Illinois
Environmental
Protection Agency

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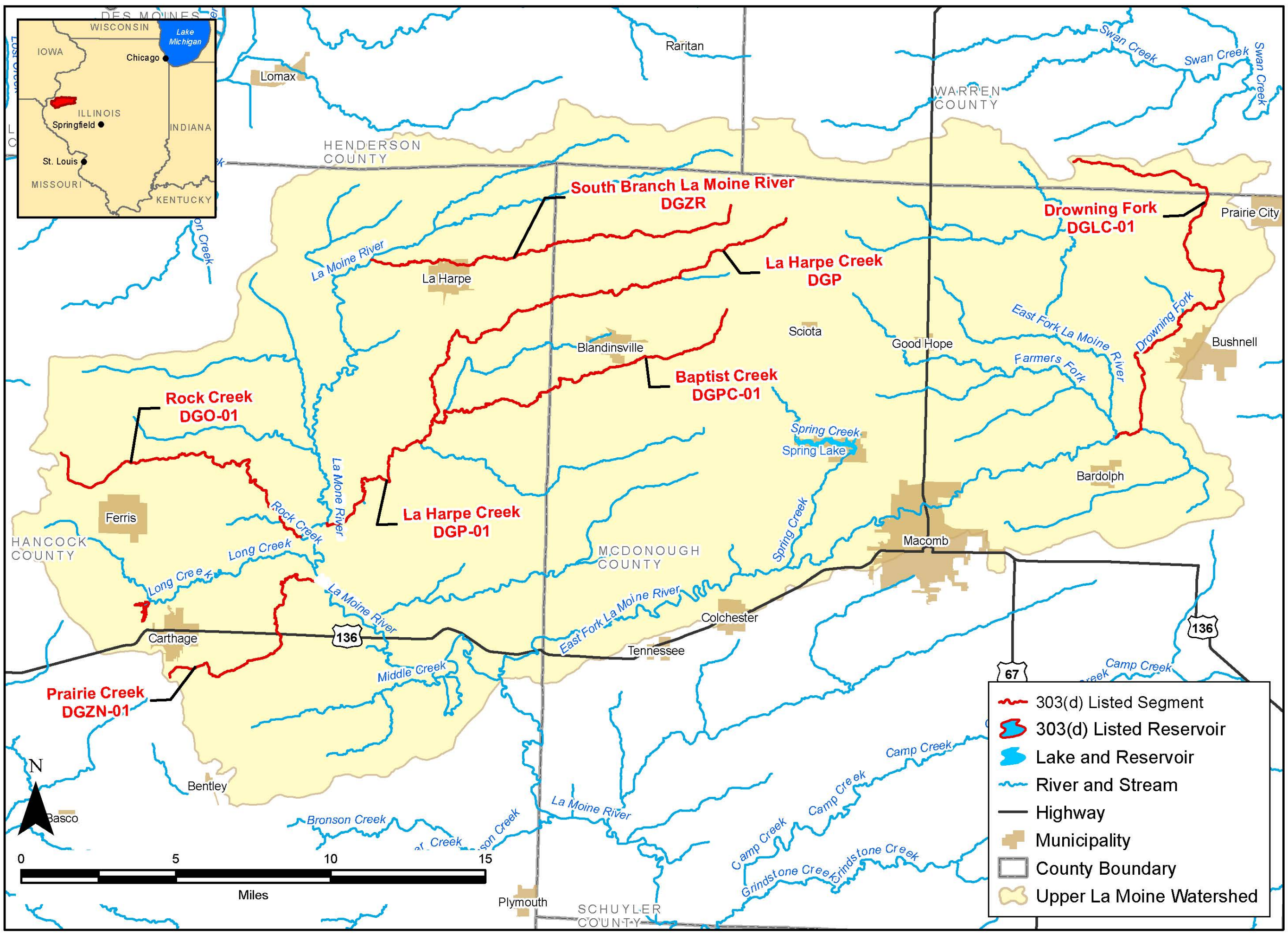
March 2021

IEPA/BOW/IL-2021-003

Upper La Moine River Watershed TMDL Report



Upper La Moine River TMDL Watershed

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TMDL Development for the Upper La Moine River Watershed, Illinois

This file contains the following documents:

1) U.S. EPA Approval Letter and Decision Document for the Final TMDL Report
2) TMDL Report

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

REPLY TO THE ATTENTION OF:
W-16J

Sanjay Sofat, Chief
Bureau of Water
Illinois Environmental Protection Agency
P.O. Box 19276
Springfield, Illinois 62794-9276

Dear Mr. Sofat:

The U.S. Environmental Protection Agency has reviewed the approval (dated March 23, 2021) of the final Total Maximum Daily Loads (TMDL) for segments within the Upper La Moine River Watershed (ULMRW) and has determined that there was an oversight made in the Decision Document, specifically in Table 1 and Table 7. EPA did not recognize segment IL_DGP in its approval of a dissolved oxygen TMDL for La Harpe Creek. EPA has updated Table 1 and Table 7 in a revised ULMRW TMDL Decision Document.

I am enclosing a copy of the revised Decision Document for your records. If you have any questions, please contact Mr. David Werbach, TMDL Coordinator at 312-866-4242.

Sincerely,

DAVID PFEIFER

Digitally signed by DAVID PFEIFER
Date: 2021.12.14 16:29:26 -06'00'

David Pfeifer
Chief, Watersheds and Wetlands Branch

TMDL: Upper La Moine River watershed ammonia, chloride, dissolved oxygen and phosphorus TMDLs in portions of Hancock, Henderson, McDonough, and Warren Counties, Illinois
Date: December 14, 2021 (revised)

DECISION DOCUMENT
FOR THE UPPER LA MOINE RIVER WATERSHED TMDLS, HANCOCK, HENDERSON, MCDONOUGH & WARREN COUNTIES, IL

Section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations at 40 C.F.R. Part 130 describe the statutory and regulatory requirements for approvable TMDLs. Additional information is generally necessary for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations, and should be included in the submittal package. Use of the verb "must" below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation. Use of the term "should" below denotes information that is generally necessary for EPA to determine if a submitted TMDL is approvable. These TMDL review guidelines are not themselves regulations. They are an attempt to summarize and provide guidance regarding currently effective statutory and regulatory requirements relating to TMDLs. Any differences between these guidelines and EPA's TMDL regulations should be resolved in favor of the regulations themselves.

1. Identification of Water body, Pollutant of Concern, Pollutant Sources, and Priority Ranking

The TMDL submittal should identify the water body as it appears on the State's/Tribe's 303(d) list. The water body should be identified/georeferenced using the National Hydrography Dataset (NHD), and the TMDL should clearly identify the pollutant for which the TMDL is being established. In addition, the TMDL should identify the priority ranking of the water body and specify the link between the pollutant of concern and the water quality standard (see Section 2 below).

The TMDL submittal should include an identification of the point and nonpoint sources of the pollutant of concern, including location of the source(s) and the quantity of the loading, e.g., lbs/per day. The TMDL should provide the identification numbers of the NPDES permits within the water body. Where it is possible to separate natural background from nonpoint sources, the TMDL should include a description of the natural background. This information is necessary for EPA's review of the load and wasteload allocations, which are required by regulation.

The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as:

(1) the spatial extent of the watershed in which the impaired water body is located;
(2) the assumed distribution of land use in the watershed (e.g., urban, forested, agriculture);
(3) population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources;
(4) present and future growth trends, if taken into consideration in preparing the TMDL (e.g., the TMDL could include the design capacity of a wastewater treatment facility); and

(5) an explanation and analytical basis for expressing the TMDL through *surrogate measures*, if applicable. *Surrogate measures* are parameters such as percent fines and turbidity for sediment impairments; chlorophyll *a* and phosphorus loadings for excess algae; length of riparian buffer; or number of acres of best management practices.

Comment:

Location Description/Spatial Extent:

The Upper La Moine River Watershed (ULMRW) (HUC-8 #07130010) is located in western central Illinois in Hancock, Henderson, McDonough and Warren counties. The ULMRW drains approximately 369,000 acres (i.e., 576.5 square miles) in Illinois. Surface waters in the ULMRW generally flow from the northeast to the southwest where they empty into the main stem of the La Moine River north of Colmar, Illinois. The ULMRW TMDLs address a total of seven (7) impaired segments due to: excessive ammonia (1 segment), chloride (1 segment) and nutrients (i.e., total phosphorus, 1 segment) as well four (4) impaired segments which violate dissolved oxygen water quality standards (WQS) (Table 1 of this Decision Document).

Table 1: Upper La Moine River Watershed impaired waters addressed by this TMDL

Water body name	Assessment Unit ID	Affected Use	Pollutant or stressor	TMDL
Ammonia TMDL				
South Branch of the La Moine River	IL_DGZR	Aquatic Life	Ammonia/nitrogen	Ammonia TMDL
Chloride TMDL				
Drowning Fork Creek	IL_DGLC-01	Aquatic Life	Chloride	Chloride TMDL
Dissolved Oxygen TMDLs				
Rock Creek	IL_DGO-01	Aquatic Life	Nutrients (TN and TP)	Total nitrogen (TN), total phosphorus (TP), carbonaceous biochemical oxygen demand (CBOD) and sediment oxygen demand (SOD) TMDLs
La Harpe Creek	IL_DGP	Aquatic Life	Nutrients (TN and TP)	
La Harpe Creek	IL_DGP-01	Aquatic Life	Nutrients (TN and TP)	
Prairie Creek	IL_DGZN-01	Aquatic Life	Nutrients (TN and TP)	
South Branch of the La Moine River	IL_DGZR	Aquatic Life	Nutrients (TN and TP)	
Total Phosphorus TMDLs				
Carthage Lake	IL_RLE	Aesthetic quality	Phosphorus	TP TMDL

Land Use:

Land use in the ULMRW is predominantly agricultural as approximately 66% of the land use is devoted to corn or soybean fields. Forested, woodland, grasslands or shrublands cover approximately 28% of the ULMRW with the remaining land uses of developed/urban land uses (6%) and wetland/open waters (less than 1%) (Table 2 of this Decision Document).

Table 2: Upper La Moine River Watershed Land Cover - based on 2014 National Agricultural Statistics Service (NASS) Cropland Data Layer

Land Use / Land Cover Category	Acreage	Percentage
Corn	137,055	37.14%
Soybeans	104,627	28.35%
Deciduous Forest	59,764	16.19%
Grass/Pasture	42,463	11.51%
Developed/Low Intensity	11,458	3.10%
Developed/Open Space	7,331	1.99%
All others	6,351	1.72%
TOTALS	**369,049**	**100%**

Problem Identification:
Ammonia TMDL: The South Branch of the La Moine River (DGZR) ammonia impaired segment identified in Table 1 of this Decision Document was included on the 2016 Illinois 303(d) List due to excessive ammonia. Water quality monitoring within the ULMRW indicated that this segment was not attaining its designated aquatic life uses due to elevated ammonia measurements and the negative impact of those conditions on aquatic life (i.e., fish and macroinvertebrate communities).

Ammonia is naturally found in the environment and is a part of the nitrogen cycle (e.g., nitrogen fixation processes). Natural sources of ammonia include the decomposition of organic matter, gas exchange in the atmosphere, human and animal wastes and forest fires. Ammonia is toxic to fish at high concentrations and elevated concentrations in the water column can make it difficult for aquatic organisms to sufficiently excrete the toxicant (i.e., ammonia), leading to ammonia accumulating in internal tissues and blood. Environmental factors, such as pH and temperature in the water column, can affect ammonia toxicity to aquatic species.

Chloride TMDL: The Drowning Fork Creek (DGLC-01) chloride impaired segment identified in Table 1 of this Decision Document was included on the 2016 Illinois 303(d) list due to excessive chloride. Water quality monitoring within the ULMRW indicated that this segment was not attaining its designated aquatic life uses due to high chloride measurements and the negative impact of those conditions on aquatic life (i.e., fish and macroinvertebrate communities).

Low levels of chloride can be found naturally in lakes and streams. Chloride is essential for aquatic life to carry out a range of biological functions. However, high concentrations of chloride in the water column can harm cellular osmotic processes in aquatic organisms. If elevated concentrations of chloride persist in the water column, aquatic life such as fish, invertebrates and even some plant species may become stressed and/or die.

High levels of salt can also negatively affect groundwater and drinking water supplies, pets, wildlife, soils, infrastructure and vehicles.

TMDLs addressing dissolved oxygen (Total nitrogen (TN), total phosphorus (TP), carbonaceous biochemical oxygen demand (CBOD) & sediment oxygen demand (SOD): The four impaired segments identified in Table 1 of this Decision Document were included on the 2016 Illinois 303(d) list due to low concentrations of dissolved oxygen and the negative impact of those conditions on aquatic life (i.e., fish and macroinvertebrate communities). The Illinois Environmental Protection Agency (IEPA) targeted total nitrogen, total phosphorus, CBOD & SOD as the main factors influencing dissolved oxygen concentrations in the water column of the ULMRW. During development of the TMDL, IEPA determined that the low DO was the result of an interaction between these pollutants in the waterbody, and developed allocations based upon the oxygen-demanding substances identified in each waterbody (Section 8.3.4.1 of the final TMDL document). Modeling analyses found that the DO water quality standards could be attained in the ULMRW segments via a combination of reductions in nutrient load (i.e., total nitrogen and total phosphorus) and oxygen-demanding material loads (i.e., CBOD and SOD). Therefore, IEPA targeted these parameters in the development of TMDLs to address the DO impairments in the ULMRW.

Low dissolved oxygen concentrations can negatively impact aquatic life use. The decreases in dissolved oxygen can stress benthic macroinvertebrates and fish. Increased turbidity, brought on by elevated levels of nutrients within the water column, can reduce dissolved oxygen in the water column, and cause large shifts in dissolved oxygen and pH throughout the day. Shifting chemical conditions within the water column may stress aquatic biota (i.e., fish and macroinvertebrate species). In some instances, degradations in aquatic habitats or water quality have reduced fish populations or altered fish communities from those communities supporting sport fish species to communities which support more tolerant rough fish species.

Biological processes associated with the breakdown and conversion of organic carbon to carbon dioxide are measured by CBOD. SOD is a measure of the oxygen depletion of biological and chemical processes in sediment (e.g., the aerobic decay of organic materials in stream sediments). Both CBOD and SOD remove oxygen from the water column at the sediment/water column interface.

Total phosphorus TMDL: Carthage Lake (RLE) identified in Table 1 of this Decision Document was included on the 2016 Illinois 303(d) list due to excessive nutrients (phosphorus). Water quality monitoring demonstrated that Carthage Lake was not attaining its designated aquatic life and aesthetic quality uses due to excessive nutrients. Water quality monitoring within the ULMRW was completed at several locations and the data collected during these efforts served as the foundation for modeling efforts completed in this TMDL study.

While TP is an essential nutrient for aquatic life, elevated concentrations of TP can lead to nuisance algal blooms that negatively impact aquatic life and recreation (e.g., swimming, boating, fishing, etc.). Algal decomposition depletes dissolved oxygen levels within the water column. The decreases in dissolved oxygen can stress benthic macroinvertebrates and fish. Depletion of oxygen in the water column can also lead to conditions where phosphorus is released from bottom sediments (i.e., internal loading). Also, excess algae can shade the water column which limits the distribution of aquatic vegetation. Aquatic vegetation stabilizes bottom sediments, and also is an important habitat for macroinvertebrates and fish.

Priority Ranking:

The water bodies addressed by the ULMRW TMDLs were given a priority ranking for TMDL development due to: the impairment impacts on aquatic life, aesthetic quality, the public value of the impaired water resource and the timing as part of the Illinois basin monitoring process.

Pollutants of Concern:
The pollutants of concern are nitrogen, phosphorus, CBOD and SOD for the dissolved oxygen impaired water bodies, ammonia, chloride and nutrients (TP).
Source Identification (point and nonpoint sources):

Point Source Identification: The potential point sources to the ULMRW are:

<u>ULMRW ammonia TMDLs:</u>
National Pollutant Discharge Elimination Systems (NPDES) permitted facilities: NPDES permitted facilities may contribute ammonia loads to surface waters through discharges of treated wastewater. Permitted facilities must discharge treated wastewater according to their NPDES permit. IEPA determined that there is one NPDES permitted facility, the La Harpe Sewage Treatment Plant (STP) (LG580093), which contributes ammonia to the South Branch of the La Moine River (DGZR) impaired segment. This permittee received a wasteload allocation (WLA) (Tables 3 and 5 of this Decision Document).

Table 3: NPDES facilities which contribute point source pollutant loading in the Upper La Moine River Watershed TMDLs

WLAs assigned to NPDES facilities in the ULMRW			
Permit #	**Facility Name**	**Impaired Reach**	**WLA***
Ammonia WLA assigned to NPDES facilities in the ULMRW			**(lbs/day)**
ILG580093	La Harpe STP	South Branch La Moine River (IL_DGZR)	Dependent on season and flow conditions
Chloride WLA assigned to NPDES facilities in the ULMRW			**(lbs/day)**
IL0024384	Bushnell West STP	Drowning Fork (IL_DLGC-01)	1043.00
CBOD WLAs assigned to NPDES facilities in the ULMRW - DO TMDLs			**(lbs/day)**
IL0021229	Carthage STP	Prairie Creek(IL_DGZN-01)	See Table 8-13 of the final TMDL document
ILG580093	La Harpe STP	South Branch La Moine River (IL_DGZR)	

** = Design average flow was used to calculate the WLA.*

Municipal Separate Storm Sewer (MS4): MS4 communities which contribute stormwater runoff to surface waters in the ULMRW. IEPA determined that there are no MS4 communities which are contributing stormwater to surface waters in the ULMRW.

