Dissolved Oxygen	1993	17

5.1.2.1.1 Total Phosphorus

The water quality standard for total phosphorus is a maximum concentration of 0.05 mg/L. The standard is assessed 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 Spring Lake are presented in Table 5-4.

Table 5-4 Average Total Phosphorus Concentrations (mg/L) in Spring Lake at one-foot depth

	RDR-1		RDR-2		RDR-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**
1991	6; 6	0.08	6; 6	0.16	5; 5	0.25	17; 17	0.16
1992	6; 5	0.07	5; 5	0.12	5; 5	0.20	16; 15	0.13
1993	10; 10	0.12	5; 5	0.15	10; 10	0.22	25; 25	0.16
1994	5; 4	0.08	5; 5	0.16	5; 5	0.18	15; 14	0.14
1997	6; 6	0.09	NA	NA	NA	NA	6; 6	0.09
1998	4; 4	0.11	NA	NA	NA	NA	4; 4	0.11

Figure 5-2 shows the annual average total phosphorus concentrations for each sampling location as well as the average for the entire lake. Annual averages have been above the standard for each year of available data. Only two samples have been recorded below the standard. Each of the non-violating samples was collected at location RDR-1.

5.1.2.2 Argyle Lake

Argyle Lake is listed as impaired for total phosphorus. There are three active stations on the lake (see Figure 5-1). An inventory of all available phosphorus data at all depths is presented in Table 5-5.

Table 5-5 Inventory of Phosphorus Data for Argyle Lake

Argyle Lake; Sample Locations RDE-1, RDE-2, and RDE-3		
RDE-1	**Period of Record**	**Number of Samples**
Total Phosphorus	1991-2002	52
Dissolved Phosphorus	1991-2002	50
Phosphorus in Bottom Deposits	1991-1993	2
RDE-2		
Total Phosphorus	1991-2002	25
Dissolved Phosphorus	1991-2002	24
RDE-3		
Total Phosphorus	1991-2002	24
Dissolved Phosphorus	1991-2002	24
Phosphorus in Bottom Deposits	1991-1993	2

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

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

Argyle Lake; Sample Locations RDE-1, RDE-2, and RDE-3		
RDE-1	**Period of Record**	**Number of Samples**
Dissolved Oxygen (mg/L)	1991-2002	416
Chlorophyll-a Corrected	1991-2002	25
Chlorophyll-a Uncorrected	1991-2002	25
RDE-2		
Dissolved Oxygen (mg/L)	1991-2002	228
Chlorophyll-a Corrected	1991-2002	23
Chlorophyll-a Uncorrected	1991-2002	23

5.1.2.2.1 Total Phosphorus

Again, the water quality standard for total phosphorus is a maximum concentration of 0.05 mg/L. The standard is assessed 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 Argyle Lake are presented in Table 5-7.

Table 5-7 Average Total Phosphorus Concentrations (mg/L) in Argyle Lake at one-foot depth

	RDE-1		**RDE-2**		**RDE-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**
1991	5; 2	0.05	5; 2	0.06	5; 2	0.06	15; 6	0.06
1993	6; 4	0.06	5; 3	0.05	4; 2	0.05	15; 9	0.05
1996	5; 0	0.03	5; 0	0.04	5; 0	0.03	15; 0	0.03
1999	5; 0	0.02	5; 0	0.02	5; 0	0.02	15; 0	0.02
2002	5; 1	0.04	5; 0	0.04	5; 0	0.04	15; 1	0.04

Figure 5-3 shows the annual average total phosphorus concentrations for each sampling location as well as the average for the entire lake. Annual averages have been below the standard beginning in 1996. Only one violation has been recorded in the last ten years. The violating sample was collected at RDE-1 in June of 2002 and had a total phosphorus concentration of 0.06 mg/L.

5.2 Reservoir Characteristics

There are two impaired reservoirs in the East Fork La Moine River/Spring Lake Watershed. Reservoir information that can be used for future modeling efforts was collected from GIS analysis, the Illinois EPA, the U.S. Army Corps of Engineers, and USEPA water quality data. The following sections will discuss the available data for each reservoir.

5.2.1 Argyle Lake

Argyle Lake is located in McDonough County approximately two miles north of Colchester. The lake has a surface area of 95 acres and a shoreline length of 4.7 miles. The Illinois Department of Natural Resources maintains the lake as part of Argyle Lake State Park. Table 5-8 shows dam information for the lake while Table 5-9 contains depth information for each sampling location. The average maximum depth in Argyle Lake is 30.8 feet.

Table 5-8 Argyle Lake Dam Information (U.S. Army Corps of Engineers

Dam Length	670 feet
Dam Height	58 feet
Maximum Discharge	13,580 cfs
Maximum Storage	4,040 acre-feet
Normal Storage	2,200 acre-feet
Spillway Width	85 feet
Outlet Gate Type	U

Table 5-9 Average Depths (ft) for Argyle Lake Segment RDE (Illinois EPA 2002 and USEPA 2002a)

Year	RDE-1	RDE-2	RDE-3
1990	35.0	24.4	19.1
1991	32.7	15.8	18.8
1993	32.1	18.4	19.9
1996	32.2	15.9	18.4
1999	31.4	11.8	18.8
2002	21.1	16.4	16.5
Average	**30.8**	**17.1**	**18.6**

5.2.2 Spring Lake

Spring Lake is located north of Macomb in McDonough County. The lake has a surface area of 277 acres and a shoreline length of approximately five miles. In conjunction with the East Fork La Moine River and two wells near Spring Lake, Spring Lake provides drinking water to the city of Macomb (Source Water Assessment Program, Illinois EPA 2002). Table 5-10 shows dam information for the lake while Table 5-11 contains depth information for each sampling location on the lake. The average maximum water depth is 26.6 feet.

Table 5-10 Spring Lake Dam Information (U.S. Army Corps of Engineers

Dam Length	525 feet
Dam Height	45 feet
Maximum Discharge	NA
Maximum Storage	5,611 acre-feet
Normal Storage	3,363 acre-feet
Spillway Width	511 feet
Outlet Gate Type	U

Table 5-11 Average Depths (ft) for Spring Lake Segment RDR (Illinois EPA 2002 and USEPA 2002a)

Year	RDR-1	RDR-2	RDR-3
1990	28.2	7.5	3.6
1991	27.2	6.6	3.7
1992	27.7	7.5	4.8
1993	25.6	7.8	4.9
1994	25.4	5.1	3.5
1995	27.2	5.6	4.7
1996	24.8	4.9	4.8
1997	26.6	5.4	4.2
1998	26.7	5.5	4.0
Average	**26.6**	**6.2**	**4.2**

5.3 Point Sources

Point sources for the East Fork La Moine River/Spring Lake watershed have been separated into municipal/industrial sources and mining discharges. Available data have been summarized and are 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 that are then maintained in a database by the state. There are approximately 11 point sources located within the East Fork La Moine River/Spring Lake watershed. Figure 5-4 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. The impairments for each segment or downstream segment were considered when reviewing DMR data. Data have 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 East Fork LaMoine River Segment DGL 04

There are nine point sources with the potential to contribute discharge to East Fork LaMoine River Segment DGL 04. Segment DGL 04 is listed as impaired for manganese. It should be noted that the Good Hope STP and Bushnell West STP discharge significantly upstream of the impaired segment. Table 5-12 contains a summary of available and pertinent DMR data for this segment. Data related to manganese are not usually required by discharge permits; however, one facility did have samples for this parameter.

Table 5-12 Effluent Data from Point Sources discharging to or upstream of East Fork La Moine River Segment DGL 04 (IEPA 2005)

Facility Name Period of Record Permit Number	Receiving Water/ Downstream Impaired Waterbody	Constituent	Average Value	Average Loading (lb/d)
GEORGETOWN HOME ASSOC STP 1994-2005 ILG551005	LaMoine River/ East Fork LaMoine Segment DGL 04	Average Daily Flow	0.06 mgd	NA
MEADOWBROOK SUBDIVISION STP 1996-2005 ILG551029	East Fork of LaMoine River/ East Fork LaMoine Segment DGL 04	Average Daily Flow	0.099 mgd	NA
BARDOLPH STP 1994-2005 ILG580020	LaMoine River/ East Fork LaMoine Segment DGL 04	Average Daily Flow	0.07 mgd	NA
MACOMB WTP 1993-2005 IL0046370	East Branch of LaMoine River/ East Fork LaMoine Segment DGL 04	Average Daily Flow	0.142 mgd	NA
COLCHESTER STP 1994-2005 IL0028177	Tributary of East Fork LaMoine River/East Fork LaMoine Segment DGL 04	Average Daily Flow	0.17 mgd	NA
EMMETT UTILITIES INC. STP 1996-2005 IL0071030	Unnamed Tributary to East Fork LaMoine River/East Fork LaMoine Segment DGL 04	Average Daily Flow	0.006 mgd	NA
GOOD HOPE SD STP 1998-2005 ILG580194	East Fork LaMoine River/East Fork LaMoine Segment DGL 04	Average Daily Flow	0.057 mgd	NA
BUSHNELL WEST STP 1989-2005 IL0024384	Drowning Fork Creek/East Fork La Moine Segment DGL 04	Average Daily Flow	0.25 mgd	NA
WASTE MANAGEMENT OF ILLINOIS 2000-2005 IL0074161	Unnamed Tributary of East Fork LaMoine River/East Fork La Moine Segment DGL 04	Average Daily Flow	0.072 mgd	NA
		Manganese, Total	0.463 mg/L	-

5.3.1.2 Spring Lake (McDonough) Segment RDR

There is one permitted facility whose discharge has the potential to reach Spring Lake. Spring Lake is listed for a total phosphorus impairment. Table 5-13 contains a summary of available DMR data for this point source. No phosphorus data are available from DMR records.

Table 5-13 Effluent Data from Point Sources discharging to Spring Lake Segment RDR (IEPA 2005)

Facility Name Period of Record Permit Number	Receiving Water/ Downstream Impaired Waterbody	Constituent	Average Value	Average Loading (lb/d)
NORTHWESTERN HS DISTRICT 175 1994-2005 IL0053619	Unnamed Tributary of Spring Creek/ Spring Lake Segment RDR	Average Daily Flow	.002 mgd	NA

5.3.1.3 Argyle Lake Segment RDE

There is one point source that discharges to an unnamed ditch to Argyle Lake Segment RDE. Argyle Lake is listed as impaired for total phosphorus. Table 5-14 contains a summary of available DMR data for this point source. Total phosphorus records were not available.

Table 5-14 Effluent Data from Point Sources discharging to Argyle Lake Segment RDE (IEPA 2005)

Facility Name Period of Record Permit Number	Receiving Water/ Downstream Impaired Waterbody	Constituent	Average Value	Average Loading (lb/d)
COUNTRY AIRE ESTATES MHP 1994-2005 IL0054267	Unnamed Ditch to Argyle Lake/Argyle Lake Segment RDE	Average Daily Flow	0.0126 mgd	NA

5.3.2 Mining

There are no permitted mine sites or recently abandoned mines within the East Fork La Moine River/Spring Lake watershed.

5.4 Nonpoint Sources

There are many potential nonpoint sources of pollutant loading to the impaired segment and lakes in the East Fork La Moine River/Spring Lake watershed. The following sections will discuss site-specific cropping practices, animal operations, and area septic systems. Data was collected through communication with the local NRCS, Soil and Water Conservation District (SWCD), public health department, and county tax department officials.

5.4.1 Crop Information

The majority of the land found within the East Fork La Moine River/Spring Lake watershed is devoted to crops. Corn and soybean farming account for approximately 39 percent and 37 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 East Fork La Moine River/Spring Lake watershed were not available; however, the Hancock, McDonough, and Warren County practices were available and are shown in the following tables.

Table 5-15 Tillage Practices in Hancock County

Tillage System	Corn	Soybean	Small Grain
Conventional	62%	14%	0%
Reduced - Till	22%	15%	0%
Mulch - Till	5%	14%	0%
No - Till	11%	56%	100%

Table 5-16 Tillage Practices in McDonough County

Tillage System	Corn	Soybean	Small Grain
Conventional	43%	9%	0%
Reduced - Till	29%	22%	100%
Mulch - Till	16%	37%	0%
No - Till	12%	31%	0%

Table 5-17 Tillage Practices in Warren County

Tillage System	Corn	Soybean	Small Grain
Conventional	6%	0%	0%
Reduced - Till	37%	5%	0%
Mulch - Till	30%	29%	0%
No - Till	27%	66%	100%

Estimates on tile drainage were provided by the McDonough County NRCS office. It is estimated that approximately 75 percent of the portion of the East Fork La Moine River/Spring Lake Watershed within McDonough County (the majority of the watershed) is estimated to be drained by field tiles.

5.4.2 Animal Operations

Data from the National Agricultural Statistics Service were reviewed for the counties within the East Fork La Moine River/Spring Lake watershed and are presented below to show countywide livestock numbers.

Table 5-18 Hancock County Animal Population (2002 Census of Agriculture)

	1997	2002	Percent Change
Cattle and Calves	35,794	30,996	-13%
Beef	14,562	NA	NA
Dairy	507	NA	NA
Hogs and Pigs	89,641	97,609	9%
Poultry	1,099	366	-67%
Sheep and Lambs	1,152	623	-46%
Horses and Ponies	NA	629	NA

Table 5-19 McDonough County Animal Population (2002 Census of Agriculture)

	1997	2002	Percent Change
Cattle and Calves	20,529	19,377	-6%
Beef	8,566	8,780	2%
Dairy	275	450	64%
Hogs and Pigs	33,658	17,062	-49%
Poultry	372	344	-8%
Sheep and Lambs	1,682	1,743	4%
Horses and Ponies	NA	621	NA

Table 5-20 Warren County Animal Population (2002 Census of Agriculture)

	1997	2002	Percent Change
Cattle and Calves	23,540	23,209	-1%
Beef	9,273	9,087	-2%
Dairy	284	247	-13%
Hogs and Pigs	49,237	56,884	16%
Poultry	342	414	21%
Sheep and Lambs	3,616	3,300	-9%
Horses and Ponies	NA	460	NA

Watershed-specific animal information was provided by the McDonough County NRCS office. Estimates of the location and number of livestock for each animal operation were obtained. This information is summarized in Table 5-21. As shown in the table, it is estimated that there are 36 animal operations in McDonough County within the East Fork La Moine River/Spring Lake Watershed. Over half of the operations are cattle operations. With the exception of one dairy, all of the cattle operations are beef farms.

Table 5-21 McDonough County Animal Operations

	Number Operations	Number of Animals/Operation	Total Number of Animals
Blandisville Township			
Cattle and Calves	NA		NA
Beef	NA	NA	NA
Dairy	NA	NA	NA
Hogs and Pigs (confined)	1	2,500	2,500
Emmet Township			
Cattle and Calves	4		2,000
Beef	4	500	2,000
Dairy	NA	NA	NA
Hogs and Pigs	2		1,400
Confined	1	1,200	1,200
Unconfined	1	200	200
Tennessee Township			
Cattle and Calves	2		144
Beef	1[1]	80	80
	1	64	64
Dairy	NA	NA	NA
Hogs and Pigs	1[1]	400	400
Walnut Grove Township			
Cattle and Calves	6		2,890
Beef	5	556	2,780
	1[2]	110	110
Dairy	NA	NA	NA
Hogs and Pigs	3		5,625
Confined	2	2,800	5,600
Unconfined	1	25	25
Other	3		510
Elk	1	130	130
Sheep	2	190	380
Mound Township			
Cattle and Calves	3		550
Beef	2	100	200
Dairy	1	350	350
Hogs and Pigs	NA	NA	NA
Macomb Township			
Cattle and Calves	7		2,235
Beef	5	415	2,075
	1[3]	60	60
	1	100	100
Dairy	NA	NA	NA
Hogs and Pigs	NA	NA	NA
Other	1		30
Horses	1[3]	30	30

Table 5-21 McDonough County Animal Operations (continued)

	Number Operations	Number of Animals/Operation	Total Number of Animals
Sciota Township			
Cattle and Calves	1		80
Beef	1	80	80
Dairy	NA	NA	NA
Hogs and Pigs	2		2,200
Confined	1	2,000	2,000
Unconfined	1	200	200
Other	1		100
Sheep	1	100	100
Prairie City/Bushnell			
Cattle and Calves	1		200
Beef	1	200	200
Dairy	NA	NA	NA
Hogs and Pigs	NA	NA	NA
Other	1		90
Sheep	1	90	90

1. This animal operation in Tennessee Township has 400 hogs and 80cows.
2. This animal operation in Walnut Grove Township has 50 calves and 30 cow-calf pairs.
3. This animal operation in Macomb Township has 60 cows and 30 horses.

5.4.3 Septic Systems

Many 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 many 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 within the East Fork La Moine River/Spring Lake watershed has been obtained from the McDonough County Health Department. Table 5-25 is a summary of the available septic system data in the East Fork La Moine River/Spring Lake watershed.

Table 5-22 Estimated Septic Systems within the East Fork La Moine River/Spring Lake Watershed

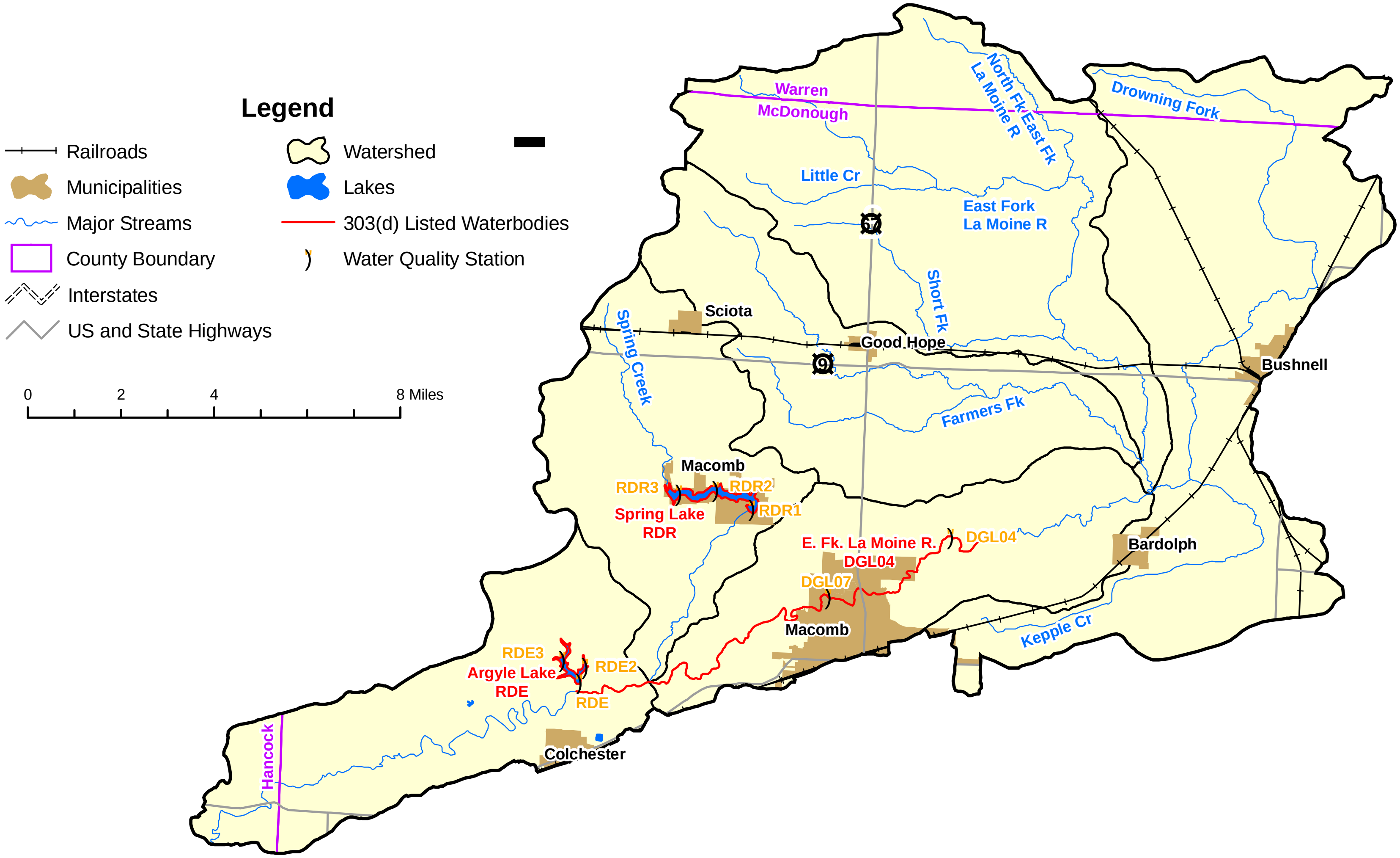
County	Estimated No. of Septic Systems	Source of Septic Areas/ No. of Septic Systems
Warren	negligible	
McDonough	1,800	Health Department
Hancock	negligible	
Total	**1,800**	

It is estimated that there are approximately 1,800 septic systems in the watershed. Macomb, Bushnell, and Colchester are served by municipal sewer systems. Bardolph is served by a lagoon system. The villages of Sciota and Good Hope are served by septic systems. In McDonough County, it is estimated that most of the septic systems, approximately 75 percent, employ subsurface drainage to well-drained soils. The remaining systems, approximately 25 percent, which are located in areas with poorly-drained soils, are aerobic treatment systems.

Although the majority of septic systems employ subsurface drainage to a septic field, a small number of "wildcat" septic systems are known to exist in Sciota and in rural areas throughout the county. A "wildcat" septic system consists of a septic tank (or group of area septic tanks) that drains to field tiles, which drain to area creeks

5.5 Watershed Information

Previous planning efforts have been conducted within the East Fork La Moine River/Spring Lake watershed. The La Moine River Ecosystem Partnership has been created with a mission to "preserve, protect, and enhance the natural resources of the La Moine River watershed area as a sustainable ecosystem." The East Fork La Moine River watershed is a portion of this larger watershed area. Many organizations are involved in the partnership and various projects have been completed including the Thistle Hills Land and Water Reserve where native shortgrass prairie will be established on 13 acres of existing cropland to provide nesting habitat for grassland-sensitive breeding birds. This project will be located two miles northwest of Macomb, in McDonough County, Illinois which falls within the East Fork La Moine River/ Spring Lake watershed. Work has also been completed on multiple datasets for this basin. Available data will be reviewed and incorporated into stages 2 and 3 of TMDL development where appropriate.