Concentrated Animal Feedlot Operations (CAFOs): IEPA determined that the ULMRW does not have CAFOs which contribute to surface waters of the ULMRW (Section 5.4.2 of the final TMDL document).

Combined Sewer Overflows (CSOs) and Sanitary Sewer Overflows (SSOs): IEPA determined that the ULMRW does not have CSOs nor SSOs which contribute to surface waters of the ULMRW.

<u>ULMRW chloride TMDLs:</u>
NPDES permitted facilities: NPDES permitted facilities may contribute chloride loads to surface waters through discharges of treated wastewater. Permitted facilities must discharge treated wastewater according to their NPDES permit. IEPA determined that there is one facility, the Bushnell West STP (IL0024384), which contributes chloride from treated wastewater releases to the Drowning Fork Creek impaired segment. This permittee received a WLA (Tables 3 and 6 of this Decision Document).

<u>ULMRW TMDLs addressing dissolved oxygen (TN/TP/CBOD/SOD):</u>
NPDES permitted facilities: NPDES permitted facilities may contribute CBOD loads to surface waters through discharges of treated wastewater. Permitted facilities must discharge treated wastewater according to their NPDES permit. IEPA determined that there are two NPDES permitted facilities in the ULMRW which contribute CBOD from treated wastewater releases, the Carthage STP (IL0021229) to the Prairie Creek (DGZN-01) impaired segment and the La Harpe STP (ILG580093) to the South Branch of the La Moine River (DGZR) impaired segment. IEPA explained that CBOD limits for both of these facilities would be reviewed as part of the next permit renewal cycle and potentially adjusted so that the CBOD limits are consistent with the assumptions of the ULMRW dissolved oxygen TMDLs.

Nonpoint Source Identification: The potential nonpoint sources to the ULMRW are:

<u>ULMRW ammonia TMDLs:</u>
Stormwater from agricultural land use practices: Runoff from agricultural lands may contain amounts of ammonia which may lead to impairments in the ULMRW. Feedlots generate manure which may be spread onto fields. Runoff from fields with spread manure can be exacerbated by tile drainage lines, which channelize the stormwater flows to surface waters.

Discharges from Septic Systems or unsewered communities: Failing septic systems are a potential source of ammonia within the ULMRW. Septic systems generally do not discharge directly into a water body, but effluents from septic systems may leach into groundwater or pond at the surface where they can be washed into surface waters via stormwater runoff events. Age, construction and use of septic systems can vary throughout a watershed and influence potential contributions of ammonia from these systems.

Non-regulated (i.e., areas not covered by a Municipal Separate Storm Sewer System (MS4) NPDES permit) urban runoff: Runoff from urban areas (e.g., urban, residential, commercial or industrial land uses) can contribute ammonia to local water bodies. Stormwater from urban areas, which drain impervious surfaces, may introduce ammonia derived from wildlife or pet droppings to surface waters.

Wildlife: Wildlife is a known source of ammonia in water bodies as many animals spend time in or around water bodies. Deer, geese, ducks, raccoons, and other animals all create potential sources of ammonia via contaminated runoff from animal habitats, such as urban park areas, forest, and rural areas.

<u>ULMRW chloride TMDLs:</u>
Non-regulated (i.e., areas not covered by a MS4 NPDES permit) stormwater contributions: Stormwater runoff from areas outside the boundaries of MS4 areas, such as non-permitted urban, residential, commercial or industrial areas, can contribute chloride to surface waters of the ULMRW. Non-regulated stormwater may drain impervious surfaces and add any residual chlorides from those surfaces to surface waters. IEPA explained that usage of road salting from municipal operators and private applicators (e.g.,

private citizens and commercial contractors salting parking lots, sidewalks and other pedestrian/automobile usage areas) are some of the main nonpoint sources of chloride in the ULMRW (Section 5.4.5 of the final TMDL document). Chloride from these sources is carried into surface waters during snowmelt or rainfall runoff events via impervious surfaces (e.g., highways, roads and other paved areas).

Discharges from septic systems or unsewered communities: Septic systems are a potential source of chloride within the ULMRW. Septic systems generally do not discharge directly into a water body, but effluents from septic systems may leach into groundwater or pond at the surface where they can be washed into surface waters via stormwater runoff events. Age, construction and use of septic systems can vary throughout a watershed and influence the chloride contribution from these systems. Water softening systems which are in areas not connected to municipal sewer lines likely discharge to septic fields and chloride contributions from those septic systems may ultimately mix with groundwater or surface water near the septic field.

Chloride contributions from agricultural lands: Chloride may be added via use of fertilizers containing chloride anions (e.g., potassium chloride (KCl)) and biosolids which are spread onto agricultural areas. Chloride may be liberated from farm fields within stormwater runoff which can be exacerbated by tile drainage lines, which channelize the stormwater flows.

ULMRW TMDLs addressing dissolved oxygen (TN/TP/CBOD/SOD):

Non-regulated (i.e., areas not covered by a MS4 NPDES permit) stormwater contributions: Stormwater runoff from areas outside the boundaries of MS4 areas, such as non-permitted urban, residential, commercial or industrial areas, can contribute ammonia and/or nutrients to surface waters of the ULMRW. Non-regulated stormwater may drain impervious surfaces and add any residual ammonia and/or nutrients from those surfaces to surface waters.

Discharges from septic systems or unsewered communities: Failing septic systems are a potential source of ammonia and/or nutrients within the ULMRW. Septic systems generally do not discharge directly into a water body, but effluents from septic systems may leach into groundwater or pond at the surface where they can be washed into surface waters via stormwater runoff events. Age, construction and use of septic systems can vary throughout a watershed and influence the nutrient contribution from these systems.

Stormwater from agricultural land use practices: Runoff from agricultural lands may contain significant amounts of ammonia and/or nutrients which may lead to impairments in the ULMRW. Feedlots generate manure which may be spread onto fields. Runoff from fields with spread manure can be exacerbated by tile drainage lines, which can channelize the stormwater flows to local surface waters.

ULMRW phosphorus TMDLs:

Non-regulated (i.e., areas not covered by a MS4 NPDES permit) stormwater contributions: Stormwater runoff from areas outside the boundaries of MS4 areas, such as non-permitted urban, residential, commercial or industrial areas, can contribute nutrients, organic material and organic rich sediment during stormwater runoff events. Runoff from urban/developed areas can include phosphorus derived from fertilizers, leaf and grass litter, pet wastes, and other sources of anthropogenic derived nutrients.

Stormwater runoff from agricultural land use practices: Runoff from agricultural lands may contain significant amounts of nutrients, organic material and organic-rich sediment which may lead to impairments in the ULMRW. Manure spread onto fields is often a source of phosphorus, and can be exacerbated by tile drainage lines, which channelize the stormwater. Tile lined fields and channelized ditches enable particles to move more efficiently into surface waters. Phosphorus, organic material and organic-rich sediment may be added via surface runoff from upland areas which are being used for Conservation Reserve Program (CRP) lands, grasslands, and agricultural lands used for growing hay or other crops. Stormwater runoff may contribute nutrients and organic-rich sediment to surface waters from livestock manure, fertilizers, vegetation and erodible soils.

Internal loading: The release of phosphorus from lake sediments contributes internal phosphorus loading to Carthage Lake. Phosphorus may build up in the bottom waters of the lake and may be resuspended or mixed into the water column when the thermocline decreases and the lake water mixes.

Wetland and Forest Sources: Phosphorus, organic material and organic-rich sediment may be added to surface waters by stormwater flows through wetland and forested areas in the ULMRW. Storm events may mobilize phosphorus through the transport of suspended solids and other organic debris.

Discharges from septic systems or unsewered communities: Failing septic systems are a potential source of nutrients within the ULMRW. Septic systems generally do not discharge directly into a water body, but effluents from septic systems may leach into groundwater or pond at the surface where they can be washed into surface waters via stormwater runoff events. Age, construction and use of septic systems can vary throughout a watershed and influence the nutrient contribution from these systems.

Wildlife: Wildlife is a known source of nutrients in water bodies as many animals spend time in or around water bodies. Deer, geese, ducks, raccoons, and other animals all create potential sources of nutrients via contaminated runoff from animal habitats, such as urban park areas, forest, and rural areas.

Future Growth:
IEPA considered information gathered during the 2010 census in determining whether or not to assign reserve capacity (RC) to the TMDL equation to account for future growth in the ULMRW. IEPA explained that it is not anticipated that significant future population growth will occur in the ULMRW (Sections 2.5 and 8.3.1.5 of the final TMDL document). The WLA and load allocations (LA) for the ULMRW TMDLs were calculated for all current and future sources. Any expansion of point or nonpoint sources will need to comply with the respective WLA and LA values calculated in the ULMRW TMDLs.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the first criterion.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

The TMDL submittal must include a description of the applicable State/Tribal water quality standard, including the designated use(s) of the water body, the applicable numeric or narrative water quality criterion, and the antidegradation policy (40 C.F.R. §130.7(c)(1)). EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

The TMDL submittal must identify a numeric water quality target(s) – a quantitative value used to measure whether or not the applicable water quality standard is attained. Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. The TMDL expresses the relationship between any necessary reduction of the pollutant of concern and the attainment of the numeric water quality target. Occasionally, the pollutant of concern is different from the pollutant that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as Dissolved Oxygen (DO) criteria). In such cases, the TMDL submittal should explain the linkage between the pollutant of concern and the chosen numeric water quality target.

Comment:
Section 4 of the final TMDL document explains that water bodies in the ULMRW are not meeting their General Use designation. The Illinois Pollution Control Board (IPCB) defines General Use standards as those 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."*

Under the General Use classification, waters are further designated as impaired for aquatic life use, aesthetic quality use and primary contact recreational use. Table 1 of this Decision Document shows the various water body segments and their associated impaired uses.

The applicable General Use water quality standards for the ULMRW TMDL water bodies are established in Illinois Administrative Rules Title 35, Environmental Protection; Subtitle C, Water Pollution; Chapter I, Pollution Control Board; Part 302, Water Quality Standards, Subpart B. Table 4 of this Decision Document lists all the water quality standards and the TMDL targets/modeling endpoints employed by IEPA in the calculation of loading capacities for ULMRW TMDLs.

Table 4: Water quality standards and TMDL targets utilized within the Upper La Moine River Watershed TMDL

Parameter	Units	Water Quality Standards	TMDL Targets
Numeric Water Quality Criterion for addressing the South Branch of the La Moine River ammonia impaired segment within the ULMRW			
Ammonia	mg/L	15**	2.1 mg/L – most conservative chronic value (applies June to August)[#]
			2.2 mg/L – most conservative seasonal chronic standard (applies March to May and September to October)[#]
			4.5 mg/L – most conservative seasonal chronic standard (applies November to February)[#]

Numeric Water Quality Criterion for addressing the Drowning Fork Creek chloride impaired segment within the ULMRW			
Chloride	mg/L	500	500
Numeric Water Quality Criterion for addressing the Dissolved Oxygen impaired segments (See Table 1 of this Decision Document) within the ULMRW			
Dissolved Oxygen (DO)	mg/L	6.0 mg/L weekly averge (March-July) 5.0 mg/L daily minimum (March-July) 4.0 mg/L weekly average (August-February) 3.5 mg/L daily minimum (August-February)	5.0 mg/L (applies March to July) # 3.5 mg/L (applies August to February) #
Numeric Water Criterion for addressing the Carthage Lake nutrient impaired segment within the ULMRW			
Total Phosphorus (TP)*	mg/L	0.05	0.05

* = Standard applies to inland lakes and reservoirs (greater than 20 acres) and in any stream at the point where it enters any such lake or reservoir.
** = This refers to the acute standard of total ammonia nitrogen, which must not be exceeded at any time (Illinois Administrative Code 302.212(b))
# = See Table 8-1 of the final TMDL document

The TMDL endpoints used by IEPA to calculate the ULMRW TMDLs include:

- ***Ammonia TMDL*** – **2.1 mg/L**, **2.2 mg/L** and **4.5 mg/L**, dependent on the season (see Table 5 of this Decision Document);
- ***Chloride TMDL*** – **500 mg/L** (see Table 6 of this Decision Document);
- ***Dissolved Oxygen TMDLs*** – **5.0 mg/L** (see Table 7 of this Decision Document); and
- ***Total Phosphorus TMDL*** – **0.05 mg/L** (see Table 8 of this Decision Document).

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the second criterion.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

A TMDL must identify the loading capacity of a water body for the applicable pollutant. EPA regulations define loading capacity as the greatest amount of a pollutant that a water can receive without violating water quality standards (40 C.F.R. §130.2(f)).

The pollutant loadings may be expressed as either mass-per-time, toxicity or other appropriate measure (40 C.F.R. §130.2(i)). If the TMDL is expressed in terms other than a daily load, e.g., an annual load, the submittal should explain why it is appropriate to express the TMDL in the unit of measurement chosen. The TMDL submittal should describe the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In many instances, this method will be a water quality model.

The TMDL submittal should contain documentation supporting the TMDL analysis, including the basis for any assumptions; a discussion of strengths and weaknesses in the analytical process; and results from any water quality modeling. EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

TMDLs must take into account *critical conditions* for steam flow, loading, and water quality parameters as part of the analysis of loading capacity (40 C.F.R. §130.7(c)(1)). TMDLs should define applicable *critical conditions* and describe their approach to estimating both point and nonpoint source loadings under such *critical conditions*. In particular, the TMDL should discuss the approach used to compute and allocate nonpoint source loadings, e.g., meteorological conditions and land use distribution.

Comment:

ULMRW ammonia TMDL: Seasonal flow duration curves (FDC) were created for the South Branch of the La Moine River (IL_DGZR) segment in the ULMRW via flow data from the USGS gage on the La Moine River at Colmar, Illinois (USGS #05584500). For the FDCs in the ULMRW, the closest available USGS gage with similar watershed characteristics to the watershed characteristics of the impaired segments was used to estimate flows using the drainage area ratio (DAR) method. IEPA used the following DAR equation to estimate flows in unaged subwatersheds:

$$Q_{ungaged} = (A_{ungaged} / A_{gaged}) * Q_{gaged}$$

where,

$Q_{ungaged}$	= Flow at the ungaged location
Q_{gaged}	= Flow at USGS gage station (e.g., #05584500)
$A_{ungaged}$	= Drainage area of the ungaged location
A_{gaged}	= Drainage area of the USGS gage location (e.g., #05584500)

Daily stream flows were necessary to implement the load duration curve (LDC) approach.

FDC graphs have flow duration interval (percentage of time flow exceeded) on the X-axis and discharge (flow per unit time) on the Y-axis. The FDC was transformed into a LDC by multiplying individual flow values by the most conservative seasonal ammonia target (see Table 4 of this Decision Document and Table 8-1 of the final TMDL document) and then multiplying that value by a conversion factor. The resulting points are plotted onto a load duration curve graph. LDC graphs, for the ULMRW ammonia TMDL, have flow duration interval (percentage of time flow exceeded) on the X-axis and ammonia loading (lbs/day) on the Y-axis (see Figure 7-15 of the final TMDL document). The curved line on a LDC graph represents the TMDL of the respective flow conditions observed at that location.

Water quality monitoring efforts were conducted for the South Branch of the La Moine River (IL_DGZR) segment and these efforts collected ammonia concentration water quality data which were then converted to individual sampling loads by multiplying the sample concentration by the instantaneous flow measurement observed/estimated at the time of sample collection. The individual sampling loads were plotted on the same figure with the created LDC. Individual LDCs are found in Section 7 (e.g., Figure 7-15) of the final TMDL document.

The LDC plots were subdivided into five flow regimes; high flow conditions (exceeded 0–10% of the time), moist flow conditions (exceeded 10–40% of the time), mid-range flow conditions (exceeded 40–50% of the time), dry flow conditions (exceeded 50–90% of the time), and low flow conditions (exceeded 90–100% of the time). LDC plots can be organized to display individual sampling loads with the calculated LDC. Watershed managers can interpret LDC graphs with individual sampling points plotted alongside the LDC to understand the relationship between flow conditions and water quality exceedances within the watershed. Individual sampling loads which plot above the LDC represent violations of the WQS and the allowable load under those flow conditions at those locations. The difference between individual sampling loads plotting above the LDC and the LDC, measured at the same flow, is the amount of reduction necessary to meet WQS.

The strengths of using the LDC method are that critical conditions and seasonal variation are considered in the creation of the FDC by plotting hydrologic conditions over the flows measured during the recreation season. Additionally, the LDC methodology is relatively easy to use and cost-effective. The weaknesses of the LDC method are that nonpoint source allocations cannot be assigned to specific sources, and specific source reductions are not quantified. Overall, IEPA believes and EPA concurs that the strengths outweigh the weaknesses for the LDC method.

Implementing the results shown by the LDC requires watershed managers to understand the sources contributing to the water quality impairment and which Best Management Practices (BMPs) may be the most effective for reducing ammonia loads based on flow magnitudes. Different sources will contribute ammonia loads under varying flow conditions. For example, if exceedances are significant during high flow events this would suggest storm events are the cause and implementation efforts can target BMPs that will reduce stormwater runoff and consequently ammonia loading into surface waters. This allows for a more efficient implementation effort.

The ammonia TMDL for the South Branch of the La Moine River (DGZR) in the ULMRW was calculated and those results are found in Table 5 of this Decision Document. The LAs were calculated after the determination of the WLA. LAs (e.g., stormwater runoff from agricultural land use practices and feedlots, septic systems, wildlife inputs etc.) were not split among individual nonpoint contributors. Instead, LAs were combined together into a categorical LA to cover all nonpoint source contributions.