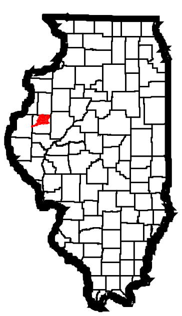


Figure 5-1:
East Fork La Moine River - Spring Lake Watershed
Water Quality Stations

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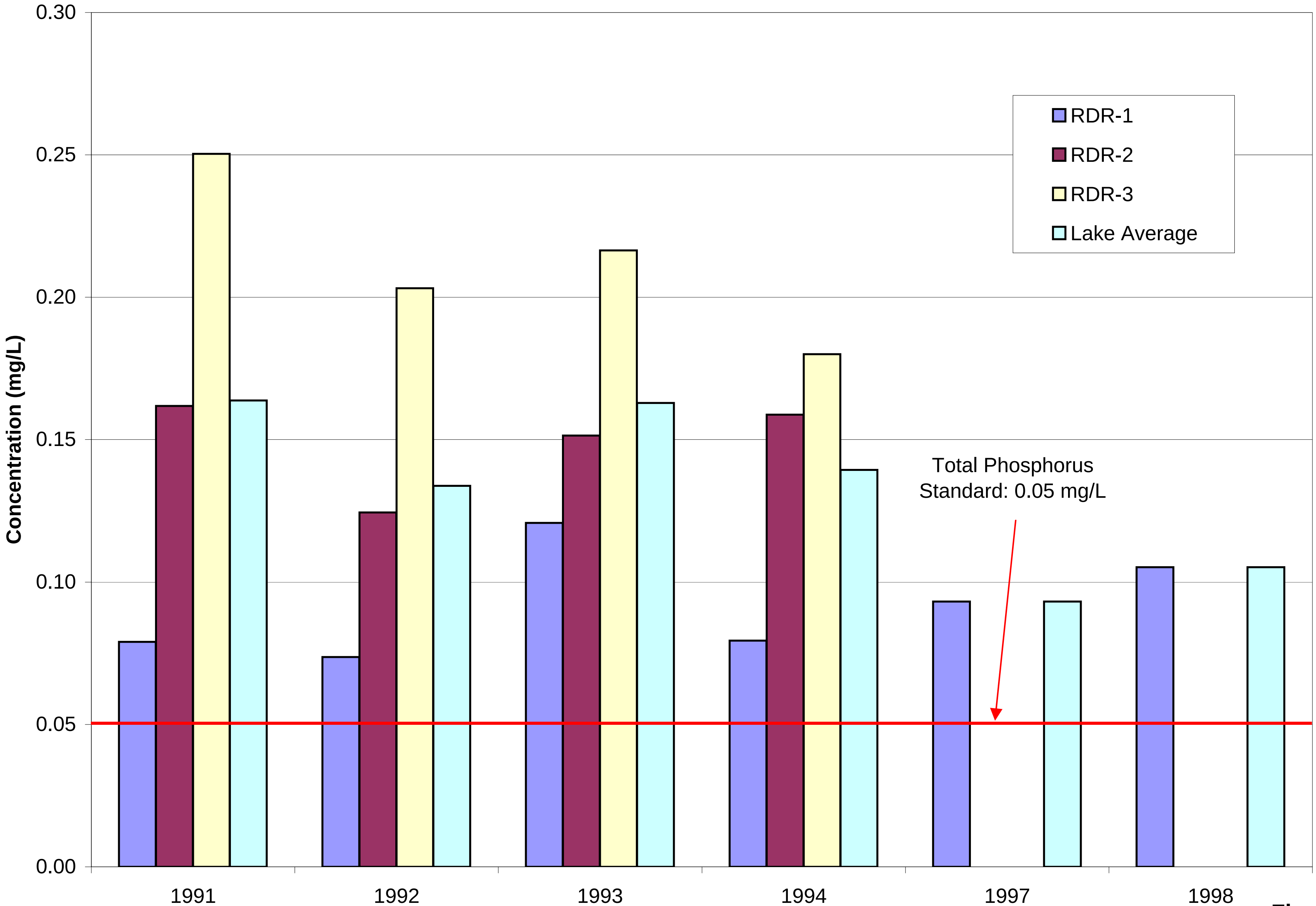

Figure 5-2:
Annual Average Total Phosphorus Concentrations
at One-Foot Depth
Spring Lake

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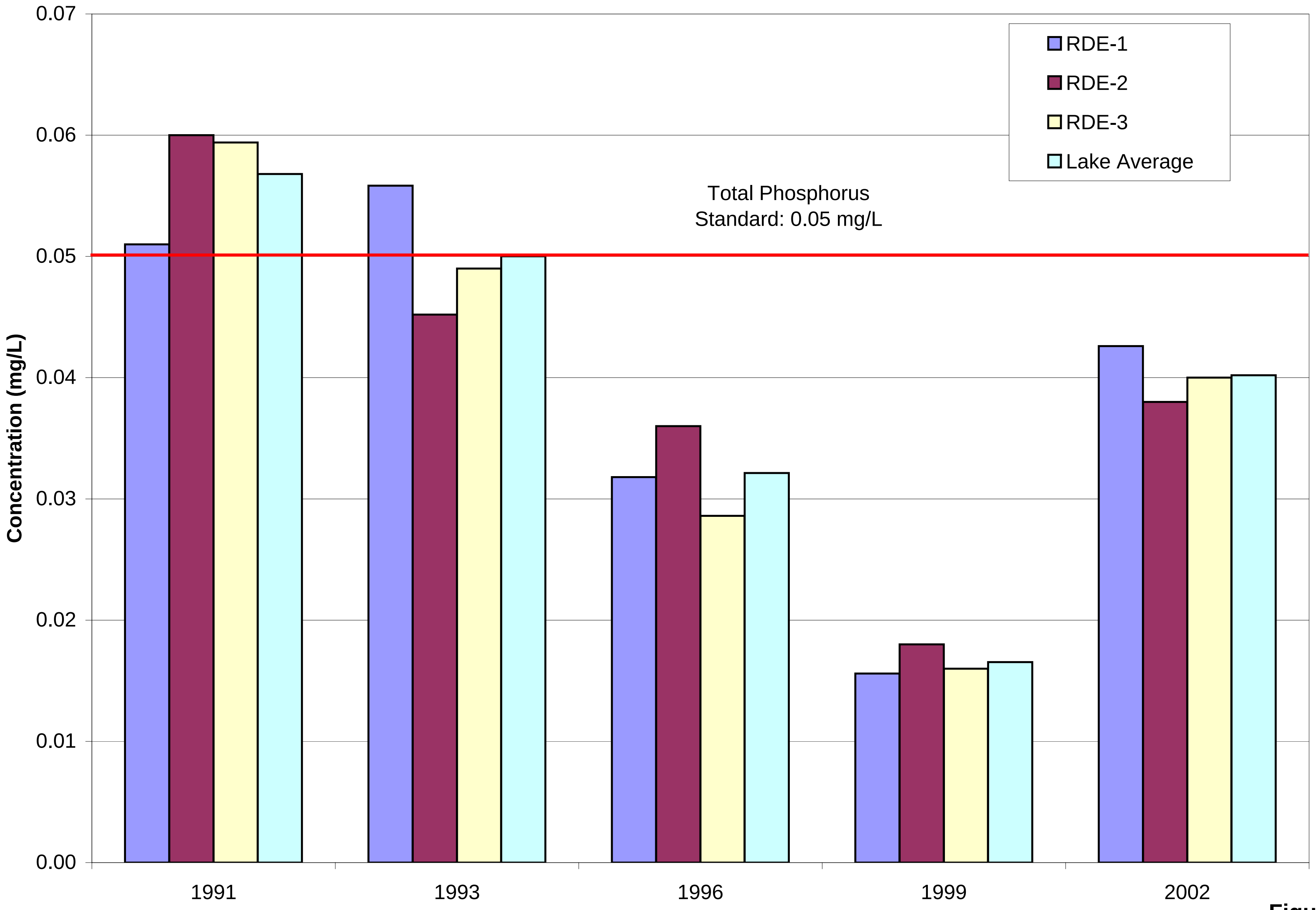

Figure 5-3:
Annual Average Total Phosphorus Concentrations
at One-Foot Depth
Argyle Lake

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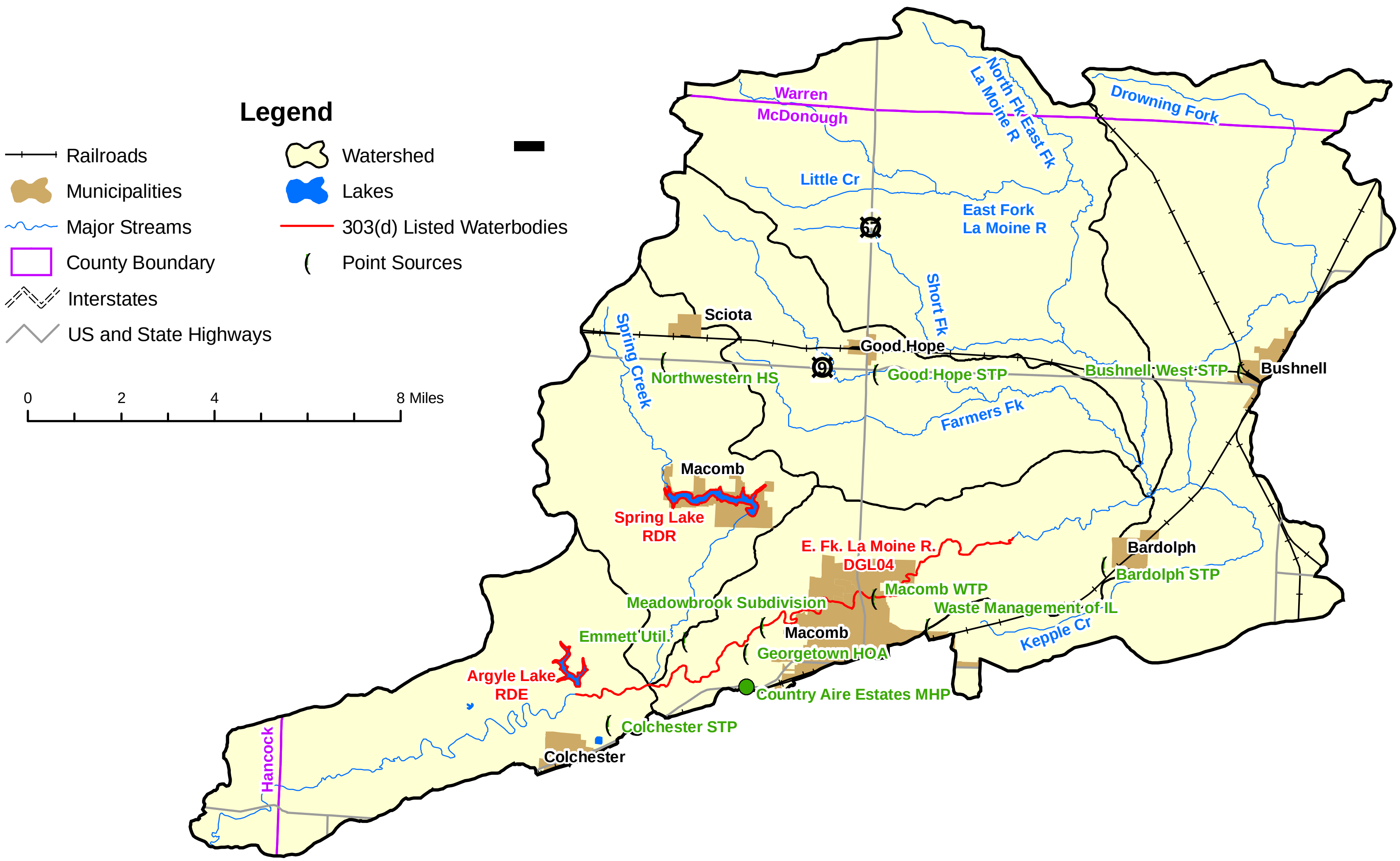

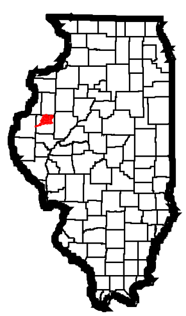

Figure 5-4:
East Fork La Moine River - Spring Lake Watershed
NPDES Permits

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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 East Fork La Moine River/Spring Lake watershed, manganese is the only parameter with a numeric water quality standard. For lakes, total phosphorus is the only parameter a with numeric water quality standard. Refer to Table 1-1 for all segments and associated impairments within the East Fork La Moine River/Spring Lake watershed. 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 simple approaches 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 East Fork La Moine/Spring Lake 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 East Fork La Moine/Spring Lake watershed.

6.2 Approaches for Developing TMDLs for Stream Segments in the East Fork La Moine/Spring Lake Watershed

Segment DGL04 of the East Fork La Moine River is the only segment listed for an impairment with a numeric standard within the watershed. The segment has been listed for a manganese impairment. The approach for developing a TMDL for this constituent is presented below.

6.2.1 Recommended Approach for Manganese TMDL

Data related to manganese are limited to six samples on segment DGL04 of the East Fork La Moine River. Two of the manganese samples have violated public water supply standards applicable to the segment. Because there is little available data and few violations, it is recommended that more data be collected. If the collected data shows that the impairments do exist, an empirical loading and spreadsheet analysis will be utilized to calculate this TMDL.

6.3 Approaches for Developing TMDLs for Argyle and Spring Lakes

Recommended TMDL approaches for lakes within the East Fork La Moine/Spring Lake watershed are presented below. It is assumed that for the lakes in the watershed, a simple model for use in TMDL development will be adequate.

6.3.1 Recommended Approach for Total Phosphorus TMDL

Both Spring Lake and Argyle Lake are listed as impaired for total phosphorus. The BATHTUB model is recommended for all lake phosphorus assessments in the 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.

Appendix A
Land Use Categories

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File names and descriptions:

Values and class names found in the Land Cover of Illinois 1999-2000 Arc/Info GRID coverage.

Value	Class Names
0	Background
	AGRICULTURAL LAND
11	Corn
12	Soybeans
13	Winter Wheat
14	Other Small Grains & Hay
15	Winter Wheat/Soybeans
16	Other Agriculture
17	Rural Grassland
	FORESTED LAND
21	Upland
25	Partial Canopy/Savannah Upland
26	Coniferous
	URBAN & BUILT-UP LAND
31	High Density
32	Low/Medium Density
35	Urban Open Space
	WETLAND
41	Shallow Marsh/Wet Meadow
42	Deep Marsh
43	Seasonally/Temporally Flooded
44	Floodplain Forest
48	Swamp
49	Shallow Water
	OTHER
51	Surface Water
52	Barren & Exposed Land
53	Clouds
54	Cloud Shadows

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Appendix B
Soil Characteristics

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Appendix B East Fork La Moine River/Spring Lake Watershed Soil Series Characteristics

STATSGO Map Unit ID and SSURGO Soil Series Code	STATSGO Map Unit ID and SSURGO Soil Series Code Definition	Acres	Percent of Watershed	Dominant Hydrologic Soil Group	Minimum K-factor	Maximum K-factor
119E2	Elco silt loam, 18 to 25 percent slopes, eroded	424.77	0.30%	B	0.28	0.49
119C2	Elco silt loam, 5 to 10 percent slopes, eroded	775.67	0.54%	B	0.28	0.43
119D2	Elco silt loam, 10 to 18 percent slopes, eroded	1808.57	1.26%	B	0.28	0.43
1334A	Birds silt loam, undrained, 0 to 2 percent slopes, frequently flooded	593.30	0.41%	B/D	0.28	0.49
16A	Rushville silt loam, 0 to 2 percent slopes	34.59	0.02%	D	0.37	0.55
17A	Keomah silt loam, 0 to 2 percent slopes	2435.47	1.70%	C	0.17	0.24
17B	Keomah silt loam, 2 to 5 percent slopes	1387.00	0.97%	C	0.24	0.55
249A	Edinburg silty clay loam, 0 to 2 percent slopes	800.87	0.56%	C/D	0.43	0.43
250D2	Velma silt loam, 10 to 18 percent slopes, eroded	14.16	0.01%	B	0.24	0.49
257A	Clarksdale silt loam, 0 to 2 percent slopes	2420.65	1.69%	C	0.32	0.49
257B	Clarksdale silt loam, 2 to 5 percent slopes	1779.90	1.24%	C	0.24	0.49
259C2	Assumption silt loam, 5 to 10 percent slopes, eroded	617.27	0.43%	B	0.37	0.55
259D2	Assumption silt loam, 10 to 18 percent slopes, eroded	181.99	0.13%	B	0.24	0.49
279B	Rozetta silt loam, 2 to 5 percent slopes	4005.58	2.80%	B	0.28	0.49
279C2	Rozetta silt loam, 5 to 10 percent slopes, eroded	6681.74	4.67%	B	0.24	0.49
279D2	Rozetta silt loam, 10 to 18 percent slopes, eroded	1293.60	0.90%	B	0.32	0.49
280D2	Fayette silt loam, 10 to 18 percent slopes, eroded	1.39	0.00%	B	0.37	0.49
280F	Fayette silt loam, 10 to 18 percent slopes, eroded	108.33	0.08%	B	0.37	0.49
3074A	Radford silt loam, 0 to 2 percent slopes, frequently flooded	1174.49	0.82%	B	0.37	0.49
3107+	Sawmill silt loam, 0 to 2 percent slopes, frequently flooded, overwash	22.81	0.02%	B/D	0.37	0.55
3107A	Sawmill silty clay loam, 0 to 2 percent slopes, frequently flooded	2903.49	2.03%	B/D	0.28	0.32
3284A	Tice silty clay loam, 0 to 2 percent slopes, frequently flooded	103.07	0.07%	B	0.37	0.49
3333A	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded	2134.01	1.49%	C	0.43	0.49
3334A	Birds silt loam, 0 to 2 percent slopes, frequently flooded	384.99	0.27%	B/D	0.28	0.55
3451A	Lawson silt loam, 0 to 2 percent slopes, frequently flooded	1365.26	0.95%	B	0.02	0.49
43A	Ipava silt loam, 0 to 2 percent slopes	36126.86	25.23%	B	0.28	0.49
43B	Ipava silt loam, 2 to 5 percent slopes	4218.10	2.95%	B	0.24	0.49
43B2	Ipava silt loam, 2 to 5 percent slopes, eroded	2648.97	1.85%	B	0.24	0.49
45A	Denny silt loam, 0 to 2 percent slopes	581.19	0.41%	D	0.37	0.49
470C2	Keller silt loam, 5 to 10 percent slopes, eroded	390.43	0.27%	C	0.24	0.49
50A	Virden silty clay loam, 0 to 2 percent slopes	1046.49	0.73%	B/D	0.37	0.43
51A	Muscatune silt loam, 0 to 2 percent slopes	684.73	0.48%	B	0.24	0.43
51B2	Muscatune silt loam, 2 to 5 percent slopes, eroded	56.12	0.04%	B	0.24	0.49

Appendix B East Fork La Moine River/Spring Lake Watershed Soil Series Characteristics

STATSGO Map Unit ID and SSURGO Soil Series Code	STATSGO Map Unit ID and SSURGO Soil Series Code Definition	Acres	Percent of Watershed	Dominant Hydrologic Soil Group	Minimum K-factor	Maximum K-factor
549F	Marseilles silt loam, 18 to 35 percent slopes	227.83	0.16%	B	0.24	0.49
549G	Marseilles silt loam, 18 to 35 percent slopes	1512.04	1.06%	B	0.32	0.32
605C2	Ursa silt loam, 5 to 10 percent slopes, eroded	4.53	0.00%	C	0.28	0.43
605D2	Ursa silt loam, 10 to 18 percent slopes, eroded	345.45	0.24%	C	0.28	0.32
675B	Greenbush silt loam, 2 to 5 percent slopes	2191.83	1.53%	B	0.28	0.32
68A	Sable silty clay loam, 0 to 2 percent slopes	19761.05	13.80%	B/D	0.24	0.49
68A+	Sable silt loam, 0 to 2 percent slopes, overwash	137.91	0.10%	B/D	0.24	0.49
699A	Timewell silt loam, 0 to 2 percent slopes	281.21	0.20%	B	0.37	0.55
6C2	Fishhook silt loam, 5 to 10 percent slopes, eroded	550.30	0.38%	D	0.24	0.49
6D2	Fishhook silt loam, 10 to 18 percent slopes, eroded	548.33	0.38%	D	0.28	0.43
7C3	Atlas silty clay loam, 5 to 10 percent slopes, severely eroded	171.44	0.12%	D	0.37	0.43
7D3	Atlas silty clay loam, 10 to 18 percent slopes, severely eroded	377.58	0.26%	D	0.28	0.28
802B	Orthents, loamy, undulating	805.81	0.56%	B	0.43	0.43
802E	Orthents loamy, hilly	501.13	0.35%	B	0.32	0.32
855A	Timewell and Ipava silt loams, 0 to 2 percent slopes	516.20	0.36%	B	0.32	0.55
86B	Osco silt loam, 2 to 5 percent slopes	11517.60	8.04%	B	0.28	0.37
86B2	Osco silt loam, 2 to 5 percent slopes, eroded	7828.31	5.47%	B	0.24	0.49
86C2	Osco silt loam, 5 to 10 percent slopes, eroded	4880.34	3.41%	B	0.24	0.49
8D2	Hickory silt loam, 10 to 18 percent slopes, eroded	1184.63	0.83%	B	0.43	0.43
8F	Hickory silt loam, 18 to 35 percent slopes	4472.61	3.12%	B	0.32	0.43
8G	Hickory silt loam, 35 to 60 percent slopes	2309.20	1.61%	B	0.28	0.37
9017A	Keomah silt loam, terrace, 0 to 2 percent slopes	75.94	0.05%	C	0.28	0.32
9017B	Keomah silt loam, terrace, 2 to 5 percent slopes	65.01	0.05%	C	0.24	0.49
9279B	Rozetta silt loam, terrace, 2 to 5 percent slopes	365.96	0.26%	B	0.28	0.49
9279C2	Rozetta silt loam, terrace, 5 to 10 percent slopes, eroded	402.04	0.28%	B	0.28	0.49
957D3	Elco-Atlas silty clay loams, 10 to 18 percent slopes, severely eroded	34.55	0.02%	B	0.28	0.43
IL004	STATSGO	314.81	0.22%	B	0.32	0.43
IL029	STATSGO	64.59	0.05%	B	0.28	0.43
IL036	STATSGO	2019.35	1.41%	B	0.20	0.43
M-W	STATSGO	34.30	0.02%	B	0.28	0.43
W	STATSGO	466.54	0.33%	B	0.28	0.43
		143174.32				

Appendix C
Water Quality Data

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Water Quality Data
East Fork La Moine River/Spring Lake Watershed

Station ID	Sample Date	Sample Depth (ft)	Parameter	Result
DGL 04	8/18/1998	NA	MANGANESE IN BOTTOM DEPOSITS (MG/KG AS MN DRY WGT)	790
DGL 04	8/12/2002	NA	MANGANESE IN BOTTOM DEPOSITS (MG/KG AS MN DRY WGT)	510
DGL 04	6/10/2002	NA	MANGANESE, DISSOLVED (UG/L AS MN)	47
DGL 04	8/12/2002	NA	MANGANESE, DISSOLVED (UG/L AS MN)	150
DGL 04	8/13/2002	NA	MANGANESE, DISSOLVED (UG/L AS MN)	15
DGL 04	9/11/2002	NA	MANGANESE, DISSOLVED (UG/L AS MN)	160
DGL 04	8/19/1998	NA	MANGANESE, TOTAL (UG/L AS MN)	340
DGL 04	9/17/1998	NA	MANGANESE, TOTAL (UG/L AS MN)	340
DGL 04	6/10/2002	NA	MANGANESE, TOTAL (UG/L AS MN)	120
DGL 04	8/12/2002	NA	MANGANESE, TOTAL (UG/L AS MN)	240
DGL 04	8/13/2002	NA	MANGANESE, TOTAL (UG/L AS MN)	85
DGL 04	9/11/2002	NA	MANGANESE, TOTAL (UG/L AS MN)	210
RDE-1	4/24/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDE-1	6/17/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.02
RDE-1	7/16/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RDE-1	8/29/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RDE-1	10/16/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDE-1	4/30/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.06
RDE-1	6/28/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.02
RDE-1	7/22/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.05
RDE-1	8/11/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDE-1	10/21/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.07
RDE-1	10/21/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDE-1	4/24/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RDE-1	6/17/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.05
RDE-1	7/16/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RDE-1	8/13/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RDE-1	10/16/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDE-1	4/27/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RDE-1	6/16/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.01
RDE-1	7/22/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.01
RDE-1	8/30/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.02
RDE-1	10/13/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.01
RDE-1	4/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDE-1	6/6/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.06
RDE-1	7/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDE-1	8/9/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDE-1	10/9/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDE-2	4/24/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RDE-2	6/17/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.02
RDE-2	7/16/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.02
RDE-2	8/29/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RDE-2	10/16/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RDE-2	4/30/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.05
RDE-2	6/28/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.02
RDE-2	7/22/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.05
RDE-2	8/11/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDE-2	10/21/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.07
RDE-2	4/24/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RDE-2	6/17/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.05
RDE-2	7/16/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04

Water Quality Data
East Fork La Moine River/Spring Lake Watershed

Station ID	Sample Date	Sample Depth (ft)	Parameter	Result
RDE-2	8/14/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RDE-2	10/16/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDE-2	4/27/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.02
RDE-2	6/16/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.01
RDE-2	7/22/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.02
RDE-2	8/30/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.02
RDE-2	10/13/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.02
RDE-2	4/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDE-2	6/6/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.05
RDE-2	7/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RDE-2	8/9/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDE-2	10/9/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDE-3	4/24/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RDE-3	6/17/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.02
RDE-3	7/16/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.02
RDE-3	8/29/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RDE-3	10/16/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDE-3	4/30/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.05
RDE-3	6/28/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RDE-3	7/22/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RDE-3	8/11/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RDE-3	4/24/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RDE-3	6/17/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.02
RDE-3	7/16/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RDE-3	8/13/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDE-3	10/16/1996	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.03
RDE-3	4/27/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.02
RDE-3	6/16/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.01
RDE-3	7/22/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.02
RDE-3	8/30/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.02
RDE-3	10/13/1999	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.01
RDE-3	4/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.05
RDE-3	6/6/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDE-3	7/23/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDE-3	8/9/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDE-3	10/9/2002	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDR-1	5/8/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.07
RDR-1	6/7/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RDR-1	7/2/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.06
RDR-1	8/12/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.05
RDR-1	9/6/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDR-1	10/7/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RDR-1	5/19/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.06
RDR-1	6/23/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RDR-1	7/21/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RDR-1	8/12/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RDR-1	8/24/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.05
RDR-1	9/23/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RDR-1	4/27/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RDR-1	6/7/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDR-1	6/28/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13

Water Quality Data
East Fork La Moine River/Spring Lake Watershed

Station ID	Sample Date	Sample Depth (ft)	Parameter	Result
RDR-1	7/9/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDR-1	7/22/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RDR-1	8/11/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RDR-1	8/24/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDR-1	8/27/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RDR-1	10/5/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RDR-1	10/21/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDR-1	5/23/1994	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.04
RDR-1	6/27/1994	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RDR-1	7/25/1994	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RDR-1	8/31/1994	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDR-1	9/23/1994	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RDR-1	5/21/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDR-1	6/25/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.07
RDR-1	7/23/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RDR-1	8/27/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RDR-1	9/24/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RDR-1	10/29/1997	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDR-1	5/29/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RDR-1	7/29/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.08
RDR-1	8/26/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDR-1	10/20/1998	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDR-2	5/8/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RDR-2	6/7/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.11
RDR-2	7/2/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDR-2	8/12/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.13
RDR-2	9/6/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.24
RDR-2	10/7/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.27
RDR-2	5/19/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RDR-2	6/23/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RDR-2	7/21/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RDR-2	8/24/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDR-2	9/23/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.10
RDR-2	4/27/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.17
RDR-2	6/28/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RDR-2	7/22/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RDR-2	8/24/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RDR-2	10/21/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RDR-2	5/23/1994	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.07
RDR-2	6/27/1994	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.23
RDR-2	7/25/1994	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.19
RDR-2	8/31/1994	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RDR-2	9/23/1994	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RDR-3	5/8/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RDR-3	6/7/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.16
RDR-3	7/2/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.21
RDR-3	8/12/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.29
RDR-3	10/7/1991	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.38
RDR-3	5/19/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.19
RDR-3	6/23/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.19
RDR-3	7/21/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14

Water Quality Data
East Fork La Moine River/Spring Lake Watershed

Station ID	Sample Date	Sample Depth (ft)	Parameter	Result
RDR-3	8/24/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.22
RDR-3	9/23/1992	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.28
RDR-3	4/27/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RDR-3	6/7/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.32
RDR-3	6/28/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.18
RDR-3	7/9/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.12
RDR-3	7/22/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.56
RDR-3	8/11/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RDR-3	8/24/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.21
RDR-3	8/27/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.19
RDR-3	10/5/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RDR-3	10/21/1993	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.14
RDR-3	5/23/1994	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.09
RDR-3	6/27/1994	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.17
RDR-3	7/25/1994	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.29
RDR-3	8/31/1994	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.15
RDR-3	9/23/1994	1	PHOSPHORUS, TOTAL (MG/L AS P)	0.20

Appendix D
Watershed Photographs

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East Fork La Moine River Segment DGL04 at 1400 East Road Looking East

East Fork La Moine River Segment DGL04 at 1400 East Road Looking West

Spring Creek South of Spring Lake Dam

Spring Creek at 1700 North Road Looking Northwest, North of Spring Lake

Spring Creek at 1700 North Road Looking Southeast, North of Spring Lake

Spring Creek Watershed


Spring Lake Dam 2


Spring Lake Dam 3


Spring Lake Dam 3


Geese in Spring Lake


Spring Lake


Spring Lake Boat Docks

Spring Lake North East Cove

Spring Lake West

Block Chute on Lewis Farm in Farmers Fork (East Fork La Moine River Tributary) Watershed

Block Chute on Lewis Farm in Farmers Fork (East Fork La Moine River Tributary) Watershed

Farmers Fork (East Fork La Moine River Tributary) Stream Restoration on Lewis Farm

Farmers Fork (East Fork La Moine River Tributary) East of Route 67 Looking East

Farmers Fork (East Fork La Moine River Tributary) East of Route 67 Looking West

Kepple Creek (East Fork La Moine River Tributary) at 2000 East Road Looking West

Kepple Creek (East Fork La Moine River Tributary) East of 2000 East Road Looking East

Kepple Creek (East Fork La Moine River Tributary) East of 2000 East Road Looking East

Kepple Creek (East Fork La Moine River Tributary) East of 2000 East Road Looking West

Kepple Creek (East Fork La Moine River Tributary) Watershed

Part 2 – Stage Three Report

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Illinois
Environmental
Protection Agency

Stage Three Report
TMDLs and Implementation Plans for Target Watersheds

Project Watershed HUC 0713001003 (East Fork LaMoine River)
Spring Lake (RDR), Argyle Lake (RDE), East Fork LaMoine River (DGL-04)

Prepared by

Baetis
ENVIRONMENTAL SERVICES, INC.
Chicago, Illinois

On behalf of Limno-Tech, Inc., Ann Arbor, Michigan

August 2007

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1.0 INTRODUCTION

1.1 TMDL PROGRAM

Section 303(d) of the 1972 Clean Water Act requires States to define impaired waters and identify them on a list, which is referred to as the 303(d) list. The State of Illinois' 2006 303(d) list is available online at: http://www.epa.state.il.us/water/tmdl/303d-list.html. Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for these listed waterbodies that are not meeting designated uses under technology-based controls. The TMDL process establishes the allowable loading of pollutants or other quantifiable parameters for a water body based on the relationship between pollution sources and instream conditions. This allowable loading represents the maximum quantity of the pollutant that the waterbody can receive without exceeding water quality standards. The TMDL also takes into account a margin of safety, which reflects scientific uncertainty, as well as the effects of seasonal variation. By following the TMDL process, States can establish water quality-based controls to reduce pollution from both point and nonpoint sources, and restore and maintain the quality of their water resources (USEPA, 1991).

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 3 TMDL development for the East Fork LaMoine River/Spring Lake Watershed. Stage 1 was completed in 2006. Stage 2 was not conducted.

The East Fork LaMoine River (IL_DGL-04), Spring Lake (IL_RDR) and Argyle Lake (IL_RDE) are listed on the 2006 Illinois Section 303(d) List of Impaired Waters (IEPA, 2006) as waterbodies that are not meeting their designated uses. As such, they have been targeted for TMDL development. This document presents the TMDLs designed to allow these waterbodies to fully support their designated uses. The report covers each step of the TMDL process and is organized as follows:

- Required TMDL Elements

- Watershed Characterization
- Description of Applicable Standards and Numeric Targets
- Development of Water Quality Models
- Public Participation and Involvement
- Adaptive Implementation Process

1.2 PROBLEM IDENTIFICATION

Three waterbodies in the East Fork LaMoine River watershed have been identified in the 303(d) list as not supporting their designated uses (IEPA, 2006). Two impaired lakes and one impaired stream segment are addressed in this TMDL. These waterbodies are listed below, with the parameters (causes) they are listed for, and the support status of each designated use, as identified in the 303(d) list. TMDLs are currently only being developed for pollutants that have numerical water quality standards. Those causes that are the focus of this report are shown in bold.

East Fork LaMoine River	
Assessment Unit ID	IL_DGL-04
Size	14.17 miles
Cause of Listing	**Manganese**
Use Support Status[1]	Aquatic Life (F), Fish Consumption (F), Public Water Supply (N), Primary Contact (X), Secondary Contact (X), Aesthetics (X)
Spring Lake	
Assessment Unit ID	IL_RDR
Size	277 acres
Cause of Listing	**Phosphorus (total)**, Total Suspended Solids, Nitrogen (Total)
Use Support Status[1]	Aquatic Life (N), Fish Consumption (X), Public Water Supply (F), Primary Contact (X), Secondary Contact (X), Aesthetics (N)
Argyle Lake	
Assessment Unit ID	IL_RDE
Size	95 acres
Cause of Listing	**Phosphorus (total)**, Total Suspended Solids
Use Support Status[1]	Aquatic Life (F), Fish Consumption (F), Primary Contact (X), Secondary Contact (X), Aesthetics (N)

[1] F = Fully supporting, N = Not supporting, X = Not assessed

2.0 REQUIRED TMDL ELEMENTS

USEPA guidance for TMDL development requires TMDLs to contain eleven specific components. Each of those components is summarized below, by waterbody.

2.1 EAST FORK LAMOINE RIVER (IL_DGL-04)

2.1.1 Identification of Waterbody, Pollutant of Concern, Pollutant Sources, and Priority Ranking

The impaired waterbody is a 14.17-mile-segment of the East Fork LaMoine River, HUC 0713001003, identified as segment IL_DGL-04, in McDonough County, Illinois. The pollutant of concern addressed in this report is manganese. Potential sources contributing to the listing of IL_DGL-04 include eroded soils, river bottom sediments, groundwater and bank erosion. The East Fork LaMoine River is reported on the 2006 303(d) list as being in category 5, meaning available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed (IEPA, 2006). This waterbody is considered a medium priority for TMDL development.

2.1.2 Applicable Water Quality Standards and Numeric Water Quality Target

The water quality standard for manganese in Illinois waters designated as public and food processing water supplies is 150 μg/L. For the East Fork LaMoine River TMDL, the target is set therefore set at 150 μg/L.

2.1.3 Loading Capacity and Allocations

A load duration analysis was performed to determine the manganese load capacity (LC) of the river (Table 1). The maximum load to maintain compliance with the water quality standard varies with stream discharge. TMDLs allot the LC to waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and a margin of safety (MOS). There are no permitted point source discharges having manganese permit limits in this watershed. Therefore, the wasteload allocation (WLA) is zero. The balance of the TMDL was allocated to loads (LA) and the margin of safety (MOS). The explicit MOS was set at 10%.

Table 1

IL_DGL-04 MANGANESE TMDL

% Time Flow is Exceeded	Flow (cfs)	LC (lb/d)	LA (lb/d)	MOS (lb/d)
1%	1,276	1030	927	103
5%	434	351	316	35
10%	227	184	165	18
20%	112	90.3	81	9
30%	68	55.3	50	5
40%	45	36.0	32	4
50%	28	22.9	20.6	2.3
60%	17	13.6	12.2	1.4
70%	9	7.5	6.8	0.8
80%	5	4.2	3.8	0.4
90%	2	1.8	1.7	0.2
95%	1	1.0	0.9	0.1
99%	0	0.3	0.26	0.03

2.1.4 Seasonal Variation

The manganese standard is to be met regardless of flow conditions in any season. The load capacity calculations specify target loads for the entire range of flow conditions that occur in the East Fork LaMoine River.

2.1.5 Reasonable Assurance

There are no permitted point sources of manganese in the East Fork LaMoine River watershed, so reasonable assurances for point sources are not discussed herein. For nonpoint sources, Illinois EPA is committed to a number of measures to assure attainment of designated use:

- Convening local experts familiar with nonpoint sources of pollution in the watershed,
- Ensuring that they define priority sources and identify restoration alternatives,
- Developing a voluntary implementation program that includes accountability, and,
- Using the results of future monitoring to conduct adaptive watershed management.

Local agencies and institutions with an interest in watershed management will be important for successful implementation of this TMDL.

2.1.6 Monitoring Plan to Track TMDL Effectiveness

Monitoring is recommended at IL_DGL-04 as part of adaptive implementation. Identification of the significance of groundwater as a source is recommended.

2.1.7 Transmittal Letter

A transmittal letter accompanies the final TMDL report.

2.1.8 Public Participation

A public meeting was held in Macomb on May 30, 2006 during Stage 1. A second public meeting was held in Macomb on July 18, 2007; Appendix E summarizes comments received from all reviewers of the draft TMDL.

2.2 SPRING LAKE (IL_RDR)

2.2.1 Identification of Waterbody, Pollutant of Concern, Pollutant Sources, and Priority Ranking

The impaired waterbody is the 277-acre Spring Lake, HUC 0713001003, identified as segment IL_RDR, in McDonough County, Illinois. The pollutant of concern addressed in this report is total phosphorus. Potential sources contributing to the listing of Spring Lake include runoff from lands used for crop production, forests, and recreation. Spring Lake is reported on the 2006 303(d) list as being in category 5, meaning available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed (IEPA, 2006). This waterbody is considered a medium priority for TMDL development.

2.2.2 Applicable Water Quality Standards and Numeric Water Quality Target

The water quality standard for total phosphorus in Illinois lakes is 50 µg/L (IAC Part 302.205). For the Spring Lake TMDL, the target is set at the water quality criterion for total phosphorus of 50 µg/L.

2.2.3 Loading Capacity – Linking Water Quality and Pollutant Sources

A watershed loading and lake response model determined the phosphorus load capacity of Spring Lake to be 1,398 kg/y (8.4 lb/d).

2.2.4 Wasteload Allocation (WLA)

There is one permitted discharger of phosphorus in the Spring Lake watershed. With a maximum permitted discharge of 0.005 MGD and an assumed phosphorus concentration of 1 mg/L, it discharges 6.9 kg of phosphorus to the lake each year. The WLA is therefore set at 6.9 kg/y.

2.2.5 Load Allocation (LA)

The LA and the MOS are shown below. The LA can be achieved through a 64% reduction in agricultural and urban land phosphorus export.

Table 2

SPRING LAKE PHOSPHORUS TMDL

Component	Allocation
Load Capacity	1,398 kg/y
Wasteload Allocation	6.9 kg/y
Load Allocation	1,264 kg/y
Margin of Safety	127 kg/y

2.2.6 Margin of Safety

The explicit MOS was set at 10% and is reasonable given the uncertainty of the lake response model and implementation success.

2.2.7 Seasonal Variation

The watershed loading and lake response model addresses mean annual conditions, and implicitly represents all seasons. The empirical basis of the lake response model includes lakes in all trophic states and all seasons, including summer, when phosphorus loads from spring runoff nurture algal blooms.

2.2.8 Reasonable Assurance

There is one permitted point source discharge of phosphorus in the Spring Lake watershed. In terms of reasonable assurances for point sources, Illinois EPA administers the NPDES permitting program for treatment plants, stormwater permitting and CAFO permitting. The permit for the point source discharger will be modified if necessary as part of the permit review process (typically every 5 years), to ensure that it is consistent with the applicable wasteload allocation.

For nonpoint sources, Illinois EPA is committed to a number of measures to assure attainment of designated use:

- Convening local experts familiar with nonpoint sources of pollution in the watershed
- Ensuring that they define priority sources and identify restoration alternatives
- Developing a voluntary implementation program that includes accountability
- Using the results of future monitoring to conduct adaptive management

Local agencies and institutions with an interest in watershed management will be important for successful implementation of this TMDL. Also, by reducing phosphorus loads to the lake, total suspended solids and chlorophyll a concentrations will be reduced as well.

2.2.9 Monitoring Plan to Track TMDL Effectiveness

Ongoing IEPA lake monitoring activities are sufficient to determine effectiveness of the TMDL implementation program at restoration of designated uses.

2.2.10 Transmittal Letter

A transmittal letter accompanies the final TMDL report.

2.2.11 Public Participation

A public meeting was held in Macomb during Stage 1. A second public meeting was held in Macomb on July 18, 2007; Appendix E summarizes comments received from all reviewers of the draft TMDL.

2.3 ARGYLE LAKE (IL_RDE)

2.3.1 Identification of Waterbody, Pollutant of Concern, Pollutant Sources, and Priority Ranking

The impaired waterbody is the 95-acre Argyle Lake, HUC 0713001003, identified as segment IL_RDE, in McDonough County. The pollutant of concern addressed in this report is total phosphorus. Potential sources contributing to the listing of Argyle Lake include runoff from lands used for crop production, forests, and recreation. Argyle Lake is reported on the 2006 303(d) list as being in category 5, meaning available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed (IEPA, 2006). This waterbody is considered a medium priority for TMDL development.

2.3.2 Applicable Water Quality Standards and Numeric Water Quality Target

The water quality standard for total phosphorus in Illinois waters designated for general use is 50 µg/L (IAC Part 302.205). For the Argyle Lake TMDL, the target is set at the water quality criterion for total phosphorus of 50 µg/L.

2.3.3 Loading Capacity – Linking Water Quality and Pollutant Sources

A watershed loading and lake response model was developed to determine the phosphorus load capacity of Argyle Lake. The maximum load to maintain compliance with the water quality standard is 472 kg/y (2.85 lb/d).

2.3.4 Allocations

There are no permitted dischargers of phosphorus in the watershed, so the WLA is zero and the load capacities are allocated to the LAs and the MOS. The LA can be achieved through a 17% reduction in phosphorus export from agricultural lands in the watershed.

Table 3

ARGYLE LAKE TMDL

Component	Allocation
Load Capacity	472 kg/y
Wasteload Allocation	0 kg/y
Load Allocation	429 kg/y
Margin of Safety	43 kg/y

2.3.5 Margin of Safety

The explicit MOS was set at 10% of the LC and is reasonable given the uncertainty of the lake response model.

2.3.6 Seasonal Variation

The watershed loading and lake response model addresses mean annual conditions, and implicitly represents all seasons. The empirical basis of the lake response model includes lakes in all trophic states and all seasons, including summer, when phosphorus loads from spring runoff nurture algal blooms.

2.3.7 Reasonable Assurance

There are no permitted point sources of phosphorus in the Argyle Lake watershed, so reasonable assurances for point sources are not discussed herein. For nonpoint sources, Illinois EPA is committed to a number of measures to assure attainment of designated use:

- Convening local experts familiar with nonpoint sources of pollution in the watershed
- Ensuring that they define priority sources and identify restoration alternatives
- Developing a voluntary implementation program that includes accountability
- Using the results of future monitoring to conduct adaptive management

Local agencies and institutions with an interest in watershed management will be important for successful implementation of this TMDL. Also, by reducing phosphorus loads to the lake, total suspended solids and chlorophyll a concentrations will be reduced as well.