Table 5: The Ammonia TMDL for the South Branch of the La Moine River (IL_DGZR) in the Upper La Moine River Watershed

Table 5 of this Decision Document reports multiple points (the midpoints of each 10% flow exceedance probability sub-flow regime) on the loading capacity curve. However, it should be understood that the components of the TMDL equation could be illustrated for any point on the entire loading capacity curve. The LDC method can be used to display collected ammonia monitoring data and allows for the estimation of load reductions necessary for attainment of the ammonia water quality targets (Table 3 of this Decision Document). Using this method, daily loads were developed based upon the flow in the water body. Loading capacities were determined for the segment for multiple flow regimes. This allows the TMDL to be represented by an allowable daily load across all flow conditions. Table 5 of this Decision Document identifies the loading capacity for the water body at each flow regime. Although there are numeric loads for each flow regime, the LDC is what is being approved for this TMDL.

Table 5 of the Decision Document presents IEPA's loading reduction estimates for the ammonia TMDL across the seasons (Summer, Spring/Fall and Winter). These loading reductions (i.e., the percent reduction row at the bottom of each TMDL table) were calculated from field sampling data collected in the ULMRW. IEPA explained that its load reduction estimates are likely more conservative since they are based on a limited water quality data set.

EPA concurs with the data analysis and LDC approach utilized by IEPA in its calculation of loading capacities, wasteload allocations, load allocations and the margin of safety for the ULMRW ammonia TMDL. The methods used for determining the TMDL are consistent with U.S. EPA technical memos.[1]

ULMRW chloride TMDL: IEPA developed a LDC to calculate a chloride TMDL for the Drowning Fork Creek (DLGC-01) segment. The same LDC development strategy was employed for the chloride TMDL as was used to calculate the ammonia LDC values. IEPA used flow measurements from USGS gage #05584500 on the La Moine River near Colman, Illinois and DAR calculations to calculate the flows which were used in the FDC and the LDC for the Drowning Fork Creek (DLGC-01) chloride TMDL. The FDC were transformed into LDC by multiplying individual flow values by the chloride TMDL target (500 mg/L) and then multiplying that value by a conversion factor.

A chloride TMDL was calculated (Table 6 of this Decision Document) by IEPA. The LA value was calculated after the determination of the WLA, and the MOS. LAs (e.g., non-MS4 urban stormwater runoff) was not split among individual nonpoint contributors. Instead, LAs were combined together into one value to cover all nonpoint source contributions. Table 6 of this Decision Document reports ten values (i.e., the midpoints of each 10% flow exceedance probability sub-flow regimes) on the loading capacity curve. However, it should be understood that the components of the TMDL equation could be illustrated for any point on the entire loading capacity curve.

The LDC method can be used to display collected chloride monitoring data and allows for the estimation of load reductions necessary for attainment of the WQS. Using this method, daily loads were developed based upon the flow in the water body. Loading capacities were determined for Drowning Fork Creek (DLGC-01) for multiple flow regimes. This allows the TMDL to be represented by an allowable daily load across all flow conditions. Although there are numeric loads for each flow regime, the LDC is what is being approved for this TMDL.

Table 6: The Chloride TMDL for the Drowning Fork Creek (IL-DLGC-01) segment in the Upper La Moine River Watershed

EPA supports the data analysis and modeling approach utilized by IEPA in its calculation of WLA, LA and MOS for the chloride TMDL for Drowning Fork Creek (DLGC-01). Additionally, EPA concurs with the loading capacities calculated by the IEPA in its ULMRW chloride TMDL. EPA finds IEPA's approach for calculating the loading capacity for its ULMRW chloride TMDL to be reasonable and consistent with EPA guidance.

ULMRW TMDLs addressing dissolved oxygen (TN/TP/CBOD/SOD): IEPA employed QUAL2K to develop the DO TMDLs in the ULMRW for segments Rock Creek (DGO-01), La Harpe Creek (DGP & DGP-01), Prairie Creek (DGZN-01) and the South Branch of the La Moine River (DGZR). IEPA explained that QUAL2K is a one-dimensional stream water quality model applicable to well-mixed streams (Section 7.2.1 of the final TMDL document). The QUAL2K model assumes steady state

[1] U.S. Environmental Protection Agency. August 2007. *An Approach for Using Load Duration Curves in the Development of TMDLs*. Office of Water. EPA-841-B-07-006. Washington, D.C.

hydraulics and allows for point source inputs, diffuse loading and tributary flows. The QUAL2K model incorporates historical water quality data, observed hydraulic information, and point source discharge data along with model defaults to predict the resulting instream DO concentrations.

IEPA used the QUAL2K model to determine load reductions of oxygen-demanding materials needed to meet the instantaneous DO minimum standard of 5.0 mg/L applicable March 1 – July 31. The QUAL2K model simulates DO dynamics as a function of nitrogenous and carbonaceous oxygen demand, atmospheric reaeration, sediment oxygen demand (SOD), and plant photosynthesis and respiration. The model also simulates the fate and transport of nutrients and biochemical oxygen demand (BOD) and the growth and abundance of floating (phytoplankton) and attached (periphyton) algae (as chlorophyll-a). IEPA used USGS collected flow data from the USGS gage (#5584500) on the La Moine River at Colmar, Illinois to set flow rates and to characterize hydraulic characteristics of the DO impaired segments.

IEPA performed a calibration exercise for kinetic and transport parameters in the QUAL2K model as well as a sensitivity analysis. These analyses confirmed IEPA's confidence in their model set up and provided a level of confidence to their QUAL2K modeling results.

IEPA calculated loading capacity values for each DO impaired segment (Table 7 of this Decision Document). The calculated loading capacity value is the maximum amount of oxygen-demanding material (e.g., total nitrogen, total phosphorus, CBOD, SOD, and other oxygen-demanding materials) that DO impaired segments can receive and still maintain compliance with the DO WQS.

Table 7: TMDLs addressing dissolved oxygen (i.e., Total Nitrogen (TN), Total Phosphorus (TP), Carbonaceous Biological Oxygen Demand (CBOD) & Sediment Oxygen Demand (SOD)) in the Upper La Moine River Watershed

Allocation	**Total Nitrogen**	**Total Phosphorus**	**CBOD**	**SOD**
	(lbs/day)	**(lbs/day)**	**(lbs/day)**	**(g O_2/m^2/day)**
Rock Creek (DGO-01)				
Wasteload Allocation TOTAL	0	0	NA	0
Load Allocation	8	5	NA	16
Margin of Safety (10%)	1	1	NA	2
Loading Capacity	**9**	**6**	**NA**	**18**
Reduction Needed (%)	96%	96%	--	46%
Prairie Creek (DGZN-01)				
Wasteload Allocation TOTAL	NA	NA	*	NA
Load Allocation	NA	NA	NA	11
Margin of Safety (10%)	NA	NA	4	1
Loading Capacity	**NA**	**NA**	**43**	**12**
Reduction Needed (%)	--	--	64%	64%
La Harpe Creek (DGP & DGP-01)				
Wasteload Allocation TOTAL	0	0	NA	0
Load Allocation	33	18	NA	25
Margin of Safety (10%)	4	2	NA	3

Loading Capacity	**37**	**20**	**NA**	**28**
Reduction Needed (%)	84%	87%	--	61%
South Branch of the La Moine River (DGZR)				
Wasteload Allocation TOTAL	NA	NA	**	NA
Load Allocation	NA	NA	NA	14
Margin of Safety (10%)	NA	NA	2	1
Loading Capacity	**NA**	**NA**	**24**	**15**
Reduction Needed (%)	--	--	61%	61%

* = For the purposes of the CBOD TMDL for the Prairie Creek (DGZN-01) (Table 8-15 of the final TMDL document), the WLA cannot exceed 39 lbs/day. For the current discharge permit effluent limits see Table 8-13 of the final TMDL document. CBOD limits for the Carthage STP (IL0021229) will be reviewed by Illinois EPA Permits Section during permit renewal.
** = For the purposes of the CBOD TMDL for South Branch of the La Moine River (DGZR) (Table 8-17 of the final TMDL document, the WLA cannot exceed 22 lbs/day. For the current discharge permit effluent limits see Table 8-13 of the final TMDL document. CBOD limits for the La Harpe STP (ILG580093), which is a general permit, will be reviewed by Illinois EPA Permits Section during permit renewal.

Table 7 of the Decision Document presents IEPA's loading reduction estimates for the DO TMDLs. These loading reductions (i.e., the percent reduction row at the bottom of each TMDL table) were calculated from field sampling data collected in the ULMRW. IEPA explained that its load reduction estimates are likely more conservative since they are based on a limited water quality data set.

EPA supports the data analysis and modeling approach utilized by IEPA in its calculation of WLA, LA and MOS for the DO TMDLs for the ULMRW. Additionally, EPA concurs with the loading capacities calculated by the IEPA for the ULMRW DO TMDLs. EPA finds IEPA's approach for calculating the loading capacity for the ULMRW DO TMDLs to be reasonable and consistent with EPA guidance.

ULMRW phosphorus TMDL: IEPA used the Simplified Lake Analysis Model (SLAM) to determine allocations for phosphorus for Carthage Lake. The SLAM model provides modeling for lake and sediment interactions which simulate lake nutrient and phytoplankton dynamics by using data inputs from several different sources (e.g., online databases and GIS-compatible data) (Sections 7.1.3 and 7.2.3 of the final TMDL document). A more traditional method for lake analysis, such as the BATHTUB lake model, was not used for the Carthage Lake phosphorus TMDL because IEPA determined that SLAM could also integrate the sediment dynamics and characteristics within lakes to determine phosphorus loading by using lake and sediment interactions. Parameter inputs considered in the calculations include: lake morphology, hydraulics, and thermal stratification; segmentation and flow direction; watershed inflows via runoff and point source discharge into the reservoir watershed; in-lake nutrients, settling velocity and nutrient uptake and burial; and sediment layer dynamics. Confirmatory analysis was also completed to document that the observed and simulated values supported the methodology (Section 7.2.3.1.6 of the final TMDL document).

IEPA subdivided the loading capacity among the WLA, LA, and MOS components of the TMDL (Table 8 of this Decision Document). These calculations were based on the critical condition, the summer growing season, which is typically when the water quality in Carthage Lake is typically degraded and phosphorus loading inputs are the greatest.

Table 8: TP TMDL for Carthage Lake (RLE) in the Upper La Moine River Watershed

TP Allocation	*(lbs/day)*
Carthage Lake (IL_RLE)	
Wasteload Allocation	0.00
Load Allocation - Internal Sources	0.12
Load Allocation - External Sources	1.13
Load Allocation TOTAL	1.25
Margin of Safety (10%)	0.14
Loading Capacity	**1.390**
Percent Reduction	70%

Table 8 of this Decision Document communicate IEPA's estimate of the reduction required for Carthage Lake to meet its phosphorus water quality target (0.05 mg/L). This loading reduction (i.e., the percent reduction row) were estimated from existing and TMDL load calculations. IEPA expects that this reductions will result in the attainment of the water quality target and that the lake water quality will return to a level where the designated uses are no longer considered impaired.

EPA supports the data analysis and modeling approach utilized by IEPA in its calculation of WLA, LA and MOS for the Carthage Lake TP TMDL. Additionally, EPA concurs with the loading capacities calculated by the IEPA in its Carthage Lake TP TMDL. EPA finds IEPA's approach for calculating the loading capacity for its Carthage Lake TP TMDL to be reasonable and consistent with EPA guidance.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the third criterion.

4. Load Allocations (LA)

EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity attributed to existing and future nonpoint sources and to natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. §130.2(g)). Where possible, load allocations should be described separately for natural background and nonpoint sources.

Comment:
IEPA determined the LA calculations for each of the TMDLs based on the applicable WQS. IEPA recognized that LAs for each of the individual TMDLs addressed by the ULMRW TMDLs can be attributed to different nonpoint sources.

ULMRW ammonia TMDL: The calculated LA value for the ammonia TMDLs is applicable across all flow conditions in the ULMRW (Table 5 of this Decision Document). IEPA identified several nonpoint sources which contribute ammonia loads to the surface waters of the ULMRW, including; stormwater from agricultural areas, failing septic systems, non-regulated urban runoff and wildlife (e.g., deer, geese, ducks, raccoons, turkeys and other animals). IEPA did not determine individual LA values for each of these potential nonpoint source considerations, but aggregated the nonpoint sources into a categorical LA value.

IEPA explained that under the dry and low flow regimes (Table 5 of this Decision Document) of the LDC framework, IEPA anticipates that most of the loading capacity will be made of WLA contributions (from the La Harpe STP) and that LA contributions will be less than 1 lb/day and/or close to 0 lbs/day.

ULMRW chloride TMDL: The calculated LA values for the chloride TMDL are applicable across all flow conditions. IEPA identified several nonpoint sources which contribute chloride nonpoint source loads to the surface waters in the ULMRW (Table 6 of this Decision Document). LAs were recognized as originating from many diverse nonpoint sources including; non-regulated stormwater runoff, discharges from septic systems and contributions from agricultural lands. IEPA did not determine individual load allocation values for each of these potential nonpoint source considerations, but aggregated the nonpoint sources into one categorical LA value.

IEPA explained that under the low flow regime (Table 6 of this Decision Document) of the LDC framework, IEPA anticipates that most of the loading capacity will be made of WLA contributions (from the Bushnell West STP) and that LA contributions will be less than 1 lb/day and/or close to 0 lbs/day.

ULMRW TMDLs addressing dissolved oxygen (TN/TP/CBOD/SOD): The calculated LA values for the DO TMDLs are applicable across all flow conditions. IEPA identified several nonpoint sources which contribute oxygen demanding material (e.g., total nitrogen, total phosphorus, CBOD, SOD) nonpoint source loads to the surface waters in the ULMRW (Table 7 of this Decision Document). Load allocations were recognized as originating from many diverse nonpoint sources including; non-regulated stormwater runoff, discharges from septic systems and contributions from agricultural lands. IEPA did not determine individual LA values for each of these potential nonpoint source considerations, but aggregated the nonpoint sources into one categorical LA value.

ULMRW phosphorus TMDL: The calculated LA values for the total phosphorus TMDL are applicable across all flow conditions. IEPA identified several nonpoint sources which contribute total phosphorus nonpoint source loads to the surface waters in the ULMRW (Table 8 of this Decision Document). LAs were recognized as originating from many diverse nonpoint sources including; non-regulated stormwater runoff, contributions from agricultural lands and discharges, internal loading, wetland and forest sources, discharges from septic systems and wildlife nutrient contributions. IEPA did not determine individual LA values for each of these potential nonpoint source considerations, but aggregated the nonpoint sources into one categorical LA value.

EPA finds IEPA's approach for calculating the LA to be reasonable and consistent with EPA guidance.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the fourth criterion.

5. Wasteload Allocations (WLAs)

EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to individual existing and future point source(s) (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i)). In some cases, WLAs may cover more than one discharger, e.g., if the source is contained within a general permit.

The individual WLAs may take the form of uniform percentage reductions or individual mass based limitations for dischargers where it can be shown that this solution meets WQSs and does not result in localized impairments. These individual WLAs may be adjusted during the NPDES permitting process. If the WLAs are adjusted, the individual effluent limits for each permit issued to a discharger on the impaired water must be consistent with the assumptions and requirements of the adjusted WLAs in the TMDL. If the WLAs are not adjusted, effluent limits contained in the permit must be consistent with the individual WLAs specified in the TMDL. If a draft permit provides for a higher load for a discharger than the corresponding individual WLA in the TMDL, the State/Tribe must demonstrate that the total WLA in the TMDL will be achieved through reductions in the remaining individual WLAs and that localized impairments will not result. All permittees should be notified of any deviations from the initial individual WLAs contained in the TMDL. EPA does not require the establishment of a new TMDL to reflect these revised allocations as long as the total WLA, as expressed in the TMDL, remains the same or decreases, and there is no reallocation between the total WLA and the total LA.

Comment:
ULMRW ammonia TMDL: IEPA identified one NPDES permitted facility, the La Harpe Sewage Treatment Plant (STP) (LG580093), which contributes ammonia to the South Branch of the La Moine River (DGZR) impaired segment (Table 5 of this Decision Document). IEPA used the facility's design average flow (DAF) multiplied by the ammonia TMDL target value (see Table 3 of this Decision Document, dependent on the season to calculate the ammonia WLAs. IEPA explained that the WLAs for these ammonia TMDLs would be applicable across the water year and that the WLAs will be consistent with the water quality based effluent limits (WQBEL) and NPDES permit language.

EPA finds IEPA's approach for calculating the WLAs for the South Branch of the La Moine River ammonia TMDL to be reasonable and consistent with EPA guidance.

ULMRW chloride TMDL: IEPA identified one facility, the Bushnell West STP (IL0024384) which contributes chloride loading to the Drowning Fork Creek impaired segment (Table 6 of this Decision Document). The WLA assigned to the Bushnell West STP was calculated based on the DAF and the chloride TMDL target (500 mg/L) for all flow regimes except for the Very Low flow regime (Table 6 of this Decision Document). IEPA adjusted the WLA for the Very Low flow regime to account for the calculated loading capacity, the MOS (10% of the loading capacity) and LA assumption which was that the LA was set close to 0 lbs/day.

EPA finds IEPA's approach for calculating the WLA for the Drowning Fork Creek chloride TMDL to be reasonable and consistent with EPA guidance.

ULMRW TMDLs addressing dissolved oxygen (TN/TP/CBOD/SOD): The QUAL2K model demonstrated that the main drivers for low dissolved oxygen concentrations in the water column were attributed to a combination of nutrient inputs and accompanying plant growth within the water column, aerobic respiration from those plants and elevated sediment oxygen demanding interactions at the water-sediment interface. IEPA also acknowledged that certain point sources likely contribute loading of sediment and oxygen-demanding materials into the impaired segments.