2.3.8 Monitoring Plan to Track TMDL Effectiveness

Ongoing IEPA lake monitoring activities are sufficient to determine effectiveness of the TMDL implementation program at restoration of designated uses.

2.3.9 Transmittal Letter

A transmittal letter accompanies the final TMDL report.

2.3.10 Public Participation

A public meeting was held in Macomb during Stage 1. A second public meeting was held in Macomb on July 18, 2007; Appendix E summarizes comments received from all reviewers of the draft TMDL.

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3.0 WATERSHED CHARACTERIZATION

A description of the East Fork LaMoine River watershed to support the identification of sources contributing to the listed impairments was initiated in Stage 1. Some additional watershed characterization and clarification was necessary to develop the TMDL, and is presented in this chapter.

3.1 EAST FORK LAMOINE RIVER (IL_DGL-04)

The IEPA monitors this waterbody at the Ambient Water Quality Monitoring Network (AWQMN) Station DGL-04 near Macomb, Illinois. The watershed defined by this monitoring point is shown in Figure 1. This 149-square mile area is 96% agricultural uses (Table 4). It includes three treated wastewater discharges owned by the Bushnell, Bardolph and Good Hope.

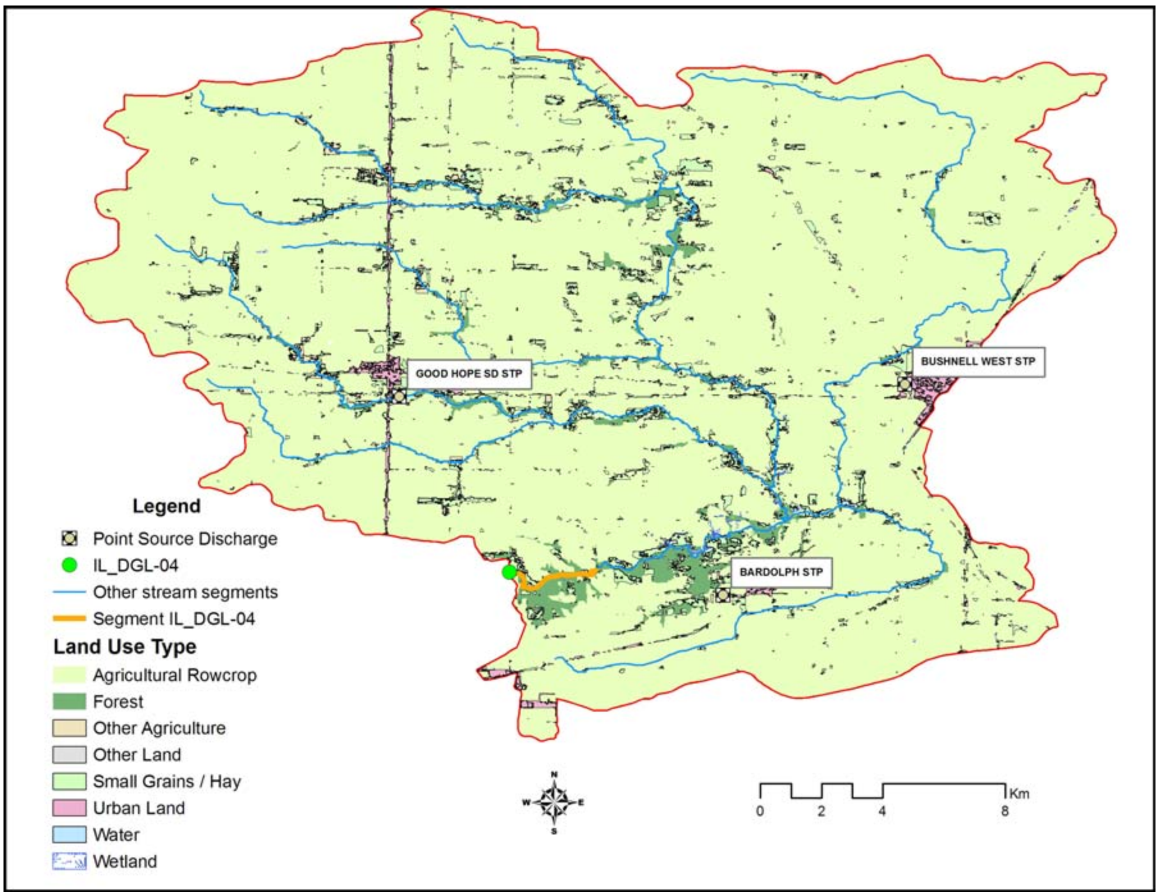

Figure 1. Land Use and Point Source Discharges in the IL_DGL-04 Watershed.

The long-term average precipitation for the watershed, as recorded at the Macomb Airport 1991-2006, is 34.9 inches per year (0.89 m). Long-term unit runoff, as transposed from a gage at Colmar, Illinois (USGS 05584500) is 9.4 inches per year (0.24 m). There are only two active stream gages in the LaMoine watershed, one at Colmar and the other at Ripley. The Colmar gage is much closer to Macomb and is a more accurate depiction of hydrology there than the Ripley gage. Flow duration statistics, transposed from data collected at Colmar, are given in Table 5. The 7-day 10-year low flow at DGL-04 is zero.

Table 4

LAND USE IN THE IL_DGL-04 WATERSHED

Land Use Type	**Acres**
Small Grains / Hay	4,946
Agricultural Rowcrops	85,687
Other Agriculture	483
Wetland	109
Forest	2,763
Water	60
Other Land	15
Urban Land	1,288
Undefined Area	21
Total	95,373

Table 5

FLOW DURATION STATISTICS AT IL_DGL-04

Percentile	Discharge (cfs)
0.01%	5022
1%	1276
5%	434
10%	227
20%	112
30%	68
40%	45
50%	28
60%	17
70%	9
80%	5
90%	2
95%	1
99%	0

The 2006 integrated water quality report and 303(d) list indicates the sources of manganese in the watershed are unknown (IEPA, 2006). The Stage One Report references a NPDES permitted discharge (IL0074161), a landfill which discharges treated groundwater containing manganese, but this was found to be erroneous. The landfill discharge is downstream of IL_DGL-04.

Active or abandoned coal mines can be a source of manganese in surface waters. While there are records of coal mines in the watershed, all records are downstream of IL_DGL-04.

Manganese is a common component in soils, and solubility is increased at slightly acid pH values (Bohn *et al.,* 1979). Soil pH, drainage, phosphate availability, texture and other factors affect manganese fate and transport in soils. Soil erosion, groundwater seeps, and possibly tile drains are all likely sources of manganese at IL_DGL-04.

3.2 SPRING LAKE (IL-RDR)

The IEPA monitors Spring Lake at three stations RDR-1, RDR-2, and RDR-3, shown in Figure 2. Spring Lake is a water supply reservoir for the City of Macomb. Land use/land cover in the watershed upstream of the dam is shown in Figure 2. Eighty-five percent (85%) of the 21-square-mile watershed is used for agricultural production, largely corn and soybeans.

Table 6

LAND USE IN THE SPRING LAKE WATERSHED

Land Use	Acres
Small Grains / Hay	1,170
Agricultural Rowcrops	10,112
Other Agriculture	147
Wetland	17
Forest	1,577
Urban Land	181
Water	284
Other Land	3
Undefined Area	1
Total	13,492

There is one permitted wastewater discharge in the watershed. West Prairie High School in Sciota, Illinois discharges to an unnamed tributary of Spring Lake. NPDES Permit No. IL0053619 was reissued in April 2006 for a design average flow of 0.002 million gallons per day (MGD) and a maximum daily flow of 0.005 MGD. The load limits for the treatment facility were not increased for this reissue. Discharge monitoring reports from June 2006 through March 2007 indicate that the average effluent flow is 0.0021 MGD. No phosphorus concentration data are available for this effluent.

3.3 ARGYLE LAKE (IL_RDE)

The IEPA monitors Argyle Lake at three stations RDE-1, RDE-2, and RDE-3, shown in Figure 2. Argyle Lake is a recreation reservoir owned by the State of Illinois. About two-thirds (67%) of the 6.3-square-mile watershed is used for agricultural production (Table 7).

Table 7

LAND USE IN THE ARGYLE LAKE WATERSHED

Land Use	**Acres**
Small Grains / Hay	328.9
Agricultural Rowcrops	2,356.9
Other Agriculture	11.2
Wetland	19.2
Forest	1,170.5
Water	114.4
Other Land	0.9
Urban Land	6.2
Undefined Area	0.4
Total	4,008.5

The Stage One Report indicated that one NPDES permitted treatment plant discharged in the Argyle Lake watershed. We found this to be erroneous. There are no permitted wastewater discharges in the watershed.

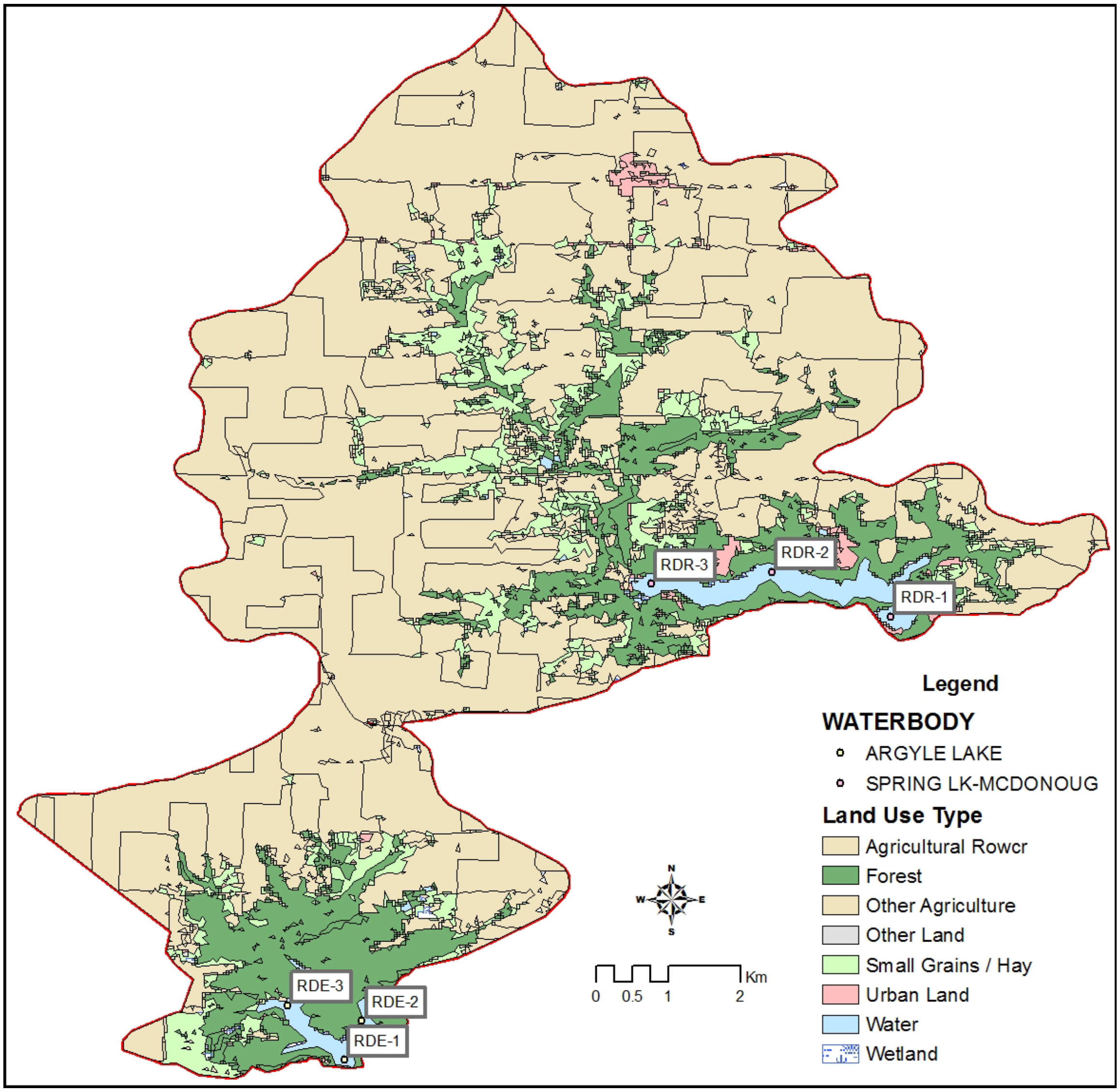

Figure 2. Land Use in the Spring Lake (RDR) and Argyle Lake (RDE) Watersheds.

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4.0 APPLICABLE STANDARDS AND NUMERIC TARGETS

The goal of TMDL development is to achieve attainment with water quality standards. A water quality standard consists of the designated uses of the waterbody, water quality criteria to protect designated uses, and an antidegradation policy to maintain and protect existing uses and high quality waters. Water quality criteria are sometimes in a form that are not directly amenable for use in TMDL development and may need to be translated into a target value for TMDLs. This section discusses the applicable designated uses, use support, criteria and TMDL targets for the three impaired waterbodies in the East Fork LaMoine River watershed.

4.1 DESIGNATED USES AND USE SUPPORT

Water quality assessments in Illinois are based on a combination of chemical (water, sediment and fish tissue), physical (habitat and flow discharge), and biological (macroinvertebrate and fish) data. Illinois EPA conducts its assessment of waterbodies using a set of seven designated uses: aquatic life, aesthetic quality, indigenous aquatic life, primary contact, secondary contact, public and food processing water supply, and fish consumption (IEPA, 2006). For each waterbody, and for each designated use applicable to the waterbody, Illinois EPA's assessment concludes that the waterbody either "fully supports" the use or that it is non-supporting of the designated use.

Water bodies assessed as "Not Supporting" for any designated use are identified as impaired and are placed on the 303(d) list. Potential causes and sources of impairment are also identified for the impaired waters (IEPA, 2006).

4.2 WATER QUALITY CRITERIA

Illinois has established water quality criteria for allowable concentrations of manganese, total phosphorus, and other pollutants. The standard for total manganese in untreated public water supplies is 0.15 mg/L (150 µg/L) (IAC 302.304). The standard for total phosphorus in lakes or streams entering lakes is 0.05 mg/L (50 µg/L) (IAC 302.205).

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5.0 DEVELOPMENT OF WATER QUALITY MODELS

Water quality models are used in the TMDL development process to define the relationship between external pollutant loads and the resulting concentrations in receiving waters. The Stage 1 Report made some model recommendations but these have been revised due to the cancellation of Stage 2 field data collection and unavailability of some data.

5.1 MANGANESE

Manganese loads in the East Fork LaMoine River were analyzed using an empirically-based technique referred to as a load duration analysis, first utilized for TMDL development by the Kansas Department of Health and Environment (Stiles, 2001). The load duration curve approach pairs historic streamflow data with water quality measurements to gain insight into the flow conditions resulting in stream use impairment, that is, exceedances of the water quality standard. This approach allows for the identification of broad categories of sources over the entire range of flows, and the extent of controls required from these source categories to attain stream use support. A load duration curve is developed by:

1. Transposing flow data from the Colmar gage upstream to IL_DGL-04 using the watershed area ratio method, ranking the daily flow data from lowest to highest, calculating the percent of days these flows were exceeded, and graphing the results. This produces a flow duration curve;
2. Translating the resulting flow duration curve into a load duration curve by multiplying the flows by the water quality target (150 μg/L); and,
3. Overlaying observed pollutant loads (measured concentrations multiplied by stream discharge) on the same graph.

Observed manganese loads that fall above the curve exceed the water quality target, while those that fall on or below the line are in compliance. An analysis of the observed loads relative to the flow duration interval provides information on whether the pollutant source is point or nonpoint in nature.

Figure 3 is a manganese load duration curve; the computation details are presented in Appendix A. The S-shaped curve represents the 150 μg/L water quality target, calculated as the product of the 150 μg/L criterion and the flow duration interval. Manganese load as measured by the Agency at DGL-04 are shown as squares. Load measurements above the target load indicate an exceedance of the water quality standard at a given flow interval. The relative distance of the measured load data points from the target curve reflects the necessary reduction in manganese loads required to attain use support and becomes the basis for the TMDL.

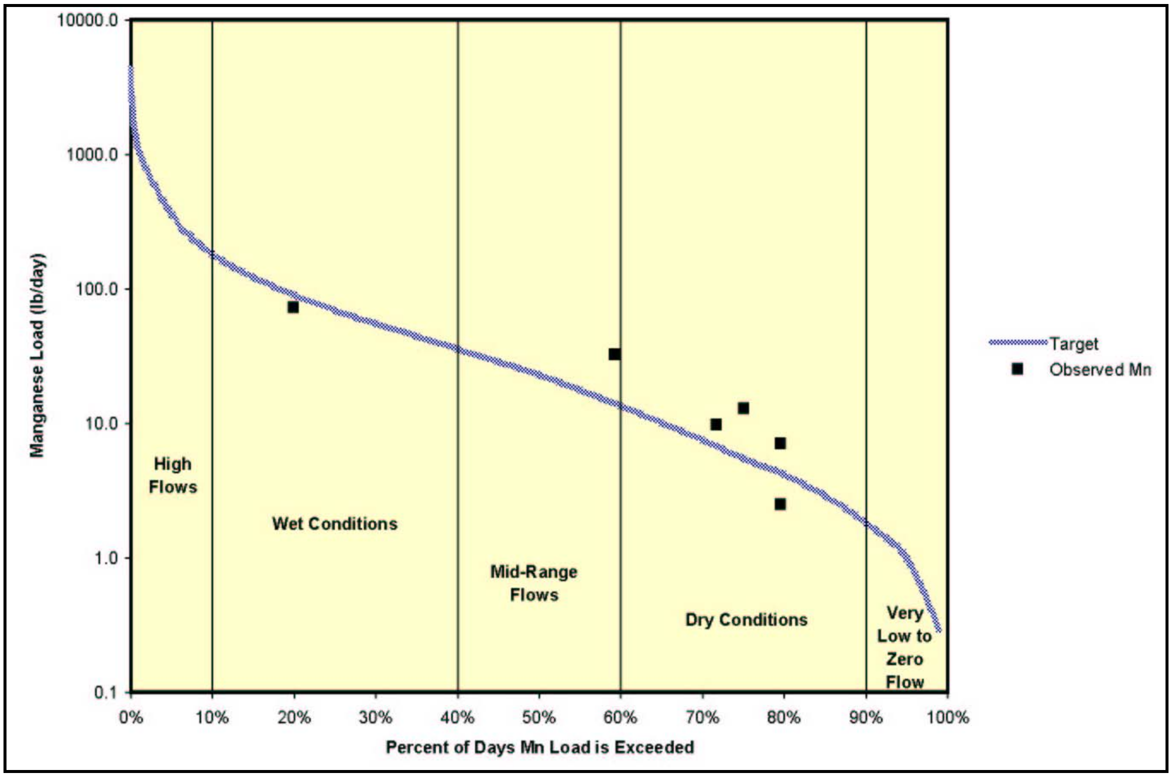

Figure 3. Manganese Load Duration Curve (IL_DGL-04).

5.2 PHOSPHORUS

The procedure for modeling phosphorus loading and lake response recommended by the Stage 1 Report was discarded in favor of the lake modeling/uncertainty analysis approach of Reckhow and Chapra (1983). The selected procedure uses unit areal loading rates (or export coefficients) to estimate watershed non-point phosphorus sources to a lake, and a steady-state solution of the lake phosphorus mass balance equation (Eq. 1) incorporating flushing and settling as phosphorus sinks:

$$P = \frac{L}{v_s + q_s} \tag{1}$$

where P is the steady-state mean lake phosphorus concentration, L is the annual areal phosphorus loading, v_s is the apparent phosphorus settling velocity, and q_s is the areal water loading. Using data from 47 north temperate lakes, collected during the National

Eutrophication Survey (NES), Reckhow regressed v_s on $q_{s,}$, reducing the number of variables and deriving Equation 2:

$$P = \frac{L}{11.6 + 1.2 q_s} \qquad (2)$$

This model allows an estimate of mean annual lake phosphorus concentration based upon estimated (or measured) phosphorus and water loads. The model is applicable to Argyle and Spring Lakes because of their geographic location, and, because the estimated *P*, *L* and q_s are within the ranges of the values in the NES dataset used by Reckhow in his derivation of Equation 2. Development of the TMDL involves available watershed data to define current loads to the lake, and using the above regression model to define the response of the lake to phosphorus loadings. Calibration is then performed to match lake water quality observations.

Model inputs included the land use data (Tables 6 and 7), hydrologic data (Table 8) and estimates of phosphorus wasteloads. Unit areal phosphorus loads were selected based upon land use/land cover, topography and soils from a compilation by Reckhow *et al*. (1980), and subsequently used as calibration variables so that the predicted mean annual phosphorus concentration reasonably matched measured concentrations. Relative levels of phosphorus unit areal loads are mapped in Figure 4.

Table 8

LAKE RESPONSE MODEL INPUTS

Waterbody ID	RDE	RDR
Waterbody Name	Argyle	Spring
Lake Area	400,973 m^2	1,019,751 m^2
Mean Net Precipitation	0.48 m/yr	0.48 m/yr
Annual Unit Runoff	0.24 m/y	0.24 m/yr
Lake Inflow	3,983,350 m^3/yr	13,327,938 m^3/yr
Areal Water Loading	9.934 m/yr	13.070 m/yr

The inputs and outputs for the watershed loading and lake response modeling are reprinted in Appendix B. The estimated loads and wasteloads from identified sources are tabulated below. The wasteload from West Prairie High School to Spring Lake was estimated as the product of maximum design flow and an assumed 1 mg/L phosphorus concentration. The high school's wasteload is 0.2% of the estimated total phosphorus loadings to Spring Lake.

The sum of the existing loads and waste loads (Table 9), together with areal water loads, is used in Equation 2 to derive estimated mean annual lake phosphorus concentrations. These estimates reflect existing conditions. Reckhow and Chapra's procedure includes an analysis of uncertainty in the form of prediction intervals. Table 10 includes the predicted means and 90% prediction intervals, and in comparison to the observations, the models are quite reasonable and validate the use of this model for developing the phosphorus TMDLs.

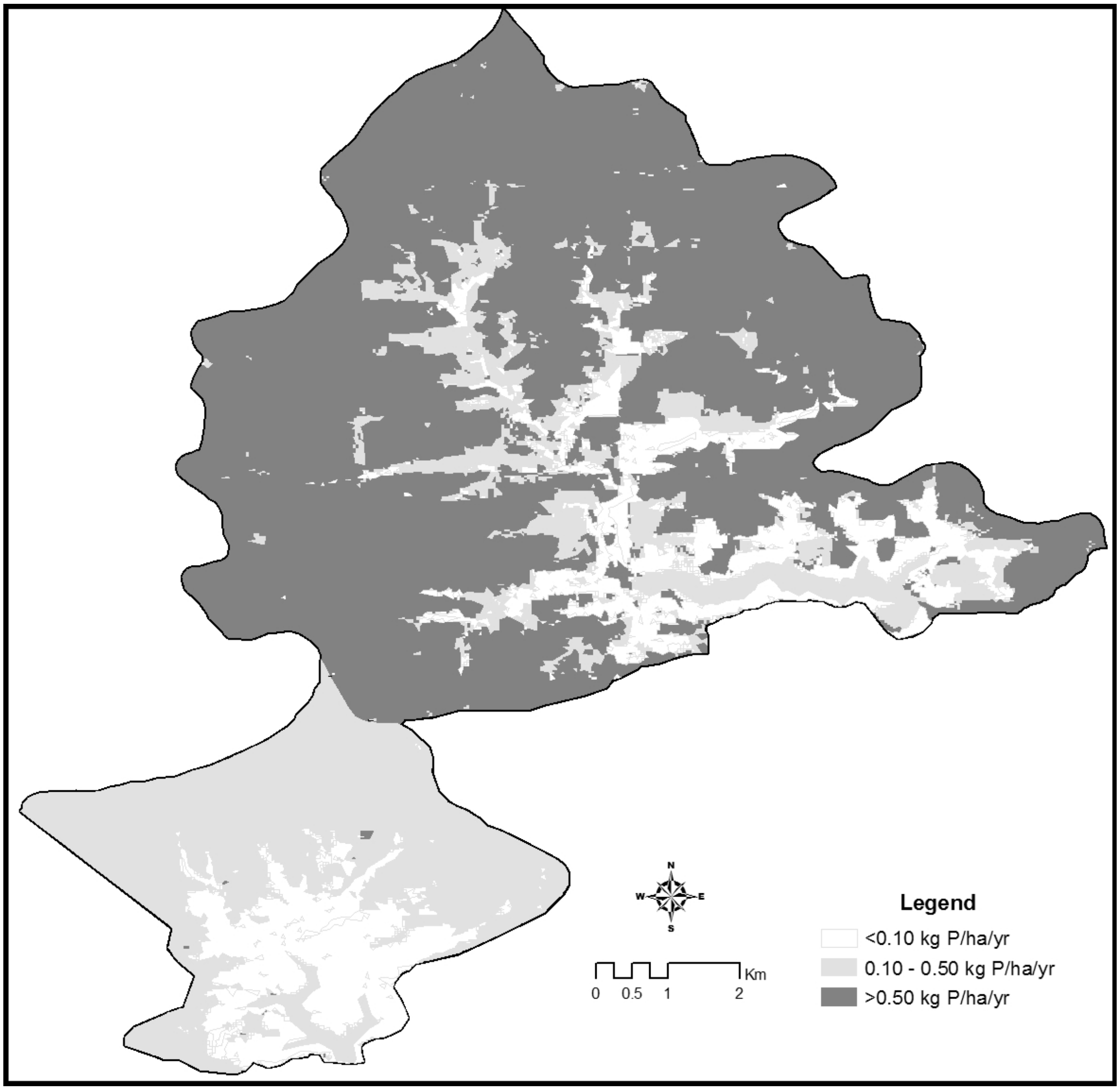

Figure 4. Phosphorus Unit Areal Loads in the Spring and Argyle Lakes Watersheds.

Table 9

PHOSPHORUS LOADS AND WASTELOADS (KG/YR)

Source	Argyle Lake	Spring Lake
Atmosphere	6.4	16
Small Grains and Hay Fields	47	237
Agricultural Rowcrops	429	3,069
Other Agriculture	1.6	21
Wetland	0.4	0.3
Forest	24	32
Water	0.3	0.7
Other Land	0.2	0.6
Urban Land	1.6	47
Unknown Land Use	0.1	0.2
Wasteloads	0	6.9
Total	510	3,431

Table 10

VERIFICATION OF LAKE PHOSPHORUS MODELS

	Argyle Lake	Spring Lake
Predicted Mean Concentration	0.054 mg/L	0.123 mg/L
90% Prediction Interval	(0.025 mg/L, 0.107 mg/L)	(0.081 mg/L, 0.167 mg/L)
Mean Observed Concentration	0.042 mg/L	0.145 mg/L
90% Confidence Interval	(0.036 mg/L, 0.047 mg/L)	(0.132 mg/L, 0.157 mg/L)

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6.0 TOTAL MAXIMUM DAILY LOADS

This section presents the development of the Total Maximum Daily Loads for the East Fork LaMoine River, Spring Lake, and Argyle Lake. This chapter presents the calculation of load capacities, the allocation of load capacities among point sources, non-point sources, and the margin of safety, and a discussion of critical conditions and seasonality.

6.1 MANGANESE

A load duration calculation approach was applied to support development of manganese (Mn) TMDL for East Fork LaMoine River, as described in the prior chapter.

6.1.1 Calculation of Load Capacity

The load capacity is defined as the maximum pollutant load that a waterbody can receive and still maintain compliance with water quality standards. The manganese load capacity was defined over a range of specified flows for the East Fork LaMoine River. The allowable load capacity was computed by multiplying flow by the water quality standard (150 µg/L). The manganese load capacity, which varies with stream discharge, is presented below.

Table 11

NORTH FORK LAMOINE RIVER(IL_DGL-04) MANGANESE LOAD CAPACITY

% Time Flow is Exceeded	Discharge (cfs)	Load Capacity (lb/d)
1%	1,276	1,030
5%	434	351
10%	227	184
20%	112	90.3
30%	68	55.3
40%	45	36.0
50%	28	22.9
60%	17	13.6
70%	9.3	7.5
80%	5.2	4.2
90%	2.3	1.8
95%	1.2	1.0
99%	0.4	0.3

The observed exceedances of the manganese water quality criterion occurred at and below mid-range flows (Figure 3). Up to a 56% reduction in manganese is needed to meet the 150 µg/L water quality target.

6.1.2 Allocation

A TMDL consists of waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and a margin of safety (MOS). There are no permitted dischargers of manganese in the watershed and the WLA is therefore zero. The remainder of the loading capacity is given to the load allocation for nonpoint sources and the margin of safety (Table 12).

Table 12

MANGANESE TMDL FOR IL_DGL-04

% Time Flow is Exceeded	Flow (cfs)	LC (lb/d)	LA (lb/d)	MOS (lb/d)
1%	1,276	1030	927	103
5%	434	351	316	35
10%	227	184	165	18
20%	112	90.3	81	9
30%	68	55.3	50	6
40%	45	36.0	32	4
50%	28	22.9	20.7	2.3
60%	17	13.6	12.2	1.4
70%	9	7.5	6.8	0.8
80%	5	4.2	3.8	0.4
90%	2	1.8	1.7	0.2
95%	1	1.0	0.9	0.1
99%	0	0.3	0.26	0.03

6.1.3 Critical Condition

TMDLs must take into account critical environmental conditions so that the water quality is protected during times when it is most vulnerable. Figure 3 is a graphical depiction of the observed Mn loads compared to the load capacity, showing that exceedances of the TMDL target occur at mid and low flow conditions. TMDL development utilizing the load duration approach applies to the full range of flow conditions; therefore critical conditions are implicitly included.

6.1.4 Seasonality

This TMDL was conducted with an explicit consideration of seasonal variation. The manganese standard will be met in any season. The load capacity calculations specify target loads for the entire range of flow conditions that are possible to occur in the river.

6.1.5 Margin of Safety

TMDLs are required to contain a margin of safety (MOS) to account for any uncertainty concerning the relationship between pollutant loading and receiving water quality. The MOS can be either implicit (e.g., incorporated into the TMDL analysis through conservative assumptions), or explicit (e.g., expressed in the TMDL as a portion of the loading), or expressed as a combination of both. The manganese TMDL contains an explicit MOS of 10%. This margin of safety addresses potential uncertainty in the effectiveness of load reduction alternatives. This MOS can be reviewed in the future as new data are made available on manganese loads at DGL-04.

6.2 PHOSPHORUS

The previous chapter presented the development of watershed loading and lake response models for Spring and Argyle Lakes. This chapter applies this model to the targeted watersheds for development of phosphorus TMDLs.

6.2.1 Calculation of Load Capacities

The phosphorus load capacities for the two lakes were defined using a model of mean annual conditions. The loading capacity was determined by reducing unit areal phosphorus loads by type until the predicted lake response demonstrated attainment with the TMDL target. The maximum areal load that resulted in compliance with water quality standards was used as each lake's load capacity (Table 13).

Table 13

PHOSPHORUS LOAD CAPACITY

Waterbody	Load Capacity
Spring Lake (RDR)	1,398 kg/y (8.4 lb/d)
Argyle Lake (RDE)	472 kg/y (2.9 lb/d)

6.2.2 Allocations

As indicated earlier, TMDLs include waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and a margin of safety (MOS). There are no permitted dischargers of phosphorus in Argyle Lake's watershed, so the WLA is zero and the load capacities are allocated to the LAs and the MOS (Table 14). There is a single permitted discharge in the Spring Lake watershed.

Table 14

PHOSPHORUS TMDLS FOR SPRING AND ARGLYE LAKES

Component	Argyle Lake (RDE)		Spring Lake (RDR)	
	Annual	Daily	Annual	Daily
Load Capacity	472 kg/y	1,293 g/d	1,398 kg/y	3,831 g/d
Wasteload Allocation	0 kg/y	0 g/d	6.9 kg/y	19 g/d
Load Allocation	429 kg/y	1,175 g/d	1,264 kg/y	3,464 g/d
Margin of Safety	43 kg/y	118 g/d	127 kg/y	348 g/d

6.2.3 Seasonality and Critical Conditions

The watershed loading and lake response models address mean annual conditions, and implicitly represents all seasons. The empirical basis of the lake response model includes lakes in all trophic states and all seasons, including summer, when phosphorus loads from spring runoff nurture algal blooms.

Pragmatically, the critical condition for loading is generally in the spring when spring runoff events wash sediment, organic materials, and associated phosphorus into the lakes. However, lake response is not immediate and is seasonal; the critical condition for water quality impacts is during summer, when high water temperatures and phosphorus availability causes algal blooms.

6.2.4 Margins of Safety

The phosphorus TMDLs each contain an explicit margin of safety of 10%. The 10% margin of safety is considered an appropriate value based upon the generally good agreement between the water quality models predicted values and observed values. Since the model reasonably reflects the conditions in the watershed, a 10% margin of safety is considered to be adequate to address the uncertainty in the TMDL, based upon the data available, as well as the success of implementation projects.

7.0 IMPLEMENTATION PLAN

TMDLs have been developed for the East Fork LaMoine River watershed to address manganese impairments in the river (IL_DGL-04) and phosphorus impairments in Spring Lake (RDR) and Argyle Lake (RDE). The TMDLs determined that significant reductions in existing pollutant loadings are needed to restore designated uses and meet water quality standards. Implementing BMPs to reduce phosphorus in Spring and Argyle Lakes will reduce total suspended solids in these waterbodies as well.

The next step in the TMDL process is to develop a voluntary implementation plan that includes accountability, reasonable assurances for success, and the potential for adaptive management. This document identifies a number of alternative actions to be considered by local stakeholders for TMDL implementation; these alternative actions are summarized, and recommendations are presented for implementation actions and additional monitoring.

7.1 EXISTING CONTROLS

The local Natural Resource Conservation Service (NRCS), Farm Service Agency (FSA), and Soil and Water Conservation District (SWCD) offices have information on existing best management practices (BMPs) within the watershed, and can be contacted to understand what efforts have been made or are planned to control nonpoint sources. The NRCS routinely works with individual landowners to implement small-scale BMPs on their properties. However, the agencies generally treat BMPs on private lands as confidential projects.

The LaMoine River Ecosystem Partnership (information at http://www.lamoineriver.org) has written a watershed plan (currently being updated) and has several ongoing nonpoint source control projects (Boeckler and Bricker, 2006) including a livestock inventory and streambank and gully erosion BMP implementation. This stakeholder group could serve to coordinate the implementation of this TMDL.

A watershed plan was prepared for Argyle Lake in 1993, but the projects recommended were not implemented (McDonough County SWCD, 1993). Consultation with the SWCD indicates a number of BMPs have been implemented in the three targeted watersheds and more are being planned. But, much work remains to be done, most notably addressing eroding stream banks. The District has recently begun development of a watershed plan for Spring Lake.

7.2 IMPLEMENTATION APPROACH

The approach to be taken for TMDL development and implementation is based upon discussions with Illinois EPA and its Scientific Advisory Committee. The approach consists of the following steps, with the first three steps corresponding to TMDL development and the latter two steps corresponding to implementation:

1. Use existing data to define overall existing pollutant loads, as opposed to developing a watershed model that might define individual loading sources.
2. Apply relatively simple tools to define the load-response relationship and define the maximum allowable pollutant load that the waterbodies can assimilate and still attain water quality standards.
3. Compare the maximum allowable load to the existing load to define the extent to which existing loads must be reduced in order to meet water quality standards.
4. Develop a voluntary implementation plan that includes both accountability and the potential for adaptive management.
5. Carry out adaptive management through the implementation of a long-term monitoring plan designed to assess the effectiveness of pollution controls as they are implemented, as well as progress towards attaining water quality standards.

This approach is intended to accelerate the pace at which TMDLs are being developed for sites dominated by nonpoint sources, which will allow implementation activities (and water quality improvement) to begin sooner. The approach also places decisions on the types of nonpoint source controls to be implemented at the local level, which will allow those with the best local knowledge to prioritize sources and identify restoration alternatives.

The adaptive management approach to be followed recognizes that water quality models are approximations, and that there is never enough data to completely remove uncertainty. The adaptive process allows watershed managers to proceed with initial decisions based on modeling, and then to update these decisions as experience and knowledge improve.

7.3 IMPLEMENTATION ALTERNATIVES

This section identifies the range of potential alternatives to reduce manganese and phosphorus loadings in the targeted watersheds. The primary sources of phosphorus are runoff from agricultural rowcrops, including soil erosion; the relative amounts of other phosphorus sources can be reviewed in Appendix B. For manganese, the primary sources are natural sources, including soils and groundwater. Manganese reductions are needed during mid- to low flow conditions. Soils naturally enriched in manganese can settle in the river and contribute to manganese exceedances during low flow, when colloidal manganese and, if anoxia develops, dissolved manganese, are in the water column. The extent to which these forms of manganese and chemical release mechanisms contribute to the exceedances of manganese is not known; however, controls targeted at reducing wet weather loads of sediment and manganese may also reduce sedimentation and subsequent release of soluble manganese during low flow periods. Because it is difficult to control groundwater sources, and phosphorus is transported with eroded materials, the identified implementation alternatives focus on measures to reduce erosion, namely:

- Conservation Tillage
- Conservation Buffers
- Wetland Restoration
- Sediment Control Structures
- Streambank Protection
- Grassed Waterways

In addition, inactivation of internal phosphorus loads and nutrient management planning for the Spring Lake and Argyle Lake watersheds is addressed. These alternatives are described briefly below, including their general costs and effectiveness in reducing manganese and phosphorus loadings of the impaired waters. Note that there is usually a wide range in the effectiveness of the various practices; this is largely due to variations in climate, soils, topography, design, construction, and maintenance of the practices.

7.3.1 Conservation Tillage

Conservation tillage provides profitable crop production while minimizing soil erosion (UIUC, 2005). The Illinois Agronomy Handbook defines conservation tillage as as any crop production system that provides either (1) a residue cover of at least 30 percent after planting to reduce soil erosion due to water or (2) at least 1,000 pounds per acre of flat, small-grain residues (or the equivalent) on the soil surface to reduce wind erosion. The most recent Illinois Soil Transect Survey (IDOA, 2006) suggests that 65% of the land under corn production in McDonough County is farmed using reduced till, mulch till, or no till. Additional conservation tillage measures should be considered as part of this implementation plan.

Conservation tillage practices have been reported to reduce sediment loads by 75%. A wide range of costs has been reported for conservation tillage practices, ranging from $12/acre to $83/acre in capital costs (EPA, 2003). For no-till, costs per acre provided in the Illinois Agronomy Handbook for machinery and labor range from $36 to $66 per acre, depending on the farm size and planting methods used (UIUC, 2005). In general, the total cost per acre for machinery and labor decreases as the amount of tillage decreases and farm size increases.

7.3.2 Conservation Buffers

Conservation buffers are strips of land in permanent native vegetation that help control pollutants (NRCS, 1999). Filter strips, riparian buffers, grassed waterways, contour strips are all examples of conservation buffers. All types of conservation buffers are voluntarily implemented.

Ancillary benefits of conservation buffers include fish and wildlife habitat and improved instream dissolved oxygen by promoting increased infiltration and baseflow, and lowering stream temperature.

Vegetated filter strips and riparian buffers can reduce suspended solids and associated pollutants in runoff under wet hydrologic conditions.

7.3.3 Wetland Restoration

Wetland restoration involves the rehabilitation of a drained or degraded wetland to its natural condition, including its vegetation, soils and hydrology. Wetland restoration can be an effective BMP for reducing loading of sediments, nutrients, and other pollutants (Johnston *et al*., 1990; Braskerud, *et al*., 2005). Wetlands reduce phosphorus concentrations through sedimentation as well as biological assimilation.

Currently there are hundreds of acres of hydric soils in the East Fork Lamoine River watershed that are not developed, forested or already have wetland hydrology and vegetation. These are potential areas where wetlands could be restored.

A wetland restoration project may be as simple as breaking drain tiles and blocking drain ditches, or it may require more engineering effort to restore hydrology and hydric vegetation communities. In addition to improving water quality, wetland restoration provides additional benefits for flood control, habitat, and recreation.

Costs for wetland restoration vary widely, depending on the acreage, the nature of the work, and land/easement costs. However, a general unit cost of $500 to $1,200 per acre has been suggested (FWS, 2006) for simple restoration projects in Illinois.

7.3.4 Sediment Control Structures

Sediment control basins trap sediments and associated pollutants before they reach surface waters. Because the manganese and phosphorus impairments have been attributed to contributions from eroded soils, sediment control basins could help restore the impaired waterbodies. Costs and sediment trapping efficiencies for these basins can vary widely depending on location, size and retention time, layout, and other factors.

7.3.5 Streambank Protection

The 1993 watershed plan – environmental assessment for Argyle Lake indicated that about one-third of soil erosion in the watershed is derived from streambank incision and gully erosion (McDonough County SWCD, 1993). Reconnaissance indicates that this is likely a reasonable approximation of much of the East Fork LaMoine River watershed, and streambank erosion control measures would aid restoration of the impaired waterbodies.

Streambank erosion control structures include rock riffle grade controls, bank riprap and biotechnical controls, and stone toe protection. Costs will range widely, depending on the selected structure, bank height, and many other factors. Because of the potential cost of stabilizing streambanks throughout the watershed, additional study is recommended to prioritize sites for streambank stabilization. Such study should include direct observation and mapping of bank conditions, as well as an assessment of stream hydraulics and geomorphology to support identification and design of effective stabilization measures.

7.3.6 Grassed Waterways

Grassed waterways are natural or constructed channels planted with suitable vegetation to reduce erosion (NRCS, 2000). Grassed waterways convey runoff with minimal erosion or flooding and reduce downstream pollutant loads. They may be used in combination with conservation buffers, and are effective at reducing sediment delivery up to 95% (Fiener and Auerswald, 2003). Typical costs of constructed grassed waterways with temporary erosion protection and seeding range between $2 to $3.50 per linear foot, depending upon depth and width.

7.3.7 Phosphorus Inactivation

Inorganic phosphate in lakes can be reduced by applying alum (aluminum sulfate) or other salts to the lakes. Alum strongly binds phosphates. When added to water, alum undergoes a series of hydrolysis reactions and forms aluminum hydroxide [Al(OH)3]. Aluminum hydroxide is highly effective at coagulating and adsorbing phosphorus within a pH range of 6 – 8. In the case of alum, this binding is essentially nonreversible. Alum applications may be single-dose treatments of the whole lake or continuous doses using metered systems. Other chemicals that have been used to inactivate phosphorus include iron salts and lime.

Whole-lake treatments with alum will greatly improve water clarity and will likely reduce seasonal hypolimnetic anoxia, as recently found at Meadow Lake in DuPage County (Baetis unpublished data). The literature suggests that alum treatments will likely need to be performed every three to five years. Treatment should be performed in spring, before significant populations of buoyant algae develop in the lake, which generally impair flocculation and settling of the alum.

A whole-lake treatment entails application of liquid alum to the water column. Alum doses on the order of 500 lbs per acre are typical in Illinois, but this dose will need to be determined individually for each lake. Costs of phosphorus inactivation can vary widely, depending on the treatment volume, water alkalinity, and other factors, but Welch indicates capital costs can be between $400 and $1,200 per acre (Welch, 2005). Additionally, without elimination of external loading, the alum application will require repetition from time to time.