IEPA identified two facilities, the Carthage STP (IL0021229) to the Prairie Creek (DGZN-01) impaired segment and the La Harpe STP (ILG580093) to the South Branch of the La Moine River (DGZR) which contribute oxygen demanding material in the form of CBOD loads to the impaired DO segments in the ULMRW (Table 7 of this Decision Document). A third facility, the Blandinsville STP (IL0072672) was identified as a potential contributor to La Harpe Creek (DGP-01) (Table 8-13 of the final TMDL document) but IEPA explained that this facility discharges to an unnamed tributary of Bishop Creek which is further upstream of the confluence with La Harpe Creek and therefore, was not included in the modeling efforts for the La Harpe Creek DO TMDL.

IEPA will evaluate the need for further point source controls or revisions to existing permits for the Carthage STP and the La Harpe STP facilities at the time when each individual facility's permit is up for renewal (Section 9.5.1 of the final TMDL document). IEPA explained that each facility's discharges should continue to be monitored on a daily basis and any violations of the effluent limits may prompt further regulatory actions.

EPA finds IEPA's approach for calculating the WLA for the ULMRW DO TMDLs to be reasonable and consistent with EPA guidance.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the fifth criterion.

6. Margin of Safety (MOS)

The statute and regulations require that a TMDL include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)). EPA's 1991 TMDL Guidance explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set aside for the MOS must be identified.

Comment:
The final TMDL submittal outlines the determination of the Margin of Safety for the ammonia, chloride, dissolved oxygen and phosphorus TMDLs. The chloride, dissolved oxygen and phosphorus incorporated an explicit MOS set at 10% of the loading capacity. The ammonia TMDL for the South Branch of the La Moine River employed both an implicit MOS.

ULMRW ammonia TMDL: IEPA employed an implicit margin of safety due to using the lowest chronic instream water quality standard (Table 3 of this Decision Document) and minimal seasonal chronic standard for the South Branch of the La Moine River segment.

ULMRW chloride TMDL, TMDLs addressing dissolved oxygen (TN/TP/CBOD/SOD) and phosphorus TMDL: IEPA employed an explicit MOS set at 10% of the loading capacity. The explicit MOS was applied by reserving 10% of the total loading capacity, and then allocating the remaining loads to point and nonpoint sources (Tables 6 to 8 of this Decision Document).

The use of the LDC approach minimized variability associated with the development of the ULMRW TMDLs because the calculation of the loading capacity was a function of flow multiplied by the target value. The MOS was set at 10% to account for uncertainty due to field sampling error, basing assumptions on water quality monitoring with low sample sizes, and imperfect water quality targets. A 10% MOS was considered appropriate, because the target values used in this TMDL had a firm technical basis and the estimated flows are believed to be relatively accurate because they were estimated based on a USGS gage located with or just outside of the subwatershed with the impaired segments.

The margin of safety is appropriate because the use of the LDC provides an accurate account of existing stream conditions (calculated by multiplying daily flows by existing pollutant levels), and an accurate account of the stream's loading capacity (calculated by multiplying daily flows by the appropriate water quality target). In other words, there is a good fit between observed (existing) data and predicted data using the LDC approach, thus providing a relatively accurate determination of the TMDL reductions needed. IEPA accounts for any uncertainty in this method by incorporating the MOS.

For the total phosphorus TMDLs, IEPA also noted that an implicit MOS is included in the loadings. IEPA believes the default values used in the SLAM model are conservative, as they are based upon a wide range of lakes and reservoirs in the East and Midwest.

The EPA finds that the TMDL document submitted by IEPA contains an appropriate MOS satisfying the requirements of the sixth criterion.

7. Seasonal Variation

The statute and regulations require that a TMDL be established with consideration of seasonal variations. The TMDL must describe the method chosen for including seasonal variations. (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)).

Comment:
ULMRW ammonia and chloride TMDLs: The Ammonia and chloride TMDLs accounted for seasonality via the LDC framework which inherently accounts for seasonal variation by using daily flows over a multi-year period. The LDC process used streamflows over a wide range of flow conditions across the entire water year. For the LDC-based TMDLs in the ULMRW, runoff is the main transport mechanism which delivers pollutant loading into the surface water environment. LDC graphs can provide insight toward understanding under which flow regimes/conditions exceedances of the WQS or water quality targets are occurring, and whether or not there is any seasonal flow component to those flow conditions (i.e., spring melt, summer precipitation events during lower flow periods, etc.)

ULMRW TMDLs addressing dissolved oxygen (TN/TP/CBOD/SOD): IEPA explained that the dissolved oxygen TMDLs accounted for seasonality via modeling inputs which represent the time of year when dissolved oxygen concentrations in the water column are at their lowest instream concentrations (Section 8.3.4.2 of the final TMDL document). IEPA identified these low dissolved oxygen conditions in the water column as the critical conditions for TMDL analyses and implementation planning.

ULMRW phosphorus TMDL: IEPA explained that the phosphorus TMDL accounted for seasonality in its SLAM modeling efforts by using annual calculations which account for seasonal effects in Carthage Lake (Section 8.3.5.2 of the final TMDL document). Source inputs contribute different loadings to the lake at varying times of the year (e.g., agricultural processes occurring at different times of the year, seasonal changes in precipitation which result in differences in runoff volumes to surface waters, etc.) IEPA determined that capturing these differences on the annual scale and converting those annual calculations to daily loading estimates was best for the capturing seasonal changes to Carthage Lake. IEPA explained that the critical condition for Carthage Lake was the summer growing season which is typically when the water quality in Carthage Lake is typically degraded and phosphorus loading inputs are the greatest.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the seventh criterion.

8. Reasonable Assurance

When a TMDL is developed for waters impaired by point sources only, the issuance of a NPDES permit(s) provides the reasonable assurance that the wasteload allocations contained in the TMDL will be achieved. This is because 40 C.F.R. 122.44(d)(1)(vii)(B) requires that effluent limits in permits be consistent with, "the assumptions and requirements of any available wasteload allocation" in an approved TMDL.

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to implement water quality standards.

EPA's August 1997 TMDL Guidance also directs Regions to work with States to achieve TMDL load allocations in waters impaired only by nonpoint sources. However, EPA cannot disapprove a TMDL for nonpoint source-only impaired waters, which do not have a demonstration of reasonable assurance that LAs will be achieved, because such a showing is not required by current regulations.

Comment:
The ULMRW ammonia, chloride, dissolved oxygen and phosphorus TMDLs provide reasonable assurance that actions identified in the implementation section of the final TMDL (i.e., Section 9 of the final TMDL document), will be applied to attain the loading capacities and allocations calculated for the impaired reaches within the ULMRW. The recommendations made by IEPA will be successful at improving water quality if the appropriate local groups work to implement these recommendations. Those mitigation suggestions, which fall outside of regulatory authority, will require commitment from state agencies and local stakeholders to carry out the suggested actions.

IEPA outlines its reasonable assurance efforts in Section 9 of the final TMDL document. IEPA outlines management measures and programs which will be employed to attain the loading capacities and allocations calculated for the impaired reaches within the ULMRW. Section includes components of a more formal Implementation Plan for the ULMRW.

Reasonable assurance that the WLA set forth will be implemented is provided by regulatory actions. According to 40 C.F.R. 122.44(d)(1)(vii)(B), NPDES permit effluent limits must be consistent with assumptions and requirements of all WLAs in an approved TMDL. IEPA's NPDES permit program is one of the implementing programs for ensuring WLA are consistent with the TMDL. Current NPDES permits will remain in effect until the permits are reissued, provided that IEPA receives the NPDES permit renewal application prior to the expiration date of the existing NPDES permit.

Section 9 of the TMDL discusses various BMPs that, when implemented, will significantly reduce ammonia, chloride, oxygen demanding material and phosphorus inputs to surface waters of the ULMRW. In Table 9-9 of Section 9.13 of the final TMDL document, IEPA lists site-specific BMP costs, the programming which typically provide financial assistance for these BMPs (e.g., USDA-NRCS - Conservation Reserve Program (CRP), USDA- NRCS-Environmental Quality Incentives Program (EQIP), IDA-Conservation Practices Program (CPP)) and potential sponsors. In the amended WBP of 2014, most projects involved the incorporation of urbanized BMPs to the ULMRW. These BMPs included; green infrastructure projects, urban filter strips, brush management and streambank restoration efforts, culvert resizing, floodplain management and reconnection, wetland restoration, dam removal and vegetated swales.

Table 9-10 of the TMDL provides an estimated implementation schedule of actions and activities in the watershed that can reduce ammonia, chloride, oxygen demanding material and phosphorus loads into waterbodies in the ULMRW. These actions address immediate (1-2 years), mid-term (5-10 years) and long-term (continuous) timeframes.

IEPA has also developed Load Reduction Strategies (LRS) for various pollutants in the watershed. These LRSs address impairments where numeric criteria have not been developed (e.g., total suspended solids (TSS), sedimentation/siltation). Although these are not TMDLs, the LRSs discuss sources and reductions needed for the various pollutants which impact overall water quality in the ULMRW. IEPA has concluded that reducing these pollutants will improve water quality in ULMRW and assist in implementing BMPs in the watershed.

The EPA finds that this criterion has been adequately addressed.

9. Monitoring Plan to Track TMDL Effectiveness

EPA's 1991 document, *Guidance for Water Quality-Based Decisions: The TMDL Process* (EPA 440/4-91-001), recommends a monitoring plan to track the effectiveness of a TMDL, particularly when a TMDL involves both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur. Such a TMDL should provide assurances that nonpoint source controls will achieve expected load reductions and, such TMDL should include a monitoring plan that describes the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring and leading to attainment of water quality standards.

Comment:
The final TMDL document contains discussion on future monitoring within the ULMRW and milestones (Section 9.14 of the final TMDL document). Continued water quality monitoring within the basin is supported by IEPA. Additional water quality monitoring results could provide insight into the success or failure of BMP systems designed to reduce ammonia, chloride, oxygen demanding material and phosphorus loading into the surface waters of the watershed. Local watershed managers would be able to reflect on the progress of the various pollutant removal strategies and would have the opportunity to change course if observed progress is unsatisfactory.

Progress of TMDL implementation will be measured through monitoring efforts focused on:

- Tracking implementation of BMPs in the watershed;
- Estimating the effectiveness of BMPs;
- Additional monitoring of point source discharges in the watershed;
- Continued monitoring of impaired stream segments and tributaries;
- Monitoring storm-based high flow events; and
- Low flow monitoring in impaired stream segments.

IEPA anticipates continuing to measure water quality in the ULMRW via its Intensive Basin Survey water quality monitoring which occurs every 5 years. Additionally, IEPA explained that select ambient water quality locations are sampled nine times a year. Continuation of these programs will enable IEPA to evaluate water quality improvements in the ULMRW over time.

Water quality monitoring is a critical component of the adaptive management strategy employed as part of the implementation efforts utilized in the ULMRW. Water quality information will aid watershed managers in understanding how BMP pollutant removal efforts are impacting water quality. Water quality monitoring combined with an annual review of BMP efficiency will provide information on the success or failure of BMP systems designed to reduce pollutant loading into water bodies of the ULMRW. Watershed managers will have the opportunity to reflect on the progress or lack of progress, and will have the opportunity to change course if progress is unsatisfactory.

The EPA finds that this criterion has been adequately addressed.

10. Implementation

EPA policy encourages Regions to work in partnership with States/Tribes to achieve nonpoint source load allocations established for 303(d)-listed waters impaired by nonpoint sources. Regions may assist States/Tribes in developing implementation plans that include reasonable assurances that nonpoint source LAs established in TMDLs for waters impaired solely or primarily by nonpoint sources will in fact be achieved. In addition, EPA policy recognizes that other relevant watershed management processes may be used in the TMDL process. EPA is not required to and does not approve TMDL implementation plans.

Comment:
The findings from the ULMRW TMDLs will be used to inform the selection of implementation activities in the watershed. The TMDL outlined some implementation strategies in Section 9 of the final TMDL document. IEPA outlined the importance of prioritizing areas within the ULMRW, education and outreach efforts with local partners, and partnering with local stakeholders to improve water quality within the watershed. The reduction goals for the ammonia, chloride, dissolved oxygen and phosphorus TMDLs may be met via a combination of the following strategies:

ULMRW ammonia, TMDLs addressing dissolved oxygen (TN/TP/CBOD/SOD) and phosphorus TMDLs: The potential BMPs which, if installed and maintained, would likely result in decreases in ammonia, oxygen demanding materials and phosphorus to surface waters of the ULMRW are:

- ***Stormwater volume control and infiltration BMPs:*** To mitigate the impact of stormwater in the ULMRW, IEPA recommends the installation of stormwater BMPs, including some combination of; rain gardens, vegetated swales/bioswales/bioretention areas, detention ponds, rain barrels, pervious pavement and infiltration trenches. Reducing peak flow stormwater inputs within the ULMRW may be accomplished via reducing impervious cover or employing other low impact development/ green technologies which allow stormwater to infiltrate, evaporate or evapotranspire before reaching the stormwater conveyance system.
- ***Filter strips, riparian buffers, bank stabilization and erosion control*** – Protection of streambanks within the watershed through planting of vegetated/buffer areas with grasses, legumes, shrubs or trees will mitigate ammonia and nutrient inputs into surface waters. These areas will filter stormwater runoff before the runoff enters the main stem or tributaries of the ULMRW. An assessment of stream channel, river channel, and lakeshore erosional areas should be completed to evaluate areas where erosion control strategies could be implemented in the ULMRW. Implementation actions (e.g., planting deep-rooted vegetation near water bodies to stabilize streambanks) could be prioritized to target areas which are actively eroding. This strategy could prevent additional sediment inputs into surface waters of the ULMRW and minimize or eliminate degradation of habitat.
- ***Urban/Residential Nutrient Reduction Strategies:*** These strategies involve reducing stormwater runoff from lakeshore homes and other residences within the ULMRW. These practices would include; rain gardens, lawn fertilizer reduction, lake shore buffer strips, vegetation management and replacement of failing septic systems. Municipal programs, such as street sweeping, can also aid in the reduction of nutrients to surface water bodies within the ULMRW. Municipal partners can team with local watershed groups or water district partners to assess how best to utilize their monetary resources for installing new stormwater BMPs (e.g., vegetated swales) or retro-fitting existing stormwater BMPs.
- ***Nutrient management*** – These strategies involve reducing nutrient transport from fields and minimizing soil loss. Specific practices would include; erosion control through conservation tillage, reduction of winter spreading of fertilizers, elimination of fertilizer spreading near open inlets and sensitive areas, installation of stream and lake shore buffer strips, streambank stabilization practices (gully stabilization and installation of fencing near streams), and nutrient management planning.
- ***Pasture management and fencing*** - Reducing livestock access to stream environments will lower the opportunity for direct transport of ammonia and nutrients to surface waters. The installation of exclusion fencing near stream and river environments to prevent direct access for livestock, installing alternative water supplies, and installing stream crossings between pastures,

would work to reduce the influxes of ammonia and nutrients and improve water quality within the watershed. Additionally, introducing rotational grazing to increase grass coverage in pastures, and maintaining appropriate numbers of livestock per acre for grazing, can also aid in the reduction of ammonia and nutrient inputs.

- ***Phosphorus-based lawn fertilizer restrictions*** – Runoff from urban and suburban areas may include phosphorus-based fertilizers. Reducing stormwater input from residential lawns, golf courses and other urban/suburban surfaces will reduce the phosphorus inputs to surface waters. Some of these practices could include; rain gardens, municipal street sweeping efforts, lake shore buffer strips, vegetation management and water quality educational programs which aim to inform the general public on nutrient reduction efforts and their impact on water quality.
- ***Private septic system inspection and maintenance program*** - Septic systems are believed to be a source of nutrients to waters in the ULMRW. Failing systems are expected to be identified and addressed via upgrades to those septic systems not meeting local health ordinances. Septic system improvement priority should be given to those failing systems adjacent to surface waters (i.e., streams or lakes).
- ***In-lake phosphorus loading (internal loading)*** - Internal nutrient loads may be addressed to meet the TMDL allocations outlined in the Carthage Lake phosphorus TMDL.
  - *Hypolimnetic aeration:* Increasing oxygen at selected depths in a lake may enhance oxygen transfer efficiencies and reduce internal loading from phosphorus laden lake bottom sediments.
  - *Phosphorus inactivation from aluminum addition (i.e., aluminum sulfate or alum):* The addition of chemical reactants (e.g., aluminum sulfate) to Carthage Lake in order for those reactants to permanently bind phosphorus into the lake bottom sediments. This effort could decrease phosphorus releases from sediment into the lake water column during anoxic conditions.
  - *Dredging of lake bottom sediments:* IEPA explained that phosphorus release from lake bottom sediments is greatest from the recently deposited phosphorus rich layers of lake sediments. Removing this material, via dredging efforts, will contribute to reductions in internal loading.

ULMRW chloride TMDL: The potential BMPs which, if installed and maintained, would likely result in decreases in chloride to surface waters of the ULMRW are:

- ***More efficient use of salt resources:*** Improving winter maintenance practices (i.e., reducing the amount of salt used) of municipal and private applicators for smarter and more efficient use of salt resources. The key challenge in reducing salt usage is balancing the need for public safety with the growing expectation for clear, dry roads, parking lots, and sidewalks throughout the mix, severity, and duration of winter conditions in the ULMRW.

Education and Outreach Efforts - Increased education and outreach efforts to the general public bring greater awareness to the issues surrounding ammonia, chloride, oxygen demanding materials and phosphorus contamination and strategies for reducing loading and transport of these pollutants should be prioritized as part of the overall implementation strategy.

The EPA finds that this criterion has been adequately addressed. The EPA reviews but does not approve implementation plans.

11. Public Participation

EPA policy is that there should be full and meaningful public participation in the TMDL development process. The TMDL regulations require that each State/Tribe must subject calculations to establish TMDLs to public review consistent with its own continuing planning process (40 C.F.R. §130.7(c)(1)(ii)). In guidance, EPA has explained that final TMDLs submitted to EPA for review and approval should describe the State's/Tribe's public participation process, including a summary of significant comments and the State's/Tribe's responses to those comments. When EPA establishes a TMDL, EPA regulations require EPA to publish a notice seeking public comment (40 C.F.R. §130.7(d)(2)).

Provision of inadequate public participation may be a basis for disapproving a TMDL. If EPA determines that a State/Tribe has not provided adequate public participation, EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by EPA.

Comment:
The public participation section of the TMDL submittal is found in Section 3 of the final TMDL document. Throughout the development of the ULMRW TMDLs the public was given various opportunities to participate. IEPA and its TMDL contractor held a series of public meetings in the ULMRW during TMDL development, where IEPA described the watershed plan and TMDL process. The public comment period for the draft TMDL was held between November 18, 2020 and December 21, 2020. IEPA posted the draft TMDL online at (https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Pages/reports.aspx) for the public comment period.

IEPA received one public comment during the public comment period. IEPA developed a response summary to address the comments submitted. EPA reviewed IEPA's response to the comment and has determined that IEPA responded appropriately to the comment. IEPA submitted the comment received during the public notice period and its response with the final TMDL submittal packet received by the EPA on February 23, 2021.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of this eleventh element.

12. Submittal Letter

A submittal letter should be included with the TMDL submittal, and should specify whether the TMDL is being submitted for a *technical review* or *final review and approval*. Each final TMDL submitted to EPA should be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for EPA review and approval. This clearly establishes the State's/Tribe's intent to submit, and EPA's duty to review, the TMDL under the statute. The submittal letter, whether for technical review or final review and approval, should contain such identifying information as the name and location of the water body, and the pollutant(s) of concern.

Comment:
The EPA received the final Upper La Moine River Watershed TMDL document, submittal letter and accompanying documentation from IEPA on February 23, 2021. The submittal letter explicitly stated that the final TMDLs referenced in Table 1 of this Decision Document were being submitted to EPA pursuant to Section 303(d) of the Clean Water Act for EPA review and approval. The submittal letter also included the name and location of the water bodies and the causes/pollutants of concern. This TMDL was submitted per the requirements under Section 303(d) of the Clean Water Act and 40 C.F.R. 130.

The EPA finds that the TMDL transmittal letter submitted for the Upper La Moine River Watershed TMDLs by IEPA satisfies the requirements of this twelfth element.

13. Conclusion

After a full and complete review, the EPA finds that the 1 ammonia TMDL, the 1 chloride TMDL, the 4 dissolved oxygen TMDLs and the 1 total phosphorus TMDL satisfy all elements for approvable TMDLs. This TMDL approval is for **seven (7) TMDLs**, addressing segments for aquatic life and aesthetic quality use impairments (Table 1 of this Decision Document).

The EPA's approval of these TMDLs extends to the water bodies which are identified above with the exception of any portions of the water bodies that are within Indian Country, as defined in 18 U.S.C. Section 1151. The EPA is taking no action to approve or disapprove TMDLs for those waters at this time. The EPA, or eligible Indian Tribes, as appropriate, will retain responsibilities under the CWA Section 303(d) for those waters.

ATTACHMENTS

Attachment #1: **Table 5: The Ammonia TMDL for the South Branch of the La Moine River (IL_DGZR) in the Upper La Moine River Watershed**

Attachment #2: **Table 6: The Chloride TMDL for the Drowning Fork Creek (IL-DLGC-01) segment in the Upper La Moine River Watershed**

Table 5: Ammonia TMDL for the South Branch of the La Moine River (IL_DGZR) in the Upper La Moine River Watershed

Allocation	**Flow Zone**	**High Flows**	**Moist Flows**			**Mid-Range Flows**	**Dry Flows**				**Low Flows**
	Flow Exceedance Range (%)	**0 - 10**	**10 - 20**	**20 - 30**	**30 - 40**	**40 - 50**	**50 - 60**	**60 - 70**	**70 - 80**	**80 - 90**	**90 - 100**
	Source	*Ammonia load (lbs/day)*									
South Branch of the La Moine River (IL_DGZR) - Summer (June to August) conditions											
Wasteload Allocation	WLA- La Harpe STP (ILG580093)	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30
	Wasteload Allocation Total	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30
Load Allocation		558.00	165.00	82.00	48.00	29.00	17.00	9.00	5.00	0.50	*
Margin of Safety (implicit)		*(Implicit)*									
Loading Capacity		**562.30**	**169.30**	**86.30**	**52.30**	**33.30**	**21.30**	**13.30**	**9.30**	**4.80**	**4.30**
Percent Reduction		--	--	--	--	--	--	--	--	--	57%
South Branch of the La Moine River (IL_DGZR) - Spring (March to May) and Fall (September to October) conditions											
Wasteload Allocation	WLA- La Harpe STP (ILG580093)	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	
	Wasteload Allocation Total	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	
Load Allocation		628.00	233.00	132.00	86.00	57.00	35.00	17.00	5.00	*	
Margin of Safety (implicit)		*(Implicit)*									
Loading Capacity		**632.40**	**237.40**	**136.40**	**90.40**	**61.40**	**39.40**	**21.40**	**9.00**	**4.40**	
Percent Reduction		--	--	--	--	--	--	--	--	45%	

South Branch of the La Moine River (IL_DGZR) - Winter (November to February)											
Wasteload Allocation	WLA- La Harpe STP (ILG580093)	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20
	Wasteload Allocation Total	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20
Load Allocation		825.00	277.00	158.00	97.00	63.00	36.00	18.00	7.00	0.80	0.80
Margin of Safety (implicit)		*(Implicit)*									
Loading Capacity		**833.20**	**285.20**	**166.20**	**105.20**	**71.20**	**44.20**	**26.20**	**15.20**	**9.00**	**9.00**
Percent Reduction		--	--	--	--	--	--	--	--	--	--

* = IEPA explained that nonpoint source/watershed contributions during the low flow regime are expected to be near zero

Table 6: Chloride TMDL for the Drowning Fork Creek (IL-DLGC-01) segment in the Upper La Moine River Watershed

Allocation	**Flow Zone**	**High Flows**	**Moist Flows**			**Mid-Range Flows**	**Dry Flows**				**Low Flows**
	Flow Exceedance Range (%)	**0 - 10**	**10 - 20**	**20 - 30**	**30 - 40**	**40 - 50**	**50 - 60**	**60 - 70**	**70 - 80**	**80 - 90**	**90 - 100**
	Source	*Chloride (lbs/day)*									
Drowning Fork Creek (IL_DLGC-01)											
Wasteload Allocation	WLA - Bushnell West STP (IL0024384)	1,043	1,043	1,043	1,043	1,043	1,043	1,043	1,043	1,043	752
Wasteload Allocation Total		1,043	1,043	1,043	1,043	1,043	1,043	1,043	1,043	1,043	752
Load Allocation		265,976	89,692	49,769	31,363	19,697	11,920	6,346	2,976	967	*
Margin of Safety (10%)		29,669	10,082	5,646	3,601	2,304	1,440	821	446	223	84
Loading Capacity		**296,688**	**100,817**	**56,458**	**36,007**	**23,044**	**14,403**	**8,210**	**4,465**	**2,233**	**836**
Percent Reduction		--	--	--	--	--	--	--	--	--	52.0%

* = IEPA explained that nonpoint source/watershed contributions during the low flow regime are expected to be near zero

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

REPLY TO THE ATTENTION OF:
W-16J

March 23, 2021

Sanjay Sofat, Chief
Bureau of Water
Illinois Environmental Protection Agency
P.O. Box 19276
Springfield, Illinois 62794-9276

Dear Mr. Sofat:

The U.S. Environmental Protection Agency has conducted a complete review of the final Total Maximum Daily Loads (TMDL) for segments within the Upper La Moine River watershed (ULMRW), including support documentation and follow up information. The ULMRW is in western central Illinois in portions of Hancock, Henderson, McDonough and Warren Counties. The ULMRW TMDLs address impaired aquatic life use due to excessive ammonia, chloride and dissolved oxygen concentrations in the water column and aesthetic quality impairments due to excessive nutrients (total phosphorus).

EPA has determined that the ULMRW TMDLs meet the requirements of Section 303(d) of the Clean Water Act and EPA's implementing regulations set forth at 40 C.F.R. Part 130. Therefore, EPA approves Illinois's one ammonia TMDL, one chloride TMDL, four dissolved oxygen TMDLs and one total phosphorus TMDL for a total of seven TMDLs. The statutory and regulatory requirements, and EPA's review of Illinois's compliance with each requirement, are described in the enclosed decision document.

EPA acknowledges Illinois's efforts in submitting these TMDLs and looks forward to future TMDL submissions by the State of Illinois. If you have any questions, please contact Mr. Paul Proto, at 312-353-8657 or at proto.paul@epa.gov.

Sincerely,

Linda Holst
Digitally signed by LINDA HOLST
Date: 2021.03.23 16:03:56 -05'00'

Tera L. Fong
Division Director, Water Division

cc: Abel Haile, IEPA

TMDL: Upper La Moine River watershed ammonia, chloride, dissolved oxygen and phosphorus TMDLs in portions of Hancock, Henderson, McDonough, and Warren Counties, Illinois
Date: March 23, 2021

DECISION DOCUMENT
FOR THE UPPER LA MOINE RIVER WATERSHED TMDLS, HANCOCK, HENDERSON, MCDONOUGH & WARREN COUNTIES, IL

Section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations at 40 C.F.R. Part 130 describe the statutory and regulatory requirements for approvable TMDLs. Additional information is generally necessary for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations, and should be included in the submittal package. Use of the verb "must" below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation. Use of the term "should" below denotes information that is generally necessary for EPA to determine if a submitted TMDL is approvable. These TMDL review guidelines are not themselves regulations. They are an attempt to summarize and provide guidance regarding currently effective statutory and regulatory requirements relating to TMDLs. Any differences between these guidelines and EPA's TMDL regulations should be resolved in favor of the regulations themselves.

1. Identification of Water body, Pollutant of Concern, Pollutant Sources, and Priority Ranking

The TMDL submittal should identify the water body as it appears on the State's/Tribe's 303(d) list. The water body should be identified/georeferenced using the National Hydrography Dataset (NHD), and the TMDL should clearly identify the pollutant for which the TMDL is being established. In addition, the TMDL should identify the priority ranking of the water body and specify the link between the pollutant of concern and the water quality standard (see Section 2 below).

The TMDL submittal should include an identification of the point and nonpoint sources of the pollutant of concern, including location of the source(s) and the quantity of the loading, e.g., lbs/per day. The TMDL should provide the identification numbers of the NPDES permits within the water body. Where it is possible to separate natural background from nonpoint sources, the TMDL should include a description of the natural background. This information is necessary for EPA's review of the load and wasteload allocations, which are required by regulation.

The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as:

(1) the spatial extent of the watershed in which the impaired water body is located;
(2) the assumed distribution of land use in the watershed (e.g., urban, forested, agriculture);
(3) population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources;
(4) present and future growth trends, if taken into consideration in preparing the TMDL (e.g., the TMDL could include the design capacity of a wastewater treatment facility); and

(5) an explanation and analytical basis for expressing the TMDL through *surrogate measures*, if applicable. *Surrogate measures* are parameters such as percent fines and turbidity for sediment impairments; chlorophyll <u>a</u> and phosphorus loadings for excess algae; length of riparian buffer; or number of acres of best management practices.

<u>Comment:</u>

Location Description/Spatial Extent:

The Upper La Moine River Watershed (ULMRW) (HUC-8 #07130010) is located in western central Illinois in Hancock, Henderson, McDonough and Warren counties. The ULMRW drains approximately 369,000 acres (i.e., 576.5 square miles) in Illinois. Surface waters in the ULMRW generally flow from the northeast to the southwest where they empty into the main stem of the La Moine River north of Colmar, Illinois. The ULMRW TMDLs address a total of seven (7) impaired segments due to: excessive ammonia (1 segment), chloride (1 segment) and nutrients (i.e., total phosphorus, 1 segment) as well four (4) impaired segments which violate dissolved oxygen water quality standards (WQS) (Table 1 of this Decision Document).

Table 1: Upper La Moine River Watershed impaired waters addressed by this TMDL

Water body name	Assessment Unit ID	Affected Use	Pollutant or stressor	TMDL
Ammonia TMDL				
South Branch of the La Moine River	IL_DGZR	Aquatic Life	Ammonia/nitrogen	Ammonia TMDL
Chloride TMDL				
Drowning Fork Creek	IL_DGLC-01	Aquatic Life	Chloride	Chloride TMDL
Dissolved Oxygen TMDLs				
Rock Creek	IL_DGO-01	Aquatic Life	Nutrients (TN and TP)	Total nitrogen (TN), total phosphorus (TP), carbonaceous biochemical oxygen demand (CBOD) and sediment oxygen demand (SOD) TMDLs
La Harpe Creek	IL_DGP-01	Aquatic Life	Nutrients (TN and TP)	
Prairie Creek	IL_DGZN-01	Aquatic Life	Nutrients (TN and TP)	
South Branch of the La Moine River	IL_DGZR	Aquatic Life	Nutrients (TN and TP)	
Total Phosphorus TMDLs				
Carthage Lake	IL_RLE	Aesthetic quality	Phosphorus	TP TMDL

Land Use:

Land use in the ULMRW is predominantly agricultural as approximately 66% of the land use is devoted to corn or soybean fields. Forested, woodland, grasslands or shrublands cover approximately 28% of the ULMRW with the remaining land uses of developed/urban land uses (6%) and wetland/open waters (less than 1%) (Table 2 of this Decision Document).

Table 2: Upper La Moine River Watershed Land Cover - based on 2014 National Agricultural Statistics Service (NASS) Cropland Data Layer

Land Use / Land Cover Category	Acreage	Percentage
Corn	137,055	37.14%
Soybeans	104,627	28.35%
Deciduous Forest	59,764	16.19%
Grass/Pasture	42,463	11.51%
Developed/Low Intensity	11,458	3.10%
Developed/Open Space	7,331	1.99%
All others	6,351	1.72%
TOTALS	**369,049**	**100%**

Problem Identification:

Ammonia TMDL: The South Branch of the La Moine River (DGZR) ammonia impaired segment identified in Table 1 of this Decision Document was included on the 2016 Illinois 303(d) List due to excessive ammonia. Water quality monitoring within the ULMRW indicated that this segment was not attaining its designated aquatic life uses due to elevated ammonia measurements and the negative impact of those conditions on aquatic life (i.e., fish and macroinvertebrate communities).

Ammonia is naturally found in the environment and is a part of the nitrogen cycle (e.g., nitrogen fixation processes). Natural sources of ammonia include the decomposition of organic matter, gas exchange in the atmosphere, human and animal wastes and forest fires. Ammonia is toxic to fish at high concentrations and elevated concentrations in the water column can make it difficult for aquatic organisms to sufficiently excrete the toxicant (i.e., ammonia), leading to ammonia accumulating in internal tissues and blood. Environmental factors, such as pH and temperature in the water column, can affect ammonia toxicity to aquatic species.

Chloride TMDL: The Drowning Fork Creek (DGLC-01) chloride impaired segment identified in Table 1 of this Decision Document was included on the 2016 Illinois 303(d) list due to excessive chloride. Water quality monitoring within the ULMRW indicated that this segment was not attaining its designated aquatic life uses due to high chloride measurements and the negative impact of those conditions on aquatic life (i.e., fish and macroinvertebrate communities).

Low levels of chloride can be found naturally in lakes and streams. Chloride is essential for aquatic life to carry out a range of biological functions. However, high concentrations of chloride in the water column can harm cellular osmotic processes in aquatic organisms. If elevated concentrations of chloride persist in the water column, aquatic life such as fish, invertebrates and even some plant species may become stressed and/or die.

High levels of salt can also negatively affect groundwater and drinking water supplies, pets, wildlife, soils, infrastructure and vehicles.

TMDLs addressing dissolved oxygen (Total nitrogen (TN), total phosphorus (TP), carbonaceous biochemical oxygen demand (CBOD) & sediment oxygen demand (SOD): The four impaired segments identified in Table 1 of this Decision Document were included on the 2016 Illinois 303(d) list due to low concentrations of dissolved oxygen and the negative impact of those conditions on aquatic life (i.e., fish and macroinvertebrate communities). The Illinois Environmental Protection Agency (IEPA) targeted total nitrogen, total phosphorus, CBOD & SOD as the main factors influencing dissolved oxygen concentrations in the water column of the ULMRW. During development of the TMDL, IEPA determined that the low DO was the result of an interaction between these pollutants in the waterbody, and developed allocations based upon the oxygen-demanding substances identified in each waterbody (Section 8.3.4.1 of the final TMDL document). Modeling analyses found that the DO water quality standards could be attained in the ULMRW segments via a combination of reductions in nutrient load (i.e., total nitrogen and total phosphorus) and oxygen-demanding material loads (i.e., CBOD and SOD). Therefore, IEPA targeted these parameters in the development of TMDLs to address the DO impairments in the ULMRW.

Low dissolved oxygen concentrations can negatively impact aquatic life use. The decreases in dissolved oxygen can stress benthic macroinvertebrates and fish. Increased turbidity, brought on by elevated levels of nutrients within the water column, can reduce dissolved oxygen in the water column, and cause large shifts in dissolved oxygen and pH throughout the day. Shifting chemical conditions within the water column may stress aquatic biota (i.e., fish and macroinvertebrate species). In some instances, degradations in aquatic habitats or water quality have reduced fish populations or altered fish communities from those communities supporting sport fish species to communities which support more tolerant rough fish species.

Biological processes associated with the breakdown and conversion of organic carbon to carbon dioxide are measured by CBOD. SOD is a measure of the oxygen depletion of biological and chemical processes in sediment (e.g., the aerobic decay of organic materials in stream sediments). Both CBOD and SOD remove oxygen from the water column at the sediment/water column interface.

Total phosphorus TMDL: Carthage Lake (RLE) identified in Table 1 of this Decision Document was included on the 2016 Illinois 303(d) list due to excessive nutrients (phosphorus). Water quality monitoring demonstrated that Carthage Lake was not attaining its designated aquatic life and aesthetic quality uses due to excessive nutrients. Water quality monitoring within the ULMRW was completed at several locations and the data collected during these efforts served as the foundation for modeling efforts completed in this TMDL study.

While TP is an essential nutrient for aquatic life, elevated concentrations of TP can lead to nuisance algal blooms that negatively impact aquatic life and recreation (e.g., swimming, boating, fishing, etc.). Algal decomposition depletes dissolved oxygen levels within the water column. The decreases in dissolved oxygen can stress benthic macroinvertebrates and fish. Depletion of oxygen in the water column can also lead to conditions where phosphorus is released from bottom sediments (i.e., internal loading). Also, excess algae can shade the water column which limits the distribution of aquatic vegetation. Aquatic vegetation stabilizes bottom sediments, and also is an important habitat for macroinvertebrates and fish.

Priority Ranking:
The water bodies addressed by the ULMRW TMDLs were given a priority ranking for TMDL development due to: the impairment impacts on aquatic life, aesthetic quality, the public value of the impaired water resource and the timing as part of the Illinois basin monitoring process.

Pollutants of Concern:
The pollutants of concern are nitrogen, phosphorus, CBOD and SOD for the dissolved oxygen impaired water bodies, ammonia, chloride and nutrients (TP).
Source Identification (point and nonpoint sources):

Point Source Identification: The potential point sources to the ULMRW are:

<u>ULMRW ammonia TMDLs:</u>
National Pollutant Discharge Elimination Systems (NPDES) permitted facilities: NPDES permitted facilities may contribute ammonia loads to surface waters through discharges of treated wastewater. Permitted facilities must discharge treated wastewater according to their NPDES permit. IEPA determined that there is one NPDES permitted facility, the La Harpe Sewage Treatment Plant (STP) (LG580093), which contributes ammonia to the South Branch of the La Moine River (DGZR) impaired segment. This permittee received a wasteload allocation (WLA) (Tables 3 and 5 of this Decision Document).

Table 3: NPDES facilities which contribute point source pollutant loading in the Upper La Moine River Watershed TMDLs

WLAs assigned to NPDES facilities in the ULMRW			
Permit #	**Facility Name**	**Impaired Reach**	**WLA***
Ammonia WLA assigned to NPDES facilities in the ULMRW			**(lbs/day)**
ILG580093	La Harpe STP	South Branch La Moine River (IL_DGZR)	Dependent on season and flow conditions
Chloride WLA assigned to NPDES facilities in the ULMRW			**(lbs/day)**
IL0024384	Bushnell West STP	Drowning Fork (IL_DLGC-01)	1043.00
CBOD WLAs assigned to NPDES facilities in the ULMRW - DO TMDLs			**(lbs/day)**
IL0021229	Carthage STP	Prairie Creek(IL_DGZN-01)	See Table 8-13 of the final TMDL document
ILG580093	La Harpe STP	South Branch La Moine River (IL_DGZR)	

** = Design average flow was used to calculate the WLA.*

Municipal Separate Storm Sewer (MS4): MS4 communities which contribute stormwater runoff to surface waters in the ULMRW. IEPA determined that there are no MS4 communities which are contributing stormwater to surface waters in the ULMRW.

Concentrated Animal Feedlot Operations (CAFOs): IEPA determined that the ULMRW does not have CAFOs which contribute to surface waters of the ULMRW (Section 5.4.2 of the final TMDL document).

Combined Sewer Overflows (CSOs) and Sanitary Sewer Overflows (SSOs): IEPA determined that the ULMRW does not have CSOs nor SSOs which contribute to surface waters of the ULMRW.

ULMRW chloride TMDLs:
NPDES permitted facilities: NPDES permitted facilities may contribute chloride loads to surface waters through discharges of treated wastewater. Permitted facilities must discharge treated wastewater according to their NPDES permit. IEPA determined that there is one facility, the Bushnell West STP (IL0024384), which contributes chloride from treated wastewater releases to the Drowning Fork Creek impaired segment. This permittee received a WLA (Tables 3 and 6 of this Decision Document).

ULMRW TMDLs addressing dissolved oxygen (TN/TP/CBOD/SOD):
NPDES permitted facilities: NPDES permitted facilities may contribute CBOD loads to surface waters through discharges of treated wastewater. Permitted facilities must discharge treated wastewater according to their NPDES permit. IEPA determined that there are two NPDES permitted facilities in the ULMRW which contribute CBOD from treated wastewater releases, the Carthage STP (IL0021229) to the Prairie Creek (DGZN-01) impaired segment and the La Harpe STP (ILG580093) to the South Branch of the La Moine River (DGZR) impaired segment. IEPA explained that CBOD limits for both of these facilities would be reviewed as part of the next permit renewal cycle and potentially adjusted so that the CBOD limits are consistent with the assumptions of the ULMRW dissolved oxygen TMDLs.

Nonpoint Source Identification: The potential nonpoint sources to the ULMRW are:

ULMRW ammonia TMDLs:
Stormwater from agricultural land use practices: Runoff from agricultural lands may contain amounts of ammonia which may lead to impairments in the ULMRW. Feedlots generate manure which may be spread onto fields. Runoff from fields with spread manure can be exacerbated by tile drainage lines, which channelize the stormwater flows to surface waters.

Discharges from Septic Systems or unsewered communities: Failing septic systems are a potential source of ammonia within the ULMRW. Septic systems generally do not discharge directly into a water body, but effluents from septic systems may leach into groundwater or pond at the surface where they can be washed into surface waters via stormwater runoff events. Age, construction and use of septic systems can vary throughout a watershed and influence potential contributions of ammonia from these systems.

Non-regulated (i.e., areas not covered by a Municipal Separate Storm Sewer System (MS4) NPDES permit) urban runoff: Runoff from urban areas (e.g., urban, residential, commercial or industrial land uses) can contribute ammonia to local water bodies. Stormwater from urban areas, which drain impervious surfaces, may introduce ammonia derived from wildlife or pet droppings to surface waters.

Wildlife: Wildlife is a known source of ammonia in water bodies as many animals spend time in or around water bodies. Deer, geese, ducks, raccoons, and other animals all create potential sources of ammonia via contaminated runoff from animal habitats, such as urban park areas, forest, and rural areas.

ULMRW chloride TMDLs:
Non-regulated (i.e., areas not covered by a MS4 NPDES permit) stormwater contributions: Stormwater runoff from areas outside the boundaries of MS4 areas, such as non-permitted urban, residential, commercial or industrial areas, can contribute chloride to surface waters of the ULMRW. Non-regulated stormwater may drain impervious surfaces and add any residual chlorides from those surfaces to surface waters. IEPA explained that usage of road salting from municipal operators and private applicators (e.g.,

private citizens and commercial contractors salting parking lots, sidewalks and other pedestrian/automobile usage areas) are some of the main nonpoint sources of chloride in the ULMRW (Section 5.4.5 of the final TMDL document). Chloride from these sources is carried into surface waters during snowmelt or rainfall runoff events via impervious surfaces (e.g., highways, roads and other paved areas).

Discharges from septic systems or unsewered communities: Septic systems are a potential source of chloride within the ULMRW. Septic systems generally do not discharge directly into a water body, but effluents from septic systems may leach into groundwater or pond at the surface where they can be washed into surface waters via stormwater runoff events. Age, construction and use of septic systems can vary throughout a watershed and influence the chloride contribution from these systems. Water softening systems which are in areas not connected to municipal sewer lines likely discharge to septic fields and chloride contributions from those septic systems may ultimately mix with groundwater or surface water near the septic field.

Chloride contributions from agricultural lands: Chloride may be added via use of fertilizers containing chloride anions (e.g., potassium chloride (KCl)) and biosolids which are spread onto agricultural areas. Chloride may be liberated from farm fields within stormwater runoff which can be exacerbated by tile drainage lines, which channelize the stormwater flows.

ULMRW TMDLs addressing dissolved oxygen (TN/TP/CBOD/SOD):
Non-regulated (i.e., areas not covered by a MS4 NPDES permit) stormwater contributions: Stormwater runoff from areas outside the boundaries of MS4 areas, such as non-permitted urban, residential, commercial or industrial areas, can contribute ammonia and/or nutrients to surface waters of the ULMRW. Non-regulated stormwater may drain impervious surfaces and add any residual ammonia and/or nutrients from those surfaces to surface waters.

Discharges from septic systems or unsewered communities: Failing septic systems are a potential source of ammonia and/or nutrients within the ULMRW. Septic systems generally do not discharge directly into a water body, but effluents from septic systems may leach into groundwater or pond at the surface where they can be washed into surface waters via stormwater runoff events. Age, construction and use of septic systems can vary throughout a watershed and influence the nutrient contribution from these systems.

Stormwater from agricultural land use practices: Runoff from agricultural lands may contain significant amounts of ammonia and/or nutrients which may lead to impairments in the ULMRW. Feedlots generate manure which may be spread onto fields. Runoff from fields with spread manure can be exacerbated by tile drainage lines, which can channelize the stormwater flows to local surface waters.

ULMRW phosphorus TMDLs:
Non-regulated (i.e., areas not covered by a MS4 NPDES permit) stormwater contributions: Stormwater runoff from areas outside the boundaries of MS4 areas, such as non-permitted urban, residential, commercial or industrial areas, can contribute nutrients, organic material and organic rich sediment during stormwater runoff events. Runoff from urban/developed areas can include phosphorus derived from fertilizers, leaf and grass litter, pet wastes, and other sources of anthropogenic derived nutrients.

Stormwater runoff from agricultural land use practices: Runoff from agricultural lands may contain significant amounts of nutrients, organic material and organic-rich sediment which may lead to impairments in the ULMRW. Manure spread onto fields is often a source of phosphorus, and can be exacerbated by tile drainage lines, which channelize the stormwater. Tile lined fields and channelized ditches enable particles to move more efficiently into surface waters. Phosphorus, organic material and organic-rich sediment may be added via surface runoff from upland areas which are being used for Conservation Reserve Program (CRP) lands, grasslands, and agricultural lands used for growing hay or other crops. Stormwater runoff may contribute nutrients and organic-rich sediment to surface waters from livestock manure, fertilizers, vegetation and erodible soils.

Internal loading: The release of phosphorus from lake sediments contributes internal phosphorus loading to Carthage Lake. Phosphorus may build up in the bottom waters of the lake and may be resuspended or mixed into the water column when the thermocline decreases and the lake water mixes.

Wetland and Forest Sources: Phosphorus, organic material and organic-rich sediment may be added to surface waters by stormwater flows through wetland and forested areas in the ULMRW. Storm events may mobilize phosphorus through the transport of suspended solids and other organic debris.

Discharges from septic systems or unsewered communities: Failing septic systems are a potential source of nutrients within the ULMRW. Septic systems generally do not discharge directly into a water body, but effluents from septic systems may leach into groundwater or pond at the surface where they can be washed into surface waters via stormwater runoff events. Age, construction and use of septic systems can vary throughout a watershed and influence the nutrient contribution from these systems.

Wildlife: Wildlife is a known source of nutrients in water bodies as many animals spend time in or around water bodies. Deer, geese, ducks, raccoons, and other animals all create potential sources of nutrients via contaminated runoff from animal habitats, such as urban park areas, forest, and rural areas.

Future Growth:
IEPA considered information gathered during the 2010 census in determining whether or not to assign reserve capacity (RC) to the TMDL equation to account for future growth in the ULMRW. IEPA explained that it is not anticipated that significant future population growth will occur in the ULMRW (Sections 2.5 and 8.3.1.5 of the final TMDL document). The WLA and load allocations (LA) for the ULMRW TMDLs were calculated for all current and future sources. Any expansion of point or nonpoint sources will need to comply with the respective WLA and LA values calculated in the ULMRW TMDLs.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the first criterion.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

The TMDL submittal must include a description of the applicable State/Tribal water quality standard, including the designated use(s) of the water body, the applicable numeric or narrative water quality criterion, and the antidegradation policy (40 C.F.R. §130.7(c)(1)). EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

The TMDL submittal must identify a numeric water quality target(s) – a quantitative value used to measure whether or not the applicable water quality standard is attained. Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. The TMDL expresses the relationship between any necessary reduction of the pollutant of concern and the attainment of the numeric water quality target. Occasionally, the pollutant of concern is different from the pollutant that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as Dissolved Oxygen (DO) criteria). In such cases, the TMDL submittal should explain the linkage between the pollutant of concern and the chosen numeric water quality target.

Comment:
Section 4 of the final TMDL document explains that water bodies in the ULMRW are not meeting their General Use designation. The Illinois Pollution Control Board (IPCB) defines General Use standards as those 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."*

Under the General Use classification, waters are further designated as impaired for aquatic life use, aesthetic quality use and primary contact recreational use. Table 1 of this Decision Document shows the various water body segments and their associated impaired uses.

The applicable General Use water quality standards for the ULMRW TMDL water bodies are established in Illinois Administrative Rules Title 35, Environmental Protection; Subtitle C, Water Pollution; Chapter I, Pollution Control Board; Part 302, Water Quality Standards, Subpart B. Table 4 of this Decision Document lists all the water quality standards and the TMDL targets/modeling endpoints employed by IEPA in the calculation of loading capacities for ULMRW TMDLs.

Table 4: Water quality standards and TMDL targets utilized within the Upper La Moine River Watershed TMDL

Parameter	Units	Water Quality Standards	TMDL Targets
Numeric Water Quality Criterion for addressing the South Branch of the La Moine River ammonia impaired segment within the ULMRW			
Ammonia	mg/L	15**	2.1 mg/L – most conservative chronic value (applies June to August)[#]
			2.2 mg/L – most conservative seasonal chronic standard (applies March to May and September to October) [#]
			4.5 mg/L – most conservative seasonal chronic standard (applies November to February) [#]

Numeric Water Quality Criterion for addressing the Drowning Fork Creek chloride impaired segment within the ULMRW			
Chloride	mg/L	500	500
Numeric Water Quality Criterion for addressing the Dissolved Oxygen impaired segments (See Table 1 of this Decision Document) within the ULMRW			
Dissolved Oxygen (DO)	mg/L	6.0 mg/L weekly averge (March-July) 5.0 mg/L daily minimum (March-July) 4.0 mg/L weekly average (August-February) 3.5 mg/L daily minimum (August-February)	5.0 mg/L (applies March to July) # 3.5 mg/L (applies August to February) #
Numeric Water Criterion for addressing the Carthage Lake nutrient impaired segment within the ULMRW			
Total Phosphorus (TP)*	mg/L	0.05	0.05

* = Standard applies to inland lakes and reservoirs (greater than 20 acres) and in any stream at the point where it enters any such lake or reservoir.
** = This refers to the acute standard of total ammonia nitrogen, which must not be exceeded at any time (Illinois Administrative Code 302.212(b))
\# = See Table 8-1 of the final TMDL document

The TMDL endpoints used by IEPA to calculate the ULMRW TMDLs include:

- ***Ammonia TMDL*** – **2.1 mg/L**, **2.2 mg/L** and **4.5 mg/L**, dependent on the season (see Table 5 of this Decision Document);
- ***Chloride TMDL*** – **500 mg/L** (see Table 6 of this Decision Document);
- ***Dissolved Oxygen TMDLs*** – **5.0 mg/L** (see Table 7 of this Decision Document); and
- ***Total Phosphorus TMDL*** – **0.05 mg/L** (see Table 8 of this Decision Document).

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the second criterion.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

A TMDL must identify the loading capacity of a water body for the applicable pollutant. EPA regulations define loading capacity as the greatest amount of a pollutant that a water can receive without violating water quality standards (40 C.F.R. §130.2(f)).

The pollutant loadings may be expressed as either mass-per-time, toxicity or other appropriate measure (40 C.F.R. §130.2(i)). If the TMDL is expressed in terms other than a daily load, e.g., an annual load, the submittal should explain why it is appropriate to express the TMDL in the unit of measurement chosen. The TMDL submittal should describe the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In many instances, this method will be a water quality model.

The TMDL submittal should contain documentation supporting the TMDL analysis, including the basis for any assumptions; a discussion of strengths and weaknesses in the analytical process; and results from any water quality modeling. EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

TMDLs must take into account *critical conditions* for steam flow, loading, and water quality parameters as part of the analysis of loading capacity (40 C.F.R. §130.7(c)(1)). TMDLs should define applicable *critical conditions* and describe their approach to estimating both point and nonpoint source loadings under such *critical conditions*. In particular, the TMDL should discuss the approach used to compute and allocate nonpoint source loadings, e.g., meteorological conditions and land use distribution.

Comment:

ULMRW ammonia TMDL: Seasonal flow duration curves (FDC) were created for the South Branch of the La Moine River (IL_DGZR) segment in the ULMRW via flow data from the USGS gage on the La Moine River at Colmar, Illinois (USGS #05584500). For the FDCs in the ULMRW, the closest available USGS gage with similar watershed characteristics to the watershed characteristics of the impaired segments was used to estimate flows using the drainage area ratio (DAR) method. IEPA used the following DAR equation to estimate flows in unaged subwatersheds:

$$Q_{ungaged} = (A_{ungaged} / A_{gaged}) * Q_{gaged}$$

where,

$Q_{ungaged}$	= Flow at the ungaged location
Q_{gaged}	= Flow at USGS gage station (e.g., #05584500)
$A_{ungaged}$	= Drainage area of the ungaged location
A_{gaged}	= Drainage area of the USGS gage location (e.g., #05584500)

Daily stream flows were necessary to implement the load duration curve (LDC) approach.

FDC graphs have flow duration interval (percentage of time flow exceeded) on the X-axis and discharge (flow per unit time) on the Y-axis. The FDC was transformed into a LDC by multiplying individual flow values by the most conservative seasonal ammonia target (see Table 4 of this Decision Document and Table 8-1 of the final TMDL document) and then multiplying that value by a conversion factor. The resulting points are plotted onto a load duration curve graph. LDC graphs, for the ULMRW ammonia TMDL, have flow duration interval (percentage of time flow exceeded) on the X-axis and ammonia loading (lbs/day) on the Y-axis (see Figure 7-15 of the final TMDL document). The curved line on a LDC graph represents the TMDL of the respective flow conditions observed at that location.

Water quality monitoring efforts were conducted for the South Branch of the La Moine River (IL_DGZR) segment and these efforts collected ammonia concentration water quality data which were then converted to individual sampling loads by multiplying the sample concentration by the instantaneous flow measurement observed/estimated at the time of sample collection. The individual sampling loads were plotted on the same figure with the created LDC. Individual LDCs are found in Section 7 (e.g., Figure 7-15) of the final TMDL document.

The LDC plots were subdivided into five flow regimes; high flow conditions (exceeded 0–10% of the time), moist flow conditions (exceeded 10–40% of the time), mid-range flow conditions (exceeded 40–50% of the time), dry flow conditions (exceeded 50–90% of the time), and low flow conditions (exceeded 90–100% of the time). LDC plots can be organized to display individual sampling loads with the calculated LDC. Watershed managers can interpret LDC graphs with individual sampling points plotted alongside the LDC to understand the relationship between flow conditions and water quality exceedances within the watershed. Individual sampling loads which plot above the LDC represent violations of the WQS and the allowable load under those flow conditions at those locations. The difference between individual sampling loads plotting above the LDC and the LDC, measured at the same flow, is the amount of reduction necessary to meet WQS.

The strengths of using the LDC method are that critical conditions and seasonal variation are considered in the creation of the FDC by plotting hydrologic conditions over the flows measured during the recreation season. Additionally, the LDC methodology is relatively easy to use and cost-effective. The weaknesses of the LDC method are that nonpoint source allocations cannot be assigned to specific sources, and specific source reductions are not quantified. Overall, IEPA believes and EPA concurs that the strengths outweigh the weaknesses for the LDC method.

Implementing the results shown by the LDC requires watershed managers to understand the sources contributing to the water quality impairment and which Best Management Practices (BMPs) may be the most effective for reducing ammonia loads based on flow magnitudes. Different sources will contribute ammonia loads under varying flow conditions. For example, if exceedances are significant during high flow events this would suggest storm events are the cause and implementation efforts can target BMPs that will reduce stormwater runoff and consequently ammonia loading into surface waters. This allows for a more efficient implementation effort.

The ammonia TMDL for the South Branch of the La Moine River (DGZR) in the ULMRW was calculated and those results are found in Table 5 of this Decision Document. The LAs were calculated after the determination of the WLA. LAs (e.g., stormwater runoff from agricultural land use practices and feedlots, septic systems, wildlife inputs etc.) were not split among individual nonpoint contributors. Instead, LAs were combined together into a categorical LA to cover all nonpoint source contributions.

Table 5: The Ammonia TMDL for the South Branch of the La Moine River (IL_DGZR) in the Upper La Moine River Watershed

Table 5 of this Decision Document reports multiple points (the midpoints of each 10% flow exceedance probability sub-flow regime) on the loading capacity curve. However, it should be understood that the components of the TMDL equation could be illustrated for any point on the entire loading capacity curve. The LDC method can be used to display collected ammonia monitoring data and allows for the estimation of load reductions necessary for attainment of the ammonia water quality targets (Table 3 of this Decision Document). Using this method, daily loads were developed based upon the flow in the water body. Loading capacities were determined for the segment for multiple flow regimes. This allows the TMDL to be represented by an allowable daily load across all flow conditions. Table 5 of this Decision Document identifies the loading capacity for the water body at each flow regime. Although there are numeric loads for each flow regime, the LDC is what is being approved for this TMDL.

Table 5 of the Decision Document presents IEPA's loading reduction estimates for the ammonia TMDL across the seasons (Summer, Spring/Fall and Winter). These loading reductions (i.e., the percent reduction row at the bottom of each TMDL table) were calculated from field sampling data collected in the ULMRW. IEPA explained that its load reduction estimates are likely more conservative since they are based on a limited water quality data set.

EPA concurs with the data analysis and LDC approach utilized by IEPA in its calculation of loading capacities, wasteload allocations, load allocations and the margin of safety for the ULMRW ammonia TMDL. The methods used for determining the TMDL are consistent with U.S. EPA technical memos.[1]

ULMRW chloride TMDL: IEPA developed a LDC to calculate a chloride TMDL for the Drowning Fork Creek (DLGC-01) segment. The same LDC development strategy was employed for the chloride TMDL as was used to calculate the ammonia LDC values. IEPA used flow measurements from USGS gage #05584500 on the La Moine River near Colman, Illinois and DAR calculations to calculate the flows which were used in the FDC and the LDC for the Drowning Fork Creek (DLGC-01) chloride TMDL. The FDC were transformed into LDC by multiplying individual flow values by the chloride TMDL target (500 mg/L) and then multiplying that value by a conversion factor.

A chloride TMDL was calculated (Table 6 of this Decision Document) by IEPA. The LA value was calculated after the determination of the WLA, and the MOS. LAs (e.g., non-MS4 urban stormwater runoff) was not split among individual nonpoint contributors. Instead, LAs were combined together into one value to cover all nonpoint source contributions. Table 6 of this Decision Document reports ten values (i.e., the midpoints of each 10% flow exceedance probability sub-flow regimes) on the loading capacity curve. However, it should be understood that the components of the TMDL equation could be illustrated for any point on the entire loading capacity curve.

The LDC method can be used to display collected chloride monitoring data and allows for the estimation of load reductions necessary for attainment of the WQS. Using this method, daily loads were developed based upon the flow in the water body. Loading capacities were determined for Drowning Fork Creek (DLGC-01) for multiple flow regimes. This allows the TMDL to be represented by an allowable daily load across all flow conditions. Although there are numeric loads for each flow regime, the LDC is what is being approved for this TMDL.

Table 6: The Chloride TMDL for the Drowning Fork Creek (IL-DLGC-01) segment in the Upper La Moine River Watershed

EPA supports the data analysis and modeling approach utilized by IEPA in its calculation of WLA, LA and MOS for the chloride TMDL for Drowning Fork Creek (DLGC-01). Additionally, EPA concurs with the loading capacities calculated by the IEPA in its ULMRW chloride TMDL. EPA finds IEPA's approach for calculating the loading capacity for its ULMRW chloride TMDL to be reasonable and consistent with EPA guidance.

ULMRW TMDLs addressing dissolved oxygen (TN/TP/CBOD/SOD): IEPA employed QUAL2K to develop the DO TMDLs in the ULMRW for segments Rock Creek (DGO-01), La Harpe Creek (DGP-01), Prairie Creek (DGZN-01) and the South Branch of the La Moine River (DGZR). IEPA explained that QUAL2K is a one-dimensional stream water quality model applicable to well-mixed streams (Section 7.2.1 of the final TMDL document). The QUAL2K model assumes steady state hydraulics and

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[1] U.S. Environmental Protection Agency. August 2007. *An Approach for Using Load Duration Curves in the Development of TMDLs*. Office of Water. EPA-841-B-07-006. Washington, D.C.

allows for point source inputs, diffuse loading and tributary flows. The QUAL2K model incorporates historical water quality data, observed hydraulic information, and point source discharge data along with model defaults to predict the resulting instream DO concentrations.

IEPA used the QUAL2K model to determine load reductions of oxygen-demanding materials needed to meet the instantaneous DO minimum standard of 5.0 mg/L applicable March 1 – July 31. The QUAL2K model simulates DO dynamics as a function of nitrogenous and carbonaceous oxygen demand, atmospheric reaeration, sediment oxygen demand (SOD), and plant photosynthesis and respiration. The model also simulates the fate and transport of nutrients and biochemical oxygen demand (BOD) and the growth and abundance of floating (phytoplankton) and attached (periphyton) algae (as chlorophyll-a). IEPA used USGS collected flow data from the USGS gage (#5584500) on the La Moine River at Colmar, Illinois to set flow rates and to characterize hydraulic characteristics of the DO impaired segments.

IEPA performed a calibration exercise for kinetic and transport parameters in the QUAL2K model as well as a sensitivity analysis. These analyses confirmed IEPA's confidence in their model set up and provided a level of confidence to their QUAL2K modeling results.

IEPA calculated loading capacity values for each DO impaired segment (Table 7 of this Decision Document). The calculated loading capacity value is the maximum amount of oxygen-demanding material (e.g., total nitrogen, total phosphorus, CBOD, SOD, and other oxygen-demanding materials) that DO impaired segments can receive and still maintain compliance with the DO WQS.

Table 7: TMDLs addressing dissolved oxygen (i.e., Total Nitrogen (TN), Total Phosphorus (TP), Carbonaceous Biological Oxygen Demand (CBOD) & Sediment Oxygen Demand (SOD)) in the Upper La Moine River Watershed

Allocation	**Total Nitrogen**	**Total Phosphorus**	**CBOD**	**SOD**
	(lbs/day)	**(lbs/day)**	**(lbs/day)**	**(g O_2/m^2/day)**
Rock Creek (DGO-01)				
Wasteload Allocation TOTAL	0	0	NA	0
Load Allocation	8	5	NA	16
Margin of Safety (10%)	1	1	NA	2
Loading Capacity	**9**	**6**	**NA**	**18**
Reduction Needed (%)	96%	96%	--	46%
Prairie Creek (DGZN-01)				
Wasteload Allocation TOTAL	NA	NA	*	NA
Load Allocation	NA	NA	NA	11
Margin of Safety (10%)	NA	NA	4	1
Loading Capacity	**NA**	**NA**	**43**	**12**
Reduction Needed (%)	--	--	64%	64%
La Harpe Creek (DGP-01)				
Wasteload Allocation TOTAL	0	0	NA	0
Load Allocation	33	18	NA	25
Margin of Safety (10%)	4	2	NA	3

Loading Capacity	**37**	**20**	**NA**	**28**
Reduction Needed (%)	84%	87%	--	61%
South Branch of the La Moine River (DGZR)				
Wasteload Allocation TOTAL	NA	NA	**	NA
Load Allocation	NA	NA	NA	14
Margin of Safety (10%)	NA	NA	2	1
Loading Capacity	**NA**	**NA**	**24**	**15**
Reduction Needed (%)	--	--	61%	61%

* = For the purposes of the CBOD TMDL for the Prairie Creek (DGZN-01) (Table 8-15 of the final TMDL document), the WLA cannot exceed 39 lbs/day. For the current discharge permit effluent limits see Table 8-13 of the final TMDL document. CBOD limits for the Carthage STP (IL0021229) will be reviewed by Illinois EPA Permits Section during permit renewal.
** = For the purposes of the CBOD TMDL for South Branch of the La Moine River (DGZR) (Table 8-17 of the final TMDL document, the WLA cannot exceed 22 lbs/day. For the current discharge permit effluent limits see Table 8-13 of the final TMDL document. CBOD limits for the La Harpe STP (ILG580093), which is a general permit, will be reviewed by Illinois EPA Permits Section during permit renewal.

Table 7 of the Decision Document presents IEPA's loading reduction estimates for the DO TMDLs. These loading reductions (i.e., the percent reduction row at the bottom of each TMDL table) were calculated from field sampling data collected in the ULMRW. IEPA explained that its load reduction estimates are likely more conservative since they are based on a limited water quality data set.

EPA supports the data analysis and modeling approach utilized by IEPA in its calculation of WLA, LA and MOS for the DO TMDLs for the ULMRW. Additionally, EPA concurs with the loading capacities calculated by the IEPA for the ULMRW DO TMDLs. EPA finds IEPA's approach for calculating the loading capacity for the ULMRW DO TMDLs to be reasonable and consistent with EPA guidance.

ULMRW phosphorus TMDL: IEPA used the Simplified Lake Analysis Model (SLAM) to determine allocations for phosphorus for Carthage Lake. The SLAM model provides modeling for lake and sediment interactions which simulate lake nutrient and phytoplankton dynamics by using data inputs from several different sources (e.g., online databases and GIS-compatible data) (Sections 7.1.3 and 7.2.3 of the final TMDL document). A more traditional method for lake analysis, such as the BATHTUB lake model, was not used for the Carthage Lake phosphorus TMDL because IEPA determined that SLAM could also integrate the sediment dynamics and characteristics within lakes to determine phosphorus loading by using lake and sediment interactions. Parameter inputs considered in the calculations include: lake morphology, hydraulics, and thermal stratification; segmentation and flow direction; watershed inflows via runoff and point source discharge into the reservoir watershed; in-lake nutrients, settling velocity and nutrient uptake and burial; and sediment layer dynamics. Confirmatory analysis was also completed to document that the observed and simulated values supported the methodology (Section 7.2.3.1.6 of the final TMDL document).

IEPA subdivided the loading capacity among the WLA, LA, and MOS components of the TMDL (Table 8 of this Decision Document). These calculations were based on the critical condition, the summer growing season, which is typically when the water quality in Carthage Lake is typically degraded and phosphorus loading inputs are the greatest.

Table 8: TP TMDL for Carthage Lake (RLE) in the Upper La Moine River Watershed

TP Allocation	*(lbs/day)*
Carthage Lake (IL_RLE)	
Wasteload Allocation	0.00
Load Allocation - Internal Sources	0.12
Load Allocation - External Sources	1.13
Load Allocation TOTAL	1.25
Margin of Safety (10%)	0.14
Loading Capacity	**1.390**
Percent Reduction	70%

Table 8 of this Decision Document communicate IEPA's estimate of the reduction required for Carthage Lake to meet its phosphorus water quality target (0.05 mg/L). This loading reduction (i.e., the percent reduction row) were estimated from existing and TMDL load calculations. IEPA expects that this reductions will result in the attainment of the water quality target and that the lake water quality will return to a level where the designated uses are no longer considered impaired.

EPA supports the data analysis and modeling approach utilized by IEPA in its calculation of WLA, LA and MOS for the Carthage Lake TP TMDL. Additionally, EPA concurs with the loading capacities calculated by the IEPA in its Carthage Lake TP TMDL. EPA finds IEPA's approach for calculating the loading capacity for its Carthage Lake TP TMDL to be reasonable and consistent with EPA guidance.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the third criterion.

4. Load Allocations (LA)

EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity attributed to existing and future nonpoint sources and to natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. §130.2(g)). Where possible, load allocations should be described separately for natural background and nonpoint sources.

Comment:
IEPA determined the LA calculations for each of the TMDLs based on the applicable WQS. IEPA recognized that LAs for each of the individual TMDLs addressed by the ULMRW TMDLs can be attributed to different nonpoint sources.

ULMRW ammonia TMDL: The calculated LA value for the ammonia TMDLs is applicable across all flow conditions in the ULMRW (Table 5 of this Decision Document). IEPA identified several nonpoint sources which contribute ammonia loads to the surface waters of the ULMRW, including; stormwater from agricultural areas, failing septic systems, non-regulated urban runoff and wildlife (e.g., deer, geese, ducks, raccoons, turkeys and other animals). IEPA did not determine individual LA values for each of these potential nonpoint source considerations, but aggregated the nonpoint sources into a categorical LA value.

IEPA explained that under the dry and low flow regimes (Table 5 of this Decision Document) of the LDC framework, IEPA anticipates that most of the loading capacity will be made of WLA contributions (from the La Harpe STP) and that LA contributions will be less than 1 lb/day and/or close to 0 lbs/day.

ULMRW chloride TMDL: The calculated LA values for the chloride TMDL are applicable across all flow conditions. IEPA identified several nonpoint sources which contribute chloride nonpoint source loads to the surface waters in the ULMRW (Table 6 of this Decision Document). LAs were recognized as originating from many diverse nonpoint sources including; non-regulated stormwater runoff, discharges from septic systems and contributions from agricultural lands. IEPA did not determine individual load allocation values for each of these potential nonpoint source considerations, but aggregated the nonpoint sources into one categorical LA value.

IEPA explained that under the low flow regime (Table 6 of this Decision Document) of the LDC framework, IEPA anticipates that most of the loading capacity will be made of WLA contributions (from the Bushnell West STP) and that LA contributions will be less than 1 lb/day and/or close to 0 lbs/day.

ULMRW TMDLs addressing dissolved oxygen (TN/TP/CBOD/SOD): The calculated LA values for the DO TMDLs are applicable across all flow conditions. IEPA identified several nonpoint sources which contribute oxygen demanding material (e.g., total nitrogen, total phosphorus, CBOD, SOD) nonpoint source loads to the surface waters in the ULMRW (Table 7 of this Decision Document). Load allocations were recognized as originating from many diverse nonpoint sources including; non-regulated stormwater runoff, discharges from septic systems and contributions from agricultural lands. IEPA did not determine individual LA values for each of these potential nonpoint source considerations, but aggregated the nonpoint sources into one categorical LA value.

ULMRW phosphorus TMDL: The calculated LA values for the total phosphorus TMDL are applicable across all flow conditions. IEPA identified several nonpoint sources which contribute total phosphorus nonpoint source loads to the surface waters in the ULMRW (Table 8 of this Decision Document). LAs were recognized as originating from many diverse nonpoint sources including; non-regulated stormwater runoff, contributions from agricultural lands and discharges, internal loading, wetland and forest sources, discharges from septic systems and wildlife nutrient contributions. IEPA did not determine individual LA values for each of these potential nonpoint source considerations, but aggregated the nonpoint sources into one categorical LA value.

EPA finds IEPA's approach for calculating the LA to be reasonable and consistent with EPA guidance.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the fourth criterion.

5. Wasteload Allocations (WLAs)

EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to individual existing and future point source(s) (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i)). In some cases, WLAs may cover more than one discharger, e.g., if the source is contained within a general permit.

The individual WLAs may take the form of uniform percentage reductions or individual mass based limitations for dischargers where it can be shown that this solution meets WQSs and does not result in localized impairments. These individual WLAs may be adjusted during the NPDES permitting process. If the WLAs are adjusted, the individual effluent limits for each permit issued to a discharger on the impaired water must be consistent with the assumptions and requirements of the adjusted WLAs in the TMDL. If the WLAs are not adjusted, effluent limits contained in the permit must be consistent with the individual WLAs specified in the TMDL. If a draft permit provides for a higher load for a discharger than the corresponding individual WLA in the TMDL, the State/Tribe must demonstrate that the total WLA in the TMDL will be achieved through reductions in the remaining individual WLAs and that localized impairments will not result. All permittees should be notified of any deviations from the initial individual WLAs contained in the TMDL. EPA does not require the establishment of a new TMDL to reflect these revised allocations as long as the total WLA, as expressed in the TMDL, remains the same or decreases, and there is no reallocation between the total WLA and the total LA.

Comment:
ULMRW ammonia TMDL: IEPA identified one NPDES permitted facility, the La Harpe Sewage Treatment Plant (STP) (LG580093), which contributes ammonia to the South Branch of the La Moine River (DGZR) impaired segment (Table 5 of this Decision Document). IEPA used the facility's design average flow (DAF) multiplied by the ammonia TMDL target value (see Table 3 of this Decision Document, dependent on the season to calculate the ammonia WLAs. IEPA explained that the WLAs for these ammonia TMDLs would be applicable across the water year and that the WLAs will be consistent with the water quality based effluent limits (WQBEL) and NPDES permit language.

EPA finds IEPA's approach for calculating the WLAs for the South Branch of the La Moine River ammonia TMDL to be reasonable and consistent with EPA guidance.

ULMRW chloride TMDL: IEPA identified one facility, the Bushnell West STP (IL0024384) which contributes chloride loading to the Drowning Fork Creek impaired segment (Table 6 of this Decision Document). The WLA assigned to the Bushnell West STP was calculated based on the DAF and the chloride TMDL target (500 mg/L) for all flow regimes except for the Very Low flow regime (Table 6 of this Decision Document). IEPA adjusted the WLA for the Very Low flow regime to account for the calculated loading capacity, the MOS (10% of the loading capacity) and LA assumption which was that the LA was set close to 0 lbs/day.

EPA finds IEPA's approach for calculating the WLA for the Drowning Fork Creek chloride TMDL to be reasonable and consistent with EPA guidance.

ULMRW TMDLs addressing dissolved oxygen (TN/TP/CBOD/SOD): The QUAL2K model demonstrated that the main drivers for low dissolved oxygen concentrations in the water column were attributed to a combination of nutrient inputs and accompanying plant growth within the water column, aerobic respiration from those plants and elevated sediment oxygen demanding interactions at the water-sediment interface. IEPA also acknowledged that certain point sources likely contribute loading of sediment and oxygen-demanding materials into the impaired segments.

IEPA identified two facilities, the Carthage STP (IL0021229) to the Prairie Creek (DGZN-01) impaired segment and the La Harpe STP (ILG580093) to the South Branch of the La Moine River (DGZR) which contribute oxygen demanding material in the form of CBOD loads to the impaired DO segments in the ULMRW (Table 7 of this Decision Document). A third facility, the Blandinsville STP (IL0072672) was identified as a potential contributor to La Harpe Creek (DGP-01) (Table 8-13 of the final TMDL document) but IEPA explained that this facility discharges to an unnamed tributary of Bishop Creek which is further upstream of the confluence with La Harpe Creek and therefore, was not included in the modeling efforts for the La Harpe Creek DO TMDL.

IEPA will evaluate the need for further point source controls or revisions to existing permits for the Carthage STP and the La Harpe STP facilities at the time when each individual facility's permit is up for renewal (Section 9.5.1 of the final TMDL document). IEPA explained that each facility's discharges should continue to be monitored on a daily basis and any violations of the effluent limits may prompt further regulatory actions.

EPA finds IEPA's approach for calculating the WLA for the ULMRW DO TMDLs to be reasonable and consistent with EPA guidance.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the fifth criterion.

6. Margin of Safety (MOS)

The statute and regulations require that a TMDL include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)). EPA's 1991 TMDL Guidance explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set aside for the MOS must be identified.

Comment:
The final TMDL submittal outlines the determination of the Margin of Safety for the ammonia, chloride, dissolved oxygen and phosphorus TMDLs. The chloride, dissolved oxygen and phosphorus incorporated an explicit MOS set at 10% of the loading capacity. The ammonia TMDL for the South Branch of the La Moine River employed both an implicit MOS.

ULMRW ammonia TMDL: IEPA employed an implicit margin of safety due to using the lowest chronic instream water quality standard (Table 3 of this Decision Document) and minimal seasonal chronic standard for the South Branch of the La Moine River segment.

ULMRW chloride TMDL, TMDLs addressing dissolved oxygen (TN/TP/CBOD/SOD) and phosphorus TMDL: IEPA employed an explicit MOS set at 10% of the loading capacity. The explicit MOS was applied by reserving 10% of the total loading capacity, and then allocating the remaining loads to point and nonpoint sources (Tables 6 to 8 of this Decision Document).

The use of the LDC approach minimized variability associated with the development of the ULMRW TMDLs because the calculation of the loading capacity was a function of flow multiplied by the target value. The MOS was set at 10% to account for uncertainty due to field sampling error, basing assumptions on water quality monitoring with low sample sizes, and imperfect water quality targets. A 10% MOS was considered appropriate, because the target values used in this TMDL had a firm technical basis and the estimated flows are believed to be relatively accurate because they were estimated based on a USGS gage located with or just outside of the subwatershed with the impaired segments.

The margin of safety is appropriate because the use of the LDC provides an accurate account of existing stream conditions (calculated by multiplying daily flows by existing pollutant levels), and an accurate account of the stream's loading capacity (calculated by multiplying daily flows by the appropriate water quality target). In other words, there is a good fit between observed (existing) data and predicted data using the LDC approach, thus providing a relatively accurate determination of the TMDL reductions needed. IEPA accounts for any uncertainty in this method by incorporating the MOS.

For the total phosphorus TMDLs, IEPA also noted that an implicit MOS is included in the loadings. IEPA believes the default values used in the SLAM model are conservative, as they are based upon a wide range of lakes and reservoirs in the East and Midwest.

The EPA finds that the TMDL document submitted by IEPA contains an appropriate MOS satisfying the requirements of the sixth criterion.

7. Seasonal Variation

The statute and regulations require that a TMDL be established with consideration of seasonal variations. The TMDL must describe the method chosen for including seasonal variations. (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)).

Comment:
ULMRW ammonia and chloride TMDLs: The Ammonia and chloride TMDLs accounted for seasonality via the LDC framework which inherently accounts for seasonal variation by using daily flows over a multi-year period. The LDC process used streamflows over a wide range of flow conditions across the entire water year. For the LDC-based TMDLs in the ULMRW, runoff is the main transport mechanism which delivers pollutant loading into the surface water environment. LDC graphs can provide insight toward understanding under which flow regimes/conditions exceedances of the WQS or water quality targets are occurring, and whether or not there is any seasonal flow component to those flow conditions (i.e., spring melt, summer precipitation events during lower flow periods, etc.)

ULMRW TMDLs addressing dissolved oxygen (TN/TP/CBOD/SOD): IEPA explained that the dissolved oxygen TMDLs accounted for seasonality via modeling inputs which represent the time of year when dissolved oxygen concentrations in the water column are at their lowest instream concentrations (Section 8.3.4.2 of the final TMDL document). IEPA identified these low dissolved oxygen conditions in the water column as the critical conditions for TMDL analyses and implementation planning.

ULMRW phosphorus TMDL: IEPA explained that the phosphorus TMDL accounted for seasonality in its SLAM modeling efforts by using annual calculations which account for seasonal effects in Carthage Lake (Section 8.3.5.2 of the final TMDL document). Source inputs contribute different loadings to the lake at varying times of the year (e.g., agricultural processes occurring at different times of the year, seasonal changes in precipitation which result in differences in runoff volumes to surface waters, etc.) IEPA determined that capturing these differences on the annual scale and converting those annual calculations to daily loading estimates was best for the capturing seasonal changes to Carthage Lake. IEPA explained that the critical condition for Carthage Lake was the summer growing season which is typically when the water quality in Carthage Lake is typically degraded and phosphorus loading inputs are the greatest.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of the seventh criterion.

8. Reasonable Assurance

When a TMDL is developed for waters impaired by point sources only, the issuance of a NPDES permit(s) provides the reasonable assurance that the wasteload allocations contained in the TMDL will be achieved. This is because 40 C.F.R. 122.44(d)(1)(vii)(B) requires that effluent limits in permits be consistent with, "the assumptions and requirements of any available wasteload allocation" in an approved TMDL.

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to implement water quality standards.

EPA's August 1997 TMDL Guidance also directs Regions to work with States to achieve TMDL load allocations in waters impaired only by nonpoint sources. However, EPA cannot disapprove a TMDL for nonpoint source-only impaired waters, which do not have a demonstration of reasonable assurance that LAs will be achieved, because such a showing is not required by current regulations.

Comment:
The ULMRW ammonia, chloride, dissolved oxygen and phosphorus TMDLs provide reasonable assurance that actions identified in the implementation section of the final TMDL (i.e., Section 9 of the final TMDL document), will be applied to attain the loading capacities and allocations calculated for the impaired reaches within the ULMRW. The recommendations made by IEPA will be successful at improving water quality if the appropriate local groups work to implement these recommendations. Those mitigation suggestions, which fall outside of regulatory authority, will require commitment from state agencies and local stakeholders to carry out the suggested actions.

IEPA outlines its reasonable assurance efforts in Section 9 of the final TMDL document. IEPA outlines management measures and programs which will be employed to attain the loading capacities and allocations calculated for the impaired reaches within the ULMRW. Section includes components of a more formal Implementation Plan for the ULMRW.

Reasonable assurance that the WLA set forth will be implemented is provided by regulatory actions. According to 40 C.F.R. 122.44(d)(1)(vii)(B), NPDES permit effluent limits must be consistent with assumptions and requirements of all WLAs in an approved TMDL. IEPA's NPDES permit program is one of the implementing programs for ensuring WLA are consistent with the TMDL. Current NPDES permits will remain in effect until the permits are reissued, provided that IEPA receives the NPDES permit renewal application prior to the expiration date of the existing NPDES permit.

Section 9 of the TMDL discusses various BMPs that, when implemented, will significantly reduce ammonia, chloride, oxygen demanding material and phosphorus inputs to surface waters of the ULMRW. In Table 9-9 of Section 9.13 of the final TMDL document, IEPA lists site-specific BMP costs, the programming which typically provide financial assistance for these BMPs (e.g., USDA-NRCS - Conservation Reserve Program (CRP), USDA- NRCS-Environmental Quality Incentives Program (EQIP), IDA-Conservation Practices Program (CPP)) and potential sponsors. In the amended WBP of 2014, most projects involved the incorporation of urbanized BMPs to the ULMRW. These BMPs included; green infrastructure projects, urban filter strips, brush management and streambank restoration efforts, culvert resizing, floodplain management and reconnection, wetland restoration, dam removal and vegetated swales.

Table 9-10 of the TMDL provides an estimated implementation schedule of actions and activities in the watershed that can reduce ammonia, chloride, oxygen demanding material and phosphorus loads into waterbodies in the ULMRW. These actions address immediate (1-2 years), mid-term (5-10 years) and long-term (continuous) timeframes.

IEPA has also developed Load Reduction Strategies (LRS) for various pollutants in the watershed. These LRSs address impairments where numeric criteria have not been developed (e.g., total suspended solids (TSS), sedimentation/siltation). Although these are not TMDLs, the LRSs discuss sources and reductions needed for the various pollutants which impact overall water quality in the ULMRW. IEPA has concluded that reducing these pollutants will improve water quality in ULMRW and assist in implementing BMPs in the watershed.

The EPA finds that this criterion has been adequately addressed.

9. Monitoring Plan to Track TMDL Effectiveness

EPA's 1991 document, *Guidance for Water Quality-Based Decisions: The TMDL Process* (EPA 440/4-91-001), recommends a monitoring plan to track the effectiveness of a TMDL, particularly when a TMDL involves both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur. Such a TMDL should provide assurances that nonpoint source controls will achieve expected load reductions and, such TMDL should include a monitoring plan that describes the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring and leading to attainment of water quality standards.

Comment:
The final TMDL document contains discussion on future monitoring within the ULMRW and milestones (Section 9.14 of the final TMDL document). Continued water quality monitoring within the basin is supported by IEPA. Additional water quality monitoring results could provide insight into the success or failure of BMP systems designed to reduce ammonia, chloride, oxygen demanding material and phosphorus loading into the surface waters of the watershed. Local watershed managers would be able to reflect on the progress of the various pollutant removal strategies and would have the opportunity to change course if observed progress is unsatisfactory.

Progress of TMDL implementation will be measured through monitoring efforts focused on:

- Tracking implementation of BMPs in the watershed;
- Estimating the effectiveness of BMPs;
- Additional monitoring of point source discharges in the watershed;
- Continued monitoring of impaired stream segments and tributaries;
- Monitoring storm-based high flow events; and
- Low flow monitoring in impaired stream segments.

IEPA anticipates continuing to measure water quality in the ULMRW via its Intensive Basin Survey water quality monitoring which occurs every 5 years. Additionally, IEPA explained that select ambient water quality locations are sampled nine times a year. Continuation of these programs will enable IEPA to evaluate water quality improvements in the ULMRW over time.

Water quality monitoring is a critical component of the adaptive management strategy employed as part of the implementation efforts utilized in the ULMRW. Water quality information will aid watershed managers in understanding how BMP pollutant removal efforts are impacting water quality. Water quality monitoring combined with an annual review of BMP efficiency will provide information on the success or failure of BMP systems designed to reduce pollutant loading into water bodies of the ULMRW. Watershed managers will have the opportunity to reflect on the progress or lack of progress, and will have the opportunity to change course if progress is unsatisfactory.

The EPA finds that this criterion has been adequately addressed.

10. Implementation

EPA policy encourages Regions to work in partnership with States/Tribes to achieve nonpoint source load allocations established for 303(d)-listed waters impaired by nonpoint sources. Regions may assist States/Tribes in developing implementation plans that include reasonable assurances that nonpoint source LAs established in TMDLs for waters impaired solely or primarily by nonpoint sources will in fact be achieved. In addition, EPA policy recognizes that other relevant watershed management processes may be used in the TMDL process. EPA is not required to and does not approve TMDL implementation plans.

Comment:
The findings from the ULMRW TMDLs will be used to inform the selection of implementation activities in the watershed. The TMDL outlined some implementation strategies in Section 9 of the final TMDL document. IEPA outlined the importance of prioritizing areas within the ULMRW, education and outreach efforts with local partners, and partnering with local stakeholders to improve water quality within the watershed. The reduction goals for the ammonia, chloride, dissolved oxygen and phosphorus TMDLs may be met via a combination of the following strategies:

ULMRW ammonia, TMDLs addressing dissolved oxygen (TN/TP/CBOD/SOD) and phosphorus TMDLs: The potential BMPs which, if installed and maintained, would likely result in decreases in ammonia, oxygen demanding materials and phosphorus to surface waters of the ULMRW are:

- ***Stormwater volume control and infiltration BMPs:*** To mitigate the impact of stormwater in the ULMRW, IEPA recommends the installation of stormwater BMPs, including some combination of; rain gardens, vegetated swales/bioswales/bioretention areas, detention ponds, rain barrels, pervious pavement and infiltration trenches. Reducing peak flow stormwater inputs within the ULMRW may be accomplished via reducing impervious cover or employing other low impact development/ green technologies which allow stormwater to infiltrate, evaporate or evapotranspire before reaching the stormwater conveyance system.
- ***Filter strips, riparian buffers, bank stabilization and erosion control*** – Protection of streambanks within the watershed through planting of vegetated/buffer areas with grasses, legumes, shrubs or trees will mitigate ammonia and nutrient inputs into surface waters. These areas will filter stormwater runoff before the runoff enters the main stem or tributaries of the ULMRW. An assessment of stream channel, river channel, and lakeshore erosional areas should be completed to evaluate areas where erosion control strategies could be implemented in the ULMRW. Implementation actions (e.g., planting deep-rooted vegetation near water bodies to stabilize streambanks) could be prioritized to target areas which are actively eroding. This strategy could prevent additional sediment inputs into surface waters of the ULMRW and minimize or eliminate degradation of habitat.
- ***Urban/Residential Nutrient Reduction Strategies:*** These strategies involve reducing stormwater runoff from lakeshore homes and other residences within the ULMRW. These practices would include; rain gardens, lawn fertilizer reduction, lake shore buffer strips, vegetation management and replacement of failing septic systems. Municipal programs, such as street sweeping, can also aid in the reduction of nutrients to surface water bodies within the ULMRW. Municipal partners