7.3.8 Nutrient Management Planning

Nutrient management optimizes the amount, source, placement, form, and timing of the application of plant nutrients and soil amendments (NRCS, 2002). Nutrient management plans are designed to minimize nutrient losses from agricultural lands, and therefore minimize the amount of phosphorus transported to the lakes. Nutrient management on agricultural lands can reduce phosphorus loads delivered to the lakes. The focus of a nutrient management plan is to increase the efficiency with which applied nutrients are used by crops, thereby reducing the amount potentially lost to soil erosion. Nutrient management plans help guide landowners by analyzing agricultural practices and suggesting appropriate nutrient reduction techniques. This typically involves managing the type, amount, and timing of fertilizer applications to agricultural lands in the watershed. Nutrient management plans are tailored for specific soils, fields, and crops, and therefore generally require data collection specific to the field. Data collection generally involves the following:

- Maps on the field/farm size, type of crops grown, and crop rotations
- Past yields and future yield expectations
- Nutrients in the soil and types and quantities of nutrients available to the farmer
- Provisions for operation, including calibration, of fertilizer application equipment
- Annual reviews

These nutrient management plans guide farmers on fertilizer use in fields and pragmatic crop yields. The interactive Illinois Agronomy Handbook is the most specific reference currently available on nutrient management planning specific to Illinois farms (Hoeft and Nafziger, available online at http://www.aces.uiuc.edu/iah/index.php). The NRCS

Conservation Practice Standard for nutrient management planning also summarizes this practice, and includes the Illinois Phosphorus Assessment Procedure (IPAP). These information resources, as well as agency extension personnel, technical service providers, and cost sharing are available to targeted TMDL watersheds in Illinois.

Illinois Department of Agriculture, in cooperation with the Illinois EPA, began targeting TMDL targeted watersheds in the Conservation Practices Program for nutrient management. Cost share finds include \$2/acre for plan development, up to \$5/acre producer payments for initiating implementation, plus up to 60% of the cost for any BMP implemented for the control of phosphorus movement in phosphorus-impaired watersheds. To be eligible for a CPP incentive payment, a Nutrient Management Plan must follow the NRCS conservation practice standard for either Nutrient Management (Code 590) or Waste Utilization (Code 633). NRCS conservation practice standards for nutrient management plans include the Illinois Agronomy Handbook recommendations for rate, timing and placement of nutrients and procedures for soil sampling and calculating yield potential.

Nutrient management planning is also an eligible conservation practice for cost sharing under the Environment Quality Incentives Program (EQIP) in Illinois. Current cost sharing limits are 60% of the actual cost not to exceed the county average cost, and limited to \$10 per acre for up to 400 acres. Practice costs are also offset by environmental benefits and savings associated with the use of less fertilizer.

7.4 IDENTIFYING PRIORITY AREAS FOR CONTROLS

Preliminary identification of priority areas for siting implementation alternatives was accomplished through a review of available information and GIS analyses. It should be noted that additional, more detailed, evaluation may be necessary to refine the site selection and estimate costs. Information reviewed for this preliminary evaluation included the Stage 1 Report, available water quality data, GIS-based watershed data and the 1993 watershed plan.

Watershed soils, land use, and topography data were analyzed to identify areas that are expected to generate the highest sediment and associated phosphorus and manganese loads. Maps have been generated to show areas with high phosphorus export (Figure 4), steep slopes (Figure 5), highly erodible soils (Figure 6), and finally, potential areas for wetland restoration (Figure 7). Potential wetland restoration sites shown in Figure 7 are defined as areas having hydric soils, are not currently used as urban land, are not covered by water, wetlands or forests. These maps serve as a starting point for selecting areas to target for implementing non-point source control projects.

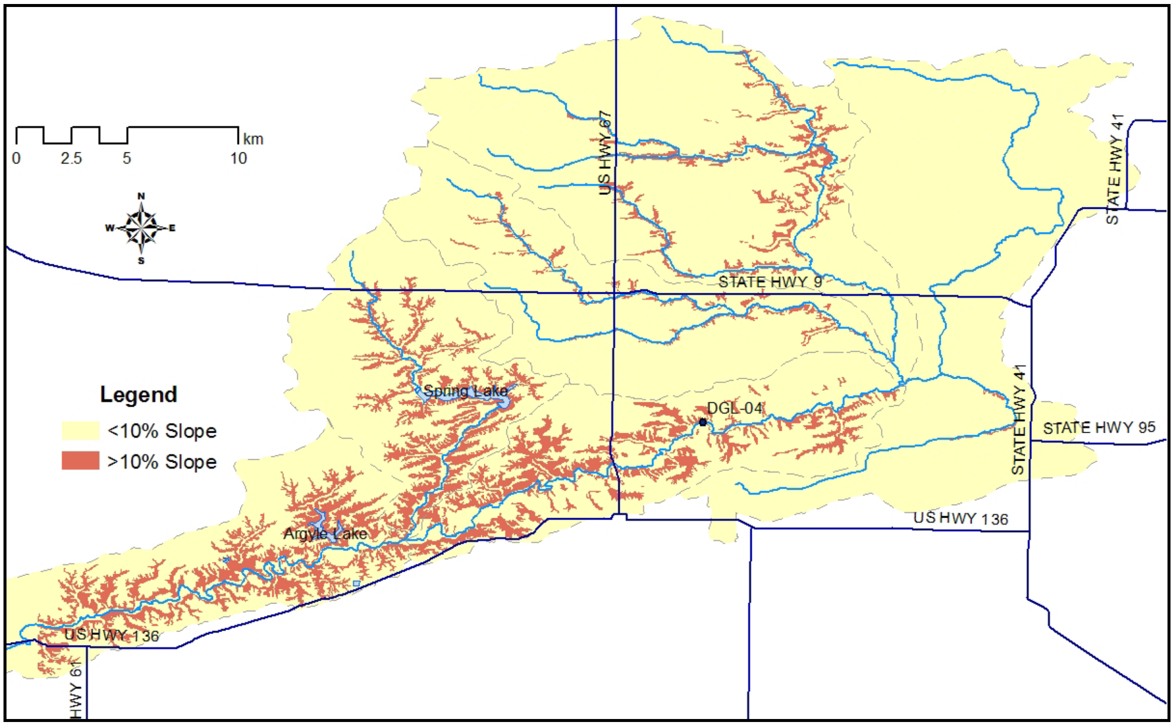

Figure 5. Areas in the Watershed with Steep Slopes.

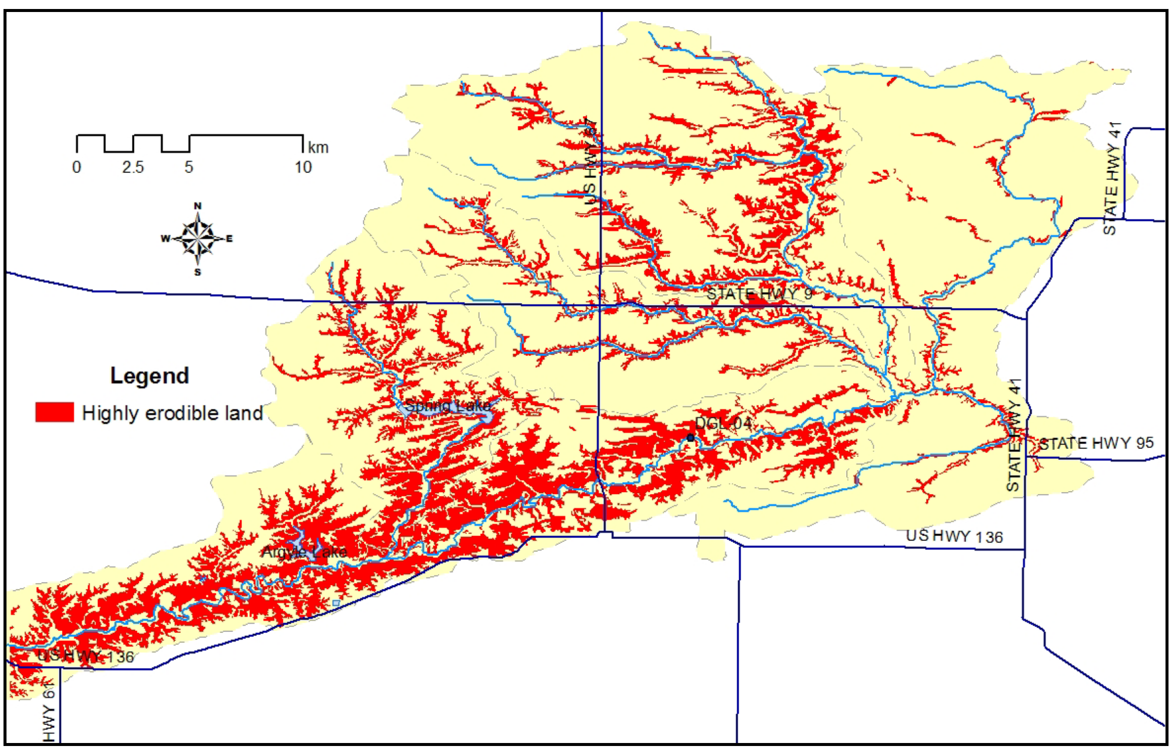

Figure 6. Highly Erodible Soils in the Watershed.

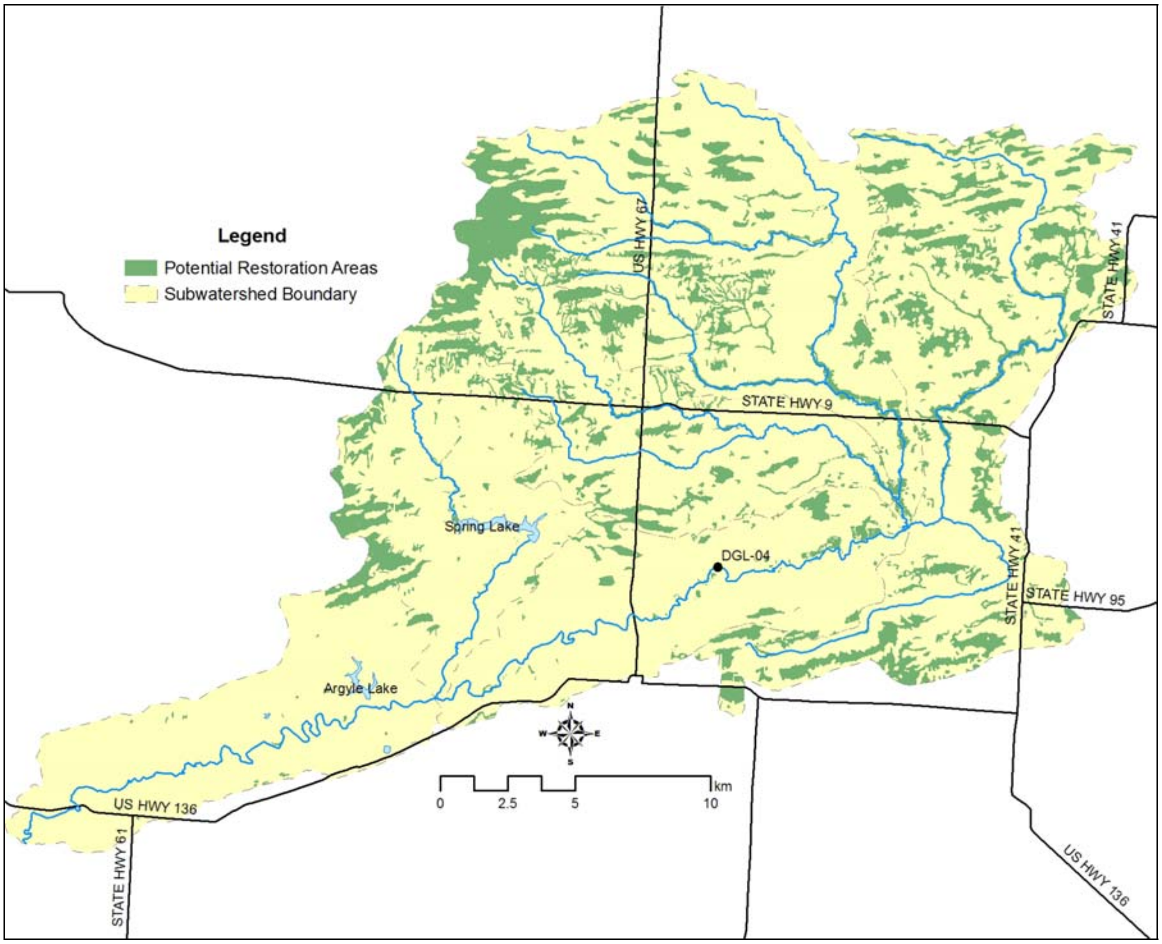

Figure 7. Potential Wetland Restoration Areas in the Watershed.

7.5 REASONABLE ASSURANCE

Reasonable assurances provide a level of confidence that the waste load allocations and load allocations in TMDLs will be implemented by Federal, State, or local authorities and/or by voluntary action. Reasonable assurance for reductions in nonpoint source loadings may be non-regulatory or incentive-based, and consistent with applicable laws and regulations. Non-enforceable, nonpoint source control assurances include:

- Demonstration of adequate funding,
- Processes by which agreements/arrangements between appropriate parties (e.g. IEPA, City of Macomb, Illinois DNR, private landowners) will be reached,
- Assessment of the future of government programs which contribute to implementation actions, and

- Demonstration of anticipated effectiveness of the actions.

Principal among these assurances are funding and institutional programs. Detailed described are provided below.

7.5.1 Local Watershed Institutions

Local forces will be needed to drive the implementation of the TMDLs in this and all impaired watersheds in Illinois. In the East Fork LaMoine River watershed, local stakeholders key to successful implementation include the LaMoine River Ecosystem Partnership, Two Rivers RC&D, McDonough County SWCD, Illinois DNR/Argyle Lake State Park and City of Macomb. The LaMoine River Ecosystem Partnership is particularly well positioned to implement the TMDL given its interagency constituency, knowledge of grant programs, and experience with nonpoint source control projects.

7.5.2 Illinois Nutrient Management Planning Program

The Illinois Department of Agriculture (IDA) and IEPA cosponsor cropland Nutrient Management Plan programs in watersheds with approved phosphorus TMDLs. Financial and technical assistance are available to landowners in the Spring Lake and Argyle Lake watersheds. Technical Service Providers (TSP), certified by the US Department of Agriculture, are utilized to supplement NRCS and IDA extension services. This program provides incentive payments to have Nutrient Management Plans developed and implemented on eligible farm lands, as well as traditional erosion control practices. Cost share finds include $2/acre for plan development by TSPs, up to $5/acre producer payments for initiating implementation, plus up to 60% of the cost for any BMP implemented for the control of phosphorus movement in phosphorus-impaired watersheds.

7.5.3 Clean Water Act Section 319 Grants

Section 319 of the Clean Water Act is specific to nonpoint sources of water pollution. Under 319, States may reallocate federal funds through grants to public and private entities, including local governments and watershed stakeholder groups. Section 319 funding is being used across the nation to implement TMDLs. TMDL implementation projects are eligible for 319 grants. A successful proposal would require a 40% local cost share.

Illinois' 319 Program encourages Ecosystem Partnerships, SWCDs and producers to participate in watershed planning and nutrient management planning where appropriate. The results of this activity will include a watershed-based plan that meets USEPA's nine minimum elements, including assessment of the potential for financial support for nonpoint control projects through federal/state programs (i.e. EQIP, CPP, SSRP, CREP, 319 and ICLP). The liaison will advertise programs, give talks, meet with landowners and act as a tool to spread the word about how each of these programs can benefit water quality. The liaison will act as an overall facilitator for water quality coordination between SWCDs, Illinois EPA and other state/federal agencies.

For stakeholders interested in 319 program support, the Illinois EPA will help guide the grant application and administrative processes.

7.5.4 Conservation 2000

Conservation 2000 is a state program. It is a multi-million dollar initiative designed to take a broad-based, long-term ecosystem approach to conserving, restoring, and managing Illinois' natural lands, soils, and water resources. It currently expires in 2009.

The Conservation 2000 Program funds nine programs across three state agencies, and includes the Illinois Clean Lakes and the IDA Conservation Practices Cost-Share Programs. The Illinois Clean Lakes Program is modeled after its federal counterpart (Section 314 of the Clean Water Act). The Illinois Clean Lakes Program includes the following funding components:

- Priority Lake and Watershed Implementation Program
- Illinois Clean Lakes Phases I, II and III Projects
- Volunteer and Ambient Lakes Monitoring
- Lake Education Assistance Program

The Priority Lake and Watershed Implementation Program (PLWIP) began in July 1997 with funds provided through Conservation 2000. PLWIP is a reimbursement grant program designed to support lake protection, restoration and enhancement activities at “priority” lakes where causes and sources of problems are apparent, project sites are highly accessible, project size is relatively small and local entities are in a position to quickly implement needed treatments.

The Illinois Clean Lakes Program (ICLP) is a financial assistance grant program for Phase I (diagnostic-feasibility studies), implementation of lake protection/restoration practices (Phase II), and follow-up monitoring activities (Phase III). The ICLP provides up to 60 percent of the Phase I study cost with the lake owner and/or other sources providing the remaining portion. The maximum amount of state funds is $75,000 for any Phase I project. Phase II grants are available upon completion of an ICLP Phase I study. 50 percent of the Phase II study cost is provided by the state ICLP with the lake owner and/or other sources providing the remaining portion. The maximum amount of state funds is $300,000 for any Phase II project. Grant availability in any given year will depend on the level of ICLP funding appropriated by the state legislature.

7.5.5 Agricultural Watershed Programs

There are several state and federal programs for soil and nutrient conservation in agricultural watersheds, including the Conservation Reserve Program (CRP), Wetlands Reserve Program (WRP), Environmental Quality Incentive Program (EQIP), and Conservation 2000 programs.

CRP is a voluntary program encouraging landowners for long-term conservation of soils, water, and wildlife resources. CRP is the USDA's single largest environmental improvement program. It is administered through the Farm Service Agency (FSA) and involves 10 to 15 year contracts.

The WRP is also a voluntary program. WRP also provides technical and financial assistance to eligible landowners to restore, enhance, and protect wetlands. At least 70 percent of each project area will be restored to the original natural condition, to the extent practicable. Landowners enroll eligible lands through permanent easements, 30-year easements, or restoration cost-share agreements. The program is offered on a continuous sign-up basis and is available nationwide. It is administered through the NRCS.

The Environmental Quality Incentive Program (EQIP) is another voluntary USDA conservation program for farmers faced with serious threats to soil, water, and related natural resources. It provides technical, financial, and educational assistance primarily in designated "priority areas", including TMDL watersheds. Landowners, in consultation with a local NRCS representative or technical service provider, are responsible for development of a site-specific conservation plan, including nutrient management planning.

In terms of reasonable assurances for TMDL implementation and nonpoint pollution source controls, Illinois EPA is committed to:

- Supporting local experts familiar with nonpoint sources of pollution in the watershed,
- Ensuring that they define priority sources and identify restoration alternatives,
- Developing a voluntary implementation program that includes accountability,
- Using the results of future monitoring to conduct adaptive management.

7.6 MONITORING AND ADAPTIVE MANAGEMENT

Future monitoring is needed to assess the effectiveness of the various restoration alternatives and conduct adaptive management. The Illinois EPA conducts a variety of water quality monitoring programs. Ongoing stream and lake monitoring programs include: a statewide 213-station Ambient Water Quality Monitoring Network (AWQMN); an Intensive Basin Survey Program that covers all major watersheds on a five-year rotation basis; an Ambient Lake Monitoring Program; a Volunteer Lake Monitoring Program; and a Facility-Related Stream Survey Program that conducts approximately 20-30 stream surveys each year. East Fork LaMoine River is monitored regularly as part of these programs. Local agencies and watershed organizations are therefore encouraged to conduct additional monitoring to assess sources of pollutants and evaluate changes in water quality in the impaired waterbodies

In particular, the following monitoring is recommended:

- Dry weather monitoring for manganese in the East Fork LaMoine River. Groundwater may be the primary source of manganese to the stream. Manganese concentrations measured in nearby valley seeps or shallow groundwater wells may suggest the significance of this source. Tile drainage may be another source, and could be sampled as well. Sampling the East Fork LaMoine River under a wider range of flow conditions at IL_DGL-04, as suggested in Stage 1, will also provide insight as to the source of the manganese.

- Confirm the assumption of 1 mg P/L in treated effluent from the West Prairie High School treatment plant.

Continued monitoring efforts will provide the basis for assessment of the effectiveness of the TMDL, as well as future adaptive management decisions. As various alternatives are implemented, the monitoring will determine their effectiveness and identify which alternatives should be expanded, and which require adjustments to meet the TMDL goals.

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APPENDIX A

MANGANESE LOAD DURATION ANALYSIS

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LOAD DURATION SUMMARY			
	Peak to Low		
	cfs	*mm*	*Load*
0.004%	5,420	34.36	4373.7
0.01%	5,022	31.83	4052.4
0.10%	3,189	20.21	2573.4
1%	1,276	8.09	1029.5
5%	434	2.75	350.6
10%	227	1.44	183.6
15%	152	0.96	122.3
20%	112	0.71	90.3
25%	86	0.55	69.6
30%	68	0.43	55.3
35%	56	0.35	44.8
40%	45	0.28	36.0
45%	35	0.22	28.6
50%	28	0.18	22.9
55%	22	0.14	17.8
60%	17	0.11	13.6
65%	13	0.08	10.1
70%	9.3	0.06	7.5
75%	6.8	0.04	5.5
80%	5.2	0.03	4.2
85%	3.6	0.02	2.9
90%	2.3	0.01	1.8
95%	1.2	0.01	1.0
99%	0.4	0.00	0.3
100%	0.0	0.00	0.0

Station ID: **IL_DGL-04**

Station name: **East Fork Lamoine River**

149.0 = **Drainage Area** ***(square miles)***

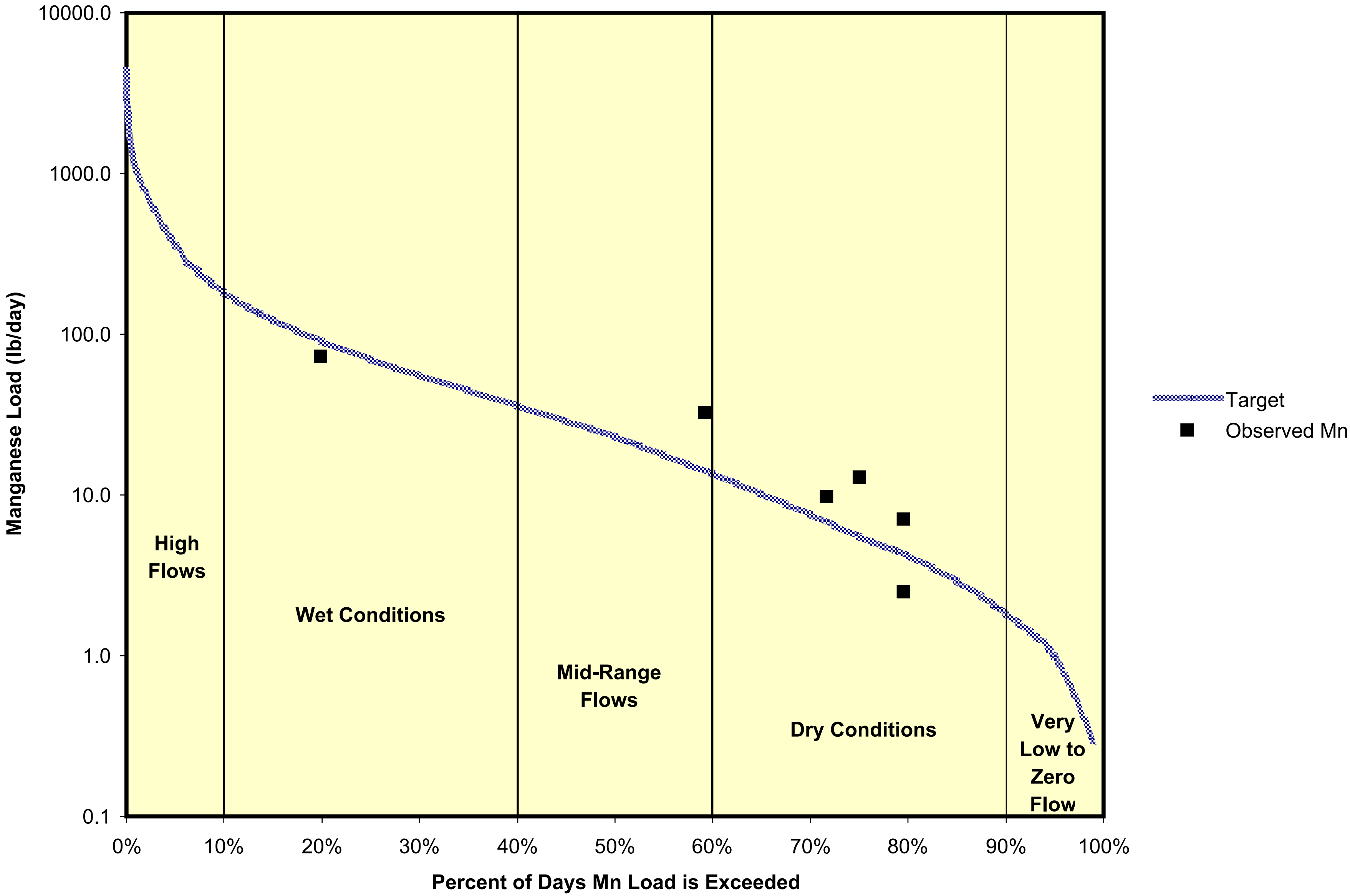
High	Moist	Mid	Dry	Low
434	86	28.4	6.8	1.2
2.754	0.547	0.180	0.043	0.008
350.63	69.58	22.95	5.51	0.99

150 ***WQ Criteria***

Key Loading Equations

*Load (lb/day) = Criteria * Flow * (0.00538)*

Stream Name		*East Fork Lamoine River*							
Site ID		*IL_DGL-04*							
USGS Gage									
8-Digit HUC		*07130010*							
Drainage Area		*149.02 square miles*							
Sample Date	**Flow *(cfs)***	**Flow Rank**	**Mn (ug/L)**	**Mn Load (lb/day)**	**Mn Target (lb/day)**		**Reduction (lb/d)**	**Reduction (%)**	
8/19/1998	7.1	75%	340	12.9	5.7		7.2	56%	
9/17/1998	17.7	59%	340	32.5	14.3		18.1	56%	
6/10/2002	112.8	20%	120	72.8	91.1		0	0%	
8/12/2002	5.5	80%	240	7.0	4.4		2.6	38%	
8/13/2002	5.5	80%	85	2.5	4.4		0	0%	
9/11/2002	8.6	72%	210	9.8	7.0		2.8	29%	


10000.0
1000.0
100.0
10.0
1.0
0.1
Manganese Load (lb/day)
High Flows
Wet Conditions
Mid-Range Flows
Dry Conditions
Very Low to Zero Flow
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Percent of Days Mn Load is Exceeded
Target
Observed Mn

Exceedance	Flow (cfs)	LC (lb/d)	LA (lb/d)	MOS (lb/d)
0.004%	5,420	4374	3936	437
0.01%	5,022	4052	3647	405
0.1%	3,189	2573	2316	257
1%	1,276	1030	927	103
5%	434	351	316	35
10%	227	184	165	18
15%	152	122	110	12
20%	112	90.3	81	9
25%	86	69.6	63	7
30%	68	55.3	50	6
35%	56	44.8	40	4
40%	45	36.0	32	4
45%	35	28.6	26	3
50%	28	22.9	20.7	2.3
55%	22	17.8	16.0	1.8
60%	17	13.6	12.2	1.4
65%	13	10.1	9.1	1.0
70%	9	7.5	6.8	0.8
75%	7	5.5	5.0	0.6
80%	5	4.2	3.8	0.4
85%	4	2.9	2.6	0.3
90%	2	1.8	1.7	0.2
95%	1	1.0	0.9	0.1
99%	0	0.3	0.26	0.03
100%	0	0.0	0.00	0.00

APPENDIX B

PHOSPHORUS LOADING AND LAKE RESPONSE MODELS

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Name	Argyle Reservoir	
ID	RDE	
County	McDonough	
Lake Area	400,973	m^2
Mean Net Precipitation	0.480	m/y
Annual Unit Runoff	0.240	m/y
Lake Inflow	3,983,350	m^3/y
Areal Water Loading	9.934	m/y

Land Use Type	**Area**	
Small Grains / Hay	1,330,839	m^2
Agricultural Rowcr	9,538,136	m^2
Other Agriculture	45,369	m^2
Wetland	77,893	m^2
Forest	4,737,046	m^2
Water	462,780	m^2
Other Land	3,600	m^2
Urban Land	24,919	m^2
Unknown	1,702	m^2
Total Area	16,222,284	m^2
Total Area	1,622	ha

PHOSPHORUS LOADING AND LAKE RESPONSE MODEL Argyle Lake

Phosphorus Export Coefficients

Source	High	Mid	Low	Units
Atmosphere	0.18	0.16	0.15	kg/ha/y
Small Grains / Hay	0.65	0.35	0.2	kg/ha/y
Agricultural Rowcr	0.75	0.45	0.4	kg/ha/y
Other Agriculture	0.5	0.35	0.1	kg/ha/y
Wetland	0.1	0.05	0	kg/ha/y
Forest	0.1	0.05	0.02	kg/ha/y
Water	0.1	0.05	0	kg/ha/y
Other Land	2	0.45	0.02	kg/ha/y
Urban Land	1.5	0.65	0.5	kg/ha/y
Unknown Land	2	0.5	0.02	kg/ha/y

Watershed Phosphorus Loads

Source	High	Mid	Low	Units
Atmosphere	7	6.4	6.0	kg/y
Small Grains / Hay	87	47	27	kg/y
Agricultural Rowcr	715	429	382	kg/y
Other Agriculture	2	1.6	0.5	kg/y
Wetland	0.8	0.4	0.0	kg/y
Forest	47	24	9	kg/y
Water	0.6	0.3	0.0	kg/y
Other Land	0.7	0.2	0.0	kg/y
Urban Land	3.7	1.6	1.2	kg/y
Unknown Land	0.3	0.1	0.0	kg/y
Total	865	510	425	kg/y

Areal P Load	2.16	1.27	1.06	g/m^2/y
Lake P Concentration	0.092	0.054	0.045	mg/L

PHOSPHORUS LOADING AND LAKE RESPONSE MODEL UNCERTAINTY Argyle Lake

	High	Mid	Low	
log P		-1.2670		mg/L
"Positive" model error		0.0185		mg/L
"Negative" model error		-0.0138		mg/L
"Positive" loading error		0.0188		mg/L
"Negative" loading error		0.0045		mg/L
Total "positive" uncertainty		0.0264		mg/L
Total "negative" uncertainty		0.0145		mg/L
55% confidence limits	0.080		0.040	mg/L
90% confidence limits	0.107		0.025	mg/L

PHOSPHORUS LOADING AND LAKE RESPONSE MODEL Argyle Lake

Phosphorus Export Coefficients

Source	Reduction	Unit Areal Load	
Atmosphere	0%	0.16	kg/ha/y
Small Grains / Hay	17%	0.29	kg/ha/y
Agricultural Rowcr	17%	0.37	kg/ha/y
Other Agriculture	17%	0.29	kg/ha/y
Wetland	0%	0.05	kg/ha/y
Forest	0%	0.05	kg/ha/y
Water	0%	0.05	kg/ha/y
Other Land	0%	0.45	kg/ha/y
Urban Land	0%	0.65	kg/ha/y
Unknown Land	0%	0.50	kg/ha/y

Watershed Phosphorus Loads

Source	kg/y		
Atmosphere	6		
Small Grains / Hay	39		
Agricultural Rowcr	356		
Other Agriculture	1		
Wetland	0.4		
Forest	24		
Water	0.3		
Other Land	0.2		
Urban Land	2		
Unknown Land	0.1		
Load Allocation	428.9		
MOS	42.9	10%	
Load Capacity	472		2.9 lb/d

Areal Load Capacity 1.18 g/m^2/y

Lake P Concentration 0.050 mg/L

Name	Spring Lake	
ID	RDR	
County	McDonough	
Lake Area	1,019,751	m^2
Mean Net Precipitation	0.480	m/y
Annual Unit Runoff	0.240	m/y
Lake Inflow	13,327,938	m^3/y
Areal Water Loading	13.070	m/y

Land Use Type	**Area**	
Small Grains / Hay	4,735,591	m^2
Agricultural Rowcr	40,924,115	m^2
Other Agriculture	592,900	m^2
Wetland	67,238	m^2
Forest	6,383,143	m^2
Water	1,150,530	m^2
Other Land	12,314	m^2
Urban Land	730,577	m^2
Unknown	4,851	m^2
Total Area	54,601,259	m^2
Total Area	5,460	ha

PHOSPHORUS LOADING AND LAKE RESPONSE MODEL Spring Lake

Phosphorus Export Coefficients

Source	High	Mid	Low	Units
Atmosphere	0.18	0.16	0.15	kg/ha/y
Small Grains / Hay	0.7	0.5	0.3	kg/ha/y
Agricultural Rowcr	1	0.75	0.5	kg/ha/y
Other Agriculture	0.5	0.35	0.1	kg/ha/y
Wetland	0.1	0.05	0	kg/ha/y
Forest	0.1	0.05	0.02	kg/ha/y
Water	0.1	0.05	0	kg/ha/y
Other Land	2	0.45	0.02	kg/ha/y
Urban Land	1.5	0.65	0.5	kg/ha/y
Unknown Land	2	0.5	0.02	kg/ha/y

Watershed Phosphorus Loads

Source	High	Mid	Low	Units
Atmosphere	18	16	15	kg/y
Small Grains / Hay	331	237	142	kg/y
Agricultural Rowcr	4092	3069	2046	kg/y
Other Agriculture	30	21	5.9	kg/y
Wetland	0.7	0.3	0.0	kg/y
Forest	64	32	13	kg/y
Water	1.3	0.7	0.0	kg/y
Other Land	2.5	0.6	0.0	kg/y
Urban Land	110	47	37	kg/y
Unknown Land	1.0	0.2	0.0	kg/y
West Prairie H.S.	7.6	6.9	6.2	kg/y
Total	4651	3431	2259	kg/y

Areal P Load	4.56	3.36	2.22	g/m^2/y
Lake P Concentration	0.167	0.123	0.081	mg/L

PHOSPHORUS LOADING AND LAKE RESPONSE MODEL UNCERTAINTY Spring Lake

	High	Mid	Low	
log P		-0.9089		mg/L
"Positive" model error		0.0423		mg/L
"Negative" model error		-0.0315		mg/L
"Positive" loading error		0.0219		mg/L
"Negative" loading error		0.0211		mg/L
Total "positive" uncertainty		0.0476		mg/L
Total "negative" uncertainty		0.0379		mg/L
55% confidence limits	0.171		0.085	mg/L
90% confidence limits	0.219		0.048	mg/L

PHOSPHORUS LOADING AND LAKE RESPONSE MODEL Spring Lake

Phosphorus Export Coefficients

Source	Reduction	Unit Areal Load	
Atmosphere	0%	0.16	kg/ha/y
Small Grains / Hay	64%	0.18	kg/ha/y
Agricultural Rowcr	64%	0.27	kg/ha/y
Other Agriculture	64%	0.13	kg/ha/y
Wetland	0%	0.05	kg/ha/y
Forest	0%	0.05	kg/ha/y
Water	0%	0.05	kg/ha/y
Other Land	64%	0.16	kg/ha/y
Urban Land	64%	0.23	kg/ha/y
Unknown Land	0%	0.50	kg/ha/y

Watershed Phosphorus Loads

Source	kg/y		
Atmosphere	16		
Small Grains / Hay	85		
Agricultural Rowcr	1105		
Other Agriculture	7		
Wetland	0.3		
Forest	32		
Water	0.7		
Other Land	0.2		
Urban Land	17		
Unknown Land	0.2		
Load Allocation	1264		
Wasteload Allocation	6.9		
MOS	127	10%	
Load Capacity	1398		8.4 lb/d

Areal P Load 1.37 g/m^2/y

Lake P Concentration 0.050 mg/L

APPENDIX C

LAKE PHOSPHORUS DATA SUMMARY

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Obs	Lake	Station_ID	Sample_Date	Year	Depth_ft	Stratum	Species	Phosphorus
1	Argyle	RDE-1	04/24/19	1991	1	Epilimni	Total	0.09000
2	Argyle	RDE-1	06/17/19	1991	1	Epilimni	Total	0.02000
3	Argyle	RDE-1	07/16/19	1991	1	Epilimni	Total	0.03000
4	Argyle	RDE-1	08/29/19	1991	1	Epilimni	Total	0.03000
5	Argyle	RDE-1	10/16/19	1991	1	Epilimni	Total	0.09000
6	Argyle	RDE-1	04/30/19	1993	1	Epilimni	Total	0.06000
7	Argyle	RDE-1	06/28/19	1993	1	Epilimni	Total	0.02000
8	Argyle	RDE-1	07/22/19	1993	1	Epilimni	Total	0.05000
9	Argyle	RDE-1	08/11/19	1993	1	Epilimni	Total	0.04000
10	Argyle	RDE-1	10/21/19	1993	1	Epilimni	Total	0.07000
11	Argyle	RDE-1	10/21/19	1993	1	Epilimni	Total	0.09000
12	Argyle	RDE-1	04/24/19	1996	1	Epilimni	Total	0.03000
13	Argyle	RDE-1	06/17/19	1996	1	Epilimni	Total	0.05000
14	Argyle	RDE-1	07/16/19	1996	1	Epilimni	Total	0.03000
15	Argyle	RDE-1	08/13/19	1996	1	Epilimni	Total	0.03000
16	Argyle	RDE-1	10/16/19	1996	1	Epilimni	Total	0.04000
17	Argyle	RDE-1	04/27/19	1999	1	Epilimni	Total	0.03000
18	Argyle	RDE-1	06/16/19	1999	1	Epilimni	Total	0.01000
19	Argyle	RDE-1	07/22/19	1999	1	Epilimni	Total	0.01000
20	Argyle	RDE-1	08/30/19	1999	1	Epilimni	Total	0.02000
21	Argyle	RDE-1	10/13/19	1999	1	Epilimni	Total	0.01000
22	Argyle	RDE-1	04/23/20	2002	1	Epilimni	Total	0.04000
23	Argyle	RDE-1	06/06/20	2002	1	Epilimni	Total	0.06000
24	Argyle	RDE-1	07/23/20	2002	1	Epilimni	Total	0.04000
25	Argyle	RDE-1	08/09/20	2002	1	Epilimni	Total	0.04000
26	Argyle	RDE-1	10/09/20	2002	1	Epilimni	Total	0.04000
27	Argyle	RDE-2	04/24/19	1991	1	Epilimni	Total	0.16000
28	Argyle	RDE-2	06/17/19	1991	1	Epilimni	Total	0.02000

Obs	Lake	Station_ID	Sample_Date	Year	Depth_ft	Stratum	Species	Phosphorus
29	Argyle	RDE-2	07/16/19	1991	1	Epilimni	Total	0.02000
30	Argyle	RDE-2	08/29/19	1991	1	Epilimni	Total	0.03000
31	Argyle	RDE-2	10/16/19	1991	1	Epilimni	Total	0.08000
32	Argyle	RDE-2	04/30/19	1993	1	Epilimni	Total	0.05000
33	Argyle	RDE-2	06/28/19	1993	1	Epilimni	Total	0.02000
34	Argyle	RDE-2	07/22/19	1993	1	Epilimni	Total	0.05000
35	Argyle	RDE-2	08/11/19	1993	1	Epilimni	Total	0.04000
36	Argyle	RDE-2	10/21/19	1993	1	Epilimni	Total	0.07000
37	Argyle	RDE-2	04/24/19	1996	1	Epilimni	Total	0.03000
38	Argyle	RDE-2	06/17/19	1996	1	Epilimni	Total	0.05000
39	Argyle	RDE-2	07/16/19	1996	1	Epilimni	Total	0.04000
40	Argyle	RDE-2	08/14/19	1996	1	Epilimni	Total	0.03000
41	Argyle	RDE-2	10/16/19	1996	1	Epilimni	Total	0.04000
42	Argyle	RDE-2	04/27/19	1999	1	Epilimni	Total	0.02000
43	Argyle	RDE-2	06/16/19	1999	1	Epilimni	Total	0.01000
44	Argyle	RDE-2	07/22/19	1999	1	Epilimni	Total	0.02000
45	Argyle	RDE-2	08/30/19	1999	1	Epilimni	Total	0.02000
46	Argyle	RDE-2	10/13/19	1999	1	Epilimni	Total	0.02000
47	Argyle	RDE-2	04/23/20	2002	1	Epilimni	Total	0.04000
48	Argyle	RDE-2	06/06/20	2002	1	Epilimni	Total	0.05000
49	Argyle	RDE-2	07/23/20	2002	1	Epilimni	Total	0.03000
50	Argyle	RDE-2	08/09/20	2002	1	Epilimni	Total	0.04000
51	Argyle	RDE-2	10/09/20	2002	1	Epilimni	Total	0.04000
52	Argyle	RDE-3	04/24/19	1991	1	Epilimni	Total	0.14000
53	Argyle	RDE-3	06/17/19	1991	1	Epilimni	Total	0.02000
54	Argyle	RDE-3	07/16/19	1991	1	Epilimni	Total	0.02000
55	Argyle	RDE-3	08/29/19	1991	1	Epilimni	Total	0.03000
56	Argyle	RDE-3	10/16/19	1991	1	Epilimni	Total	0.09000

Obs	Lake	Station_ID	Sample_Date	Year	Depth_ft	Stratum	Species	Phosphorus
57	Argyle	RDE-3	04/30/19	1993	1	Epilimni	Total	0.05000
58	Argyle	RDE-3	06/28/19	1993	1	Epilimni	Total	0.03000
59	Argyle	RDE-3	07/22/19	1993	1	Epilimni	Total	0.08000
60	Argyle	RDE-3	08/11/19	1993	1	Epilimni	Total	0.03000
61	Argyle	RDE-3	04/24/19	1996	1	Epilimni	Total	0.03000
62	Argyle	RDE-3	06/17/19	1996	1	Epilimni	Total	0.02000
63	Argyle	RDE-3	07/16/19	1996	1	Epilimni	Total	0.03000
64	Argyle	RDE-3	08/13/19	1996	1	Epilimni	Total	0.04000
65	Argyle	RDE-3	10/16/19	1996	1	Epilimni	Total	0.03000
66	Argyle	RDE-3	04/27/19	1999	1	Epilimni	Total	0.02000
67	Argyle	RDE-3	06/16/19	1999	1	Epilimni	Total	0.01000
68	Argyle	RDE-3	07/22/19	1999	1	Epilimni	Total	0.02000
69	Argyle	RDE-3	08/30/19	1999	1	Epilimni	Total	0.02000
70	Argyle	RDE-3	10/13/19	1999	1	Epilimni	Total	0.01000
71	Argyle	RDE-3	04/23/20	2002	1	Epilimni	Total	0.05000
72	Argyle	RDE-3	06/06/20	2002	1	Epilimni	Total	0.04000
73	Argyle	RDE-3	07/23/20	2002	1	Epilimni	Total	0.04000
74	Argyle	RDE-3	08/09/20	2002	1	Epilimni	Total	0.04000
75	Argyle	RDE-3	10/09/20	2002	1	Epilimni	Total	0.04000
76	Spring	RDR-1	05/08/19	1991	1	Epilimni	Total	0.07000
77	Spring	RDR-1	06/07/19	1991	1	Epilimni	Total	0.10000
78	Spring	RDR-1	07/02/19	1991	1	Epilimni	Total	0.06000
79	Spring	RDR-1	08/12/19	1991	1	Epilimni	Total	0.05000
80	Spring	RDR-1	09/06/19	1991	1	Epilimni	Total	0.09000
81	Spring	RDR-1	10/07/19	1991	1	Epilimni	Total	0.11000
82	Spring	RDR-1	05/19/19	1992	1	Epilimni	Total	0.06000
83	Spring	RDR-1	06/23/19	1992	1	Epilimni	Total	0.08000
84	Spring	RDR-1	07/21/19	1992	1	Epilimni	Total	0.08000

Obs	Lake	Station_ID	Sample_Date	Year	Depth_ft	Stratum	Species	Phosphorus
85	Spring	RDR-1	08/12/19	1992	1	Epilimni	Total	0.10000
86	Spring	RDR-1	08/24/19	1992	1	Epilimni	Total	0.05000
87	Spring	RDR-1	09/23/19	1992	1	Epilimni	Total	0.08000
88	Spring	RDR-1	04/27/19	1993	1	Epilimni	Total	0.18000
89	Spring	RDR-1	06/07/19	1993	1	Epilimni	Total	0.09000
90	Spring	RDR-1	06/28/19	1993	1	Epilimni	Total	0.13000
91	Spring	RDR-1	07/09/19	1993	1	Epilimni	Total	0.09000
92	Spring	RDR-1	07/22/19	1993	1	Epilimni	Total	0.14000
93	Spring	RDR-1	08/11/19	1993	1	Epilimni	Total	0.18000
94	Spring	RDR-1	08/24/19	1993	1	Epilimni	Total	0.09000
95	Spring	RDR-1	08/27/19	1993	1	Epilimni	Total	0.10000
96	Spring	RDR-1	10/05/19	1993	1	Epilimni	Total	0.14000
97	Spring	RDR-1	10/21/19	1993	1	Epilimni	Total	0.09000
98	Spring	RDR-1	05/23/19	1994	1	Epilimni	Total	0.04000
99	Spring	RDR-1	06/27/19	1994	1	Epilimni	Total	0.08000
100	Spring	RDR-1	07/25/19	1994	1	Epilimni	Total	0.10000
101	Spring	RDR-1	08/31/19	1994	1	Epilimni	Total	0.09000
102	Spring	RDR-1	09/23/19	1994	1	Epilimni	Total	0.10000
103	Spring	RDR-1	05/21/19	1997	1	Epilimni	Total	0.09000
104	Spring	RDR-1	06/25/19	1997	1	Epilimni	Total	0.07000
105	Spring	RDR-1	07/23/19	1997	1	Epilimni	Total	0.08000
106	Spring	RDR-1	08/27/19	1997	1	Epilimni	Total	0.14000
107	Spring	RDR-1	09/24/19	1997	1	Epilimni	Total	0.10000
108	Spring	RDR-1	10/29/19	1997	1	Epilimni	Total	0.09000
109	Spring	RDR-1	05/29/19	1998	1	Epilimni	Total	0.16000
110	Spring	RDR-1	07/29/19	1998	1	Epilimni	Total	0.08000
111	Spring	RDR-1	08/26/19	1998	1	Epilimni	Total	0.09000
112	Spring	RDR-1	10/20/19	1998	1	Epilimni	Total	0.09000

Obs	Lake	Station_ID	Sample_Date	Year	Depth_ft	Stratum	Species	Phosphorus
113	Spring	RDR-2	05/08/19	1991	1	Epilimni	Total	0.13000
114	Spring	RDR-2	06/07/19	1991	1	Epilimni	Total	0.11000
115	Spring	RDR-2	07/02/19	1991	1	Epilimni	Total	0.09000
116	Spring	RDR-2	08/12/19	1991	1	Epilimni	Total	0.13000
117	Spring	RDR-2	9/6/1991	1991	1	Epilimni	Total	0.24000
118	Spring	RDR-2	10/07/19	1991	1	Epilimni	Total	0.27000
119	Spring	RDR-2	05/19/19	1992	1	Epilimni	Total	0.14000
120	Spring	RDR-2	06/23/19	1992	1	Epilimni	Total	0.18000
121	Spring	RDR-2	07/21/19	1992	1	Epilimni	Total	0.12000
122	Spring	RDR-2	08/24/19	1992	1	Epilimni	Total	0.09000
123	Spring	RDR-2	09/23/19	1992	1	Epilimni	Total	0.10000
124	Spring	RDR-2	04/27/19	1993	1	Epilimni	Total	0.17000
125	Spring	RDR-2	06/28/19	1993	1	Epilimni	Total	0.14000
126	Spring	RDR-2	07/22/19	1993	1	Epilimni	Total	0.16000
127	Spring	RDR-2	08/24/19	1993	1	Epilimni	Total	0.15000
128	Spring	RDR-2	10/21/19	1993	1	Epilimni	Total	0.14000
129	Spring	RDR-2	05/23/19	1994	1	Epilimni	Total	0.07000
130	Spring	RDR-2	06/27/19	1994	1	Epilimni	Total	0.23000
131	Spring	RDR-2	07/25/19	1994	1	Epilimni	Total	0.19000
132	Spring	RDR-2	08/31/19	1994	1	Epilimni	Total	0.16000
133	Spring	RDR-2	09/23/19	1994	1	Epilimni	Total	0.15000
134	Spring	RDR-3	05/08/19	1991	1	Epilimni	Total	0.22000
135	Spring	RDR-3	06/07/19	1991	1	Epilimni	Total	0.16000
136	Spring	RDR-3	07/02/19	1991	1	Epilimni	Total	0.21000
137	Spring	RDR-3	08/12/19	1991	1	Epilimni	Total	0.29000
138	Spring	RDR-3	10/07/19	1991	1	Epilimni	Total	0.38000
139	Spring	RDR-3	05/19/19	1992	1	Epilimni	Total	0.19000
140	Spring	RDR-3	06/23/19	1992	1	Epilimni	Total	0.19000

Obs	Lake	Station_ID	Sample_Date	Year	Depth_ft	Stratum	Species	Phosphorus
141	Spring	RDR-3	07/21/19	1992	1	Epilimni	Total	0.14000
142	Spring	RDR-3	08/24/19	1992	1	Epilimni	Total	0.22000
143	Spring	RDR-3	09/23/19	1992	1	Epilimni	Total	0.28000
144	Spring	RDR-3	04/27/19	1993	1	Epilimni	Total	0.18000
145	Spring	RDR-3	06/07/19	1993	1	Epilimni	Total	0.32000
146	Spring	RDR-3	06/28/19	1993	1	Epilimni	Total	0.18000
147	Spring	RDR-3	07/09/19	1993	1	Epilimni	Total	0.12000
148	Spring	RDR-3	07/22/19	1993	1	Epilimni	Total	0.56000
149	Spring	RDR-3	08/11/19	1993	1	Epilimni	Total	0.14000
150	Spring	RDR-3	08/24/19	1993	1	Epilimni	Total	0.21000
151	Spring	RDR-3	08/27/19	1993	1	Epilimni	Total	0.19000
152	Spring	RDR-3	10/05/19	1993	1	Epilimni	Total	0.14000
153	Spring	RDR-3	10/21/19	1993	1	Epilimni	Total	0.14000
154	Spring	RDR-3	05/23/19	1994	1	Epilimni	Total	0.09000
155	Spring	RDR-3	06/27/19	1994	1	Epilimni	Total	0.17000
156	Spring	RDR-3	07/25/19	1994	1	Epilimni	Total	0.29000
157	Spring	RDR-3	08/31/19	1994	1	Epilimni	Total	0.15000
158	Spring	RDR-3	09/23/19	1994	1	Epilimni	Total	0.20000
159	Argyle	RDE-1	08/22/20	2005	1	Epilimni	Total	0.06010
160	Argyle	RDE-1	08/22/20	2005	29	Hypolimn	Total	0.18900
161	Argyle	RDE-1	08/22/20	2005	1	Epilimni	Dissolve	0.03490
162	Argyle	RDE-1	08/22/20	2005	29	Hypolimn	Dissolve	0.15700
163	Argyle	RDE-2	08/22/20	2005	1	Epilimni	Total	0.04970
164	Argyle	RDE-2	08/22/20	2005	1	Epilimni	Dissolve	0.01070
165	Argyle	RDE-3	08/22/20	2005	1	Epilimni	Total	0.00727
166	Argyle	RDE-1	10/26/20	2005	1	Epilimni	Total	0.03400
167	Argyle	RDE-1	10/26/20	2005	1	Epilimni	Dissolve	0.03310
168	Argyle	RDE-1	10/26/20	2005	21	Hypolimn	Total	0.03680

Obs	Lake	Station_ID	Sample_Date	Year	Depth_ft	Stratum	Species	Phosphorus
169	Argyle	RDE-1	10/26/20	2005	21	Hypolimn	Dissolve	0.03110
170	Argyle	RDE-2	10/26/20	2005	1	Epilimni	Total	0.03380
171	Argyle	RDE-2	10/26/20	2005	1	Epilimni	Dissolve	0.03250
172	Argyle	RDE-3	10/26/20	2005	1	Epilimni	Total	0.03170
173	Argyle	RDE-3	10/26/20	2005	1	Epilimni	Dissolve	0.03070
174	Spring	RDR-1	07/10/20	2002	1	Epilimni	Total	0.06400
175	Spring	RDR-1	06/11/20	2003	1	Epilimni	Total	0.15900
176	Spring	RDR-1	06/11/20	2003	1	Epilimni	Dissolve	0.02400
177	Spring	RDR-1	06/11/20	2003	11	Metalimn	Total	0.09900
178	Spring	RDR-1	06/11/20	2003	11	Metalimn	Dissolve	0.01000
179	Spring	RDR-1	06/11/20	2003	20	Hypolimn	Total	0.10600
180	Spring	RDR-1	06/11/20	2003	20	Hypolimn	Dissolve	0.01300
181	Spring	RDR-2	06/11/20	2003	1	Epilimni	Total	0.21700
182	Spring	RDR-2	06/11/20	2003	1	Epilimni	Dissolve	0.02000
183	Spring	RDR-3	06/11/20	2003	1	Epilimni	Total	0.20400
184	Spring	RDR-3	06/11/20	2003	1	Epilimni	Dissolve	0.01400
185	Spring	RDR-1	06/18/20	2003	1	Epilimni	Total	0.14200
186	Spring	RDR-3	07/15/20	2003	1	Epilimni	Total	0.22300
187	Spring	RDR-3	07/15/20	2003	1	Epilimni	Dissolve	0.02000
188	Spring	RDR-2	07/15/20	2003	1	Epilimni	Total	0.15200
189	Spring	RDR-2	07/15/20	2003	1	Epilimni	Dissolve	0.01300
190	Spring	RDR-1	07/15/20	2003	1	Epilimni	Total	0.11100
191	Spring	RDR-1	07/15/20	2003	1	Epilimni	Dissolve	0.00700
192	Spring	RDR-1	07/15/20	2003	11	Metalimn	Total	0.10300
193	Spring	RDR-1	07/15/20	2003	11	Metalimn	Dissolve	0.01400
194	Spring	RDR-1	07/15/20	2003	20	Hypolimn	Total	0.08500
195	Spring	RDR-1	07/15/20	2003	20	Hypolimn	Dissolve	0.01700
196	Spring	RDR-1	07/23/20	2003	1	Epilimni	Total	0.15300

Obs	Lake	Station_ID	Sample_Date	Year	Depth_ft	Stratum	Species	Phosphorus
197	Spring	RDR-1	08/21/20	2003	1	Epilimni	Total	0.17900
198	Spring	RDR-1	08/21/20	2003	1	Epilimni	Dissolve	0.05000
199	Spring	RDR-1	08/21/20	2003	9	Metalimn	Total	0.15700
200	Spring	RDR-1	08/21/20	2003	9	Metalimn	Dissolve	0.05200
201	Spring	RDR-1	8/21/200	2003	18	Hypolimn	Total	0.10100
202	Spring	RDR-1	08/21/20	2003	18	Hypolimn	Dissolve	0.05600
203	Spring	RDR-2	08/21/20	2003	1	Epilimni	Total	0.23200
204	Spring	RDR-2	08/21/20	2003	1	Epilimni	Dissolve	0.05800
205	Spring	RDR-3	08/21/20	2003	1	Epilimni	Total	0.34900
206	Spring	RDR-3	08/21/20	2003	1	Epilimni	Dissolve	0.09900
207	Spring	RDR-1	10/01/20	2003	1	Epilimni	Total	0.06600
208	Spring	RDR-1	10/01/20	2003	1	Epilimni	Dissolve	0.02500
209	Spring	RDR-1	10/01/20	2003	11	Metalimn	Total	0.06800
210	Spring	RDR-1	10/01/20	2003	11	Metalimn	Dissolve	0.02500
211	Spring	RDR-1	10/01/20	2003	19	Hypolimn	Total	0.07100
212	Spring	RDR-1	10/01/20	2003	19	Hypolimn	Dissolve	0.02700
213	Spring	RDR-2	10/01/20	2003	1	Epilimni	Total	0.10000
214	Spring	RDR-2	10/01/20	2003	1	Epilimni	Dissolve	0.01600
215	Spring	RDR-3	10/01/20	2003	1	Epilimni	Total	0.12500
216	Spring	RDR-3	10/01/20	2003	1	Epilimni	Dissolve	0.02100

The MEANS Procedure

Analysis Variable : Phosphorus							
Lake	**Species**	**N Obs**	**Mean**	**Median**	**Std Error**	**Lower 90% CL for Mean**	**Upper 90% CL for Mean**
Argyle	Dissolve	7	0.047	0.033	0.019	0.011	0.083
	Total	83	0.042	0.034	0.003	0.036	0.047
Spring	Dissolve	20	0.029	0.021	0.005	0.020	0.038
	Total	106	0.145	0.135	0.008	0.132	0.157

The MEANS Procedure

Analysis Variable : Phosphorus								
Lake	**Stratum**	**Species**	**N Obs**	**Mean**	**Median**	**Std Error**	**Lower 90% CL for Mean**	**Upper 90% CL for Mean**
Argyle	Epilimni	Dissolve	5	0.028	0.033	0.004	0.019	0.038
		Total	81	0.040	0.034	0.003	0.035	0.045
	Hypolimn	Dissolve	2	0.094	0.094	0.063	-0.303	0.492
		Total	2	0.113	0.113	0.076	-0.368	0.593
Spring	Epilimni	Dissolve	12	0.031	0.021	0.008	0.017	0.044
		Total	98	0.149	0.140	0.008	0.135	0.162
	Hypolimn	Dissolve	4	0.028	0.022	0.010	0.005	0.051
		Total	4	0.091	0.093	0.008	0.072	0.109
	Metalimn	Dissolve	4	0.025	0.020	0.009	0.003	0.048
		Total	4	0.107	0.101	0.018	0.063	0.150

The MEANS Procedure

Analysis Variable : Phosphorus									
Lake	Year	Stratum	Species	N Obs	Mean	Median	Std Error	Lower 90% CL for Mean	Upper 90% CL for Mean
Argyle	1991	Epilimni	Total	15	0.058	0.030	0.012	0.037	0.079
	1993	Epilimni	Total	15	0.050	0.050	0.005	0.040	0.060
	1996	Epilimni	Total	15	0.035	0.030	0.002	0.031	0.038
	1999	Epilimni	Total	15	0.017	0.020	0.002	0.014	0.019
	2002	Epilimni	Total	15	0.042	0.040	0.002	0.039	0.045
	2005	Epilimni	Dissolve	5	0.028	0.033	0.004	0.019	0.038
			Total	6	0.036	0.034	0.007	0.021	0.051
		Hypolimn	Dissolve	2	0.094	0.094	0.063	-0.303	0.492
			Total	2	0.113	0.113	0.076	-0.368	0.593
Spring	1991	Epilimni	Total	17	0.159	0.130	0.023	0.120	0.199
	1992	Epilimni	Total	16	0.131	0.110	0.016	0.103	0.160
	1993	Epilimni	Total	25	0.167	0.140	0.019	0.134	0.199
	1994	Epilimni	Total	15	0.141	0.150	0.018	0.110	0.172
	1997	Epilimni	Total	6	0.095	0.090	0.010	0.075	0.115
	1998	Epilimni	Total	4	0.105	0.090	0.018	0.061	0.149
	2002	Epilimni	Total	1	0.064	0.064	.	.	.
	2003	Epilimni	Dissolve	12	0.031	0.021	0.008	0.017	0.044
			Total	14	0.172	0.156	0.019	0.139	0.206
		Hypolimn	Dissolve	4	0.028	0.022	0.010	0.005	0.051
			Total	4	0.091	0.093	0.008	0.072	0.109
		Metalimn	Dissolve	4	0.025	0.020	0.009	0.003	0.048
			Total	4	0.107	0.101	0.018	0.063	0.150

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APPENDIX D

STAGE 3 CONTACT LOG

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Stage 3 Contacts

Person	Agency	Contact Means	Contact Details	Date	Subject
Jim Bessler	City of Macomb Water Plant	Telephone	309-833-2821	Apr. 3, 2007	Spring Lake water quality data
Ken Russell	Illinois DNR - Argyle Lake SP	Telephone	309-776-3422	Apr. 9, 2007	Argyle Lake sedimentation surveys
Teri Holland	Illinois EPA - Lakes Unit	Telephone	217-782-3362	Apr. 5, 2007	Clean Lakes Program
Greg Jackson	McDonough Co. SWCD	Telephone	309-833-1711	May 15, 2007	Watershed BMPs & TMDL status

APPENDIX E

RESPONSIVENESS SUMMARY

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Appendix E: Responsiveness Summary

This responsiveness summary responds to substantive questions and comments received during the public comment period from June 27, 2007 through August 17, 2007 postmarked, including those from the July 18, 2007 public meeting discussed below.

What is a TMDL?

A Total Maximum Daily Load (TMDL) is the sum of the allowable amount of a pollutant that a water body can receive from all contributing sources and still meet water quality standards or designated uses. This TMDL is for the East Fork LaMoine Watershed, which includes East Fork LaMoine River, Spring Lake and Argyle Lake. This report details the watershed characteristics, impairment, sources, load and wasteload allocations, and reductions for each segment. The Illinois EPA implements the TMDL program in accordance with Section 303(d) of the federal Clean Water Act and regulations there under.

Background

The East Fork LaMoine watershed drains 143,000 acres and covers land within Hancock, McDonough and Warren Counties. Within this watershed, East Fork LaMoine River (14 miles), Spring Lake (277 acres) and Argyle Lake (95 acres) are listed as impaired. Land use in the watershed is 55 percent agriculture, 28 percent forest and seven percent urban. East Fork LaMoine is listed on the Illinois EPA 2006 Section 303(d) List as being impaired for public water supply use with the potential cause of manganese. Spring and Argyle Lakes are impaired for aesthetic quality use with potential causes of phosphorus and total suspended solids. The Clean Water Act and USEPA regulations require that states develop TMDLs for waters on the Section 303(d) List.

Public Meetings

Public meetings were held in Macomb on May 30, 2006 and July 18, 2007. The Illinois EPA provided public notices for all meetings by placing a display ad in the local newspaper in the watershed; the Macomb Journal. These notices gave the date, time, location, and purpose of the meetings. It also provided references to obtain additional information about this specific site, the TMDL Program and other related issues. Individuals and organizations were also sent the public notice by first class mail. The draft TMDL Report was available for review at the Macomb Public Library and online at the Agency's web page at http://www.epa.state.il.us/water/tmdl .

The first public meeting on May 30, 2006 started at 6:00 p.m. and was attended by fifteen people. The second public meeting on July 18, 2007, started at 6:00 p.m. and was attended by twelve people. The meeting record remained open until midnight, August 17, 2007.

Questions and Comments

1. Where do you get target values for the TMDL? How were those derived?

   Response
   The target values used in the TMDL are the water quality standards. The Illinois Pollution Control Board is responsible for setting water quality standards to protect designated uses in waterbodies. The Illinois EPA is responsible for developing scientifically based water quality standards and proposing them to the Illinois Pollution Control Board for adoption into state rules and regulations.

2. What if all the manganese is from groundwater? If so, there is nothing we can do about it.

   Response
   The TMDL states that manganese is a common component in soils. Manganese tends to stick to soil particles, so when soil erodes, manganese will be part of it. There are ways to control erosion in the watershed and the implementation plan addresses some of these actions.

3. LaMoine is a secondary source of drinking water. It is not used very often. Why is it still designated as a drinking water supply?

   Response
   If this source is used for drinking water at any time, it has to be designated as a drinking water supply.

4. There is much disappointment that the TMDL is not specific about implementation actions. Locals want to know what Best Management Practices (BMPs) to put in place and where they should go. What is the purpose of this report if this information is not there?

   Response
   The purpose of this report is to look at impaired waters and the causes of impairment. Loads are included from point sources (sources directly discharging to a stream) and nonpoint sources (indirect discharges). How much those sources have to be reduced to meet water quality standards is also included in the report. Illinois EPA can regulate point sources using the permit program that is in place, but Illinois EPA has no regulatory authority over nonpoint sources. An implementation plan is included in the report that has BMPs that are suitable to reduce the causes of impairments. Maps are also included that display the highly erodible soils and potential wetland restoration areas. These are available in GIS format and a person or group could use this information for their specific area. Local people have a better idea of what they can do and prioritize in their own watershed. There is already a watershed group in this area- the LaMoine River Ecosystem Partnership. They have done a lot of work and have a watershed plan for the entire LaMoine River watershed that has prioritized areas. Please visit their website at http://www.lamoineriver.org/ for more information.

5. Your map shows too much potential wetland areas. How did you come up with those maps? You should remove prime farmland from that map.

   Response
   The wetland areas are based on soil properties. Both "hydric" and "fully hydric soils" were included on the map. Since then, the map was changed to only include "fully hydric soils". The soils having

hydric qualities have wetland potential. Not only do they have potential, but historically 25 percent of land in Illinois was once wetlands. These lands have since been converted to agricultural land with the aid of tile drains. A wetland restoration project may be as simple as breaking drain tiles and blocking drain ditches, or it may require more engineering effort to restore hydrology and hydric vegetation communities.

6. As far as phosphorus is concerned, most of it is coming from row crops. What is the incentive for farmers?

   Response
   Besides the incentive of reducing pollution in the waters, if less fertilizer (phosphorus) is applied, costs will be reduced. Illinois EPA has no regulatory control over nonpoint sources of pollution. Runoff from farm fields is considered a nonpoint source and voluntary efforts from local landowners are the only way of controlling nonpoint pollution. We have recommended implementation actions for phosphorus, such as nutrient management, in the TMDL report and also included different programs that can provide cost shares.

7. How can we reduce the internal load of phosphorus? Does phosphorus leach out of sediment? Should we just dredge?

   Response
   The condition of your water depends on the balance between the amount of incoming and outgoing phosphorus and the volume of water available for dilution. If you have more phosphorus coming in the lake than leaving the lake, you will get a build-up that settles to the bottom (sediment). When a lake stratifies it becomes anoxic or oxygen depleted in the bottom layer. During these anoxic conditions, phosphorus is released from the bottom sediments. By reducing phosphorus coming in the lake, the lake will use phosphorus already in the sediment. This can be a long process, but there is no short term solution with the exception of dredging. Dredging is very effective but extremely expensive. And, if phosphorus is not reduced in the watershed, it will build up again in the sediment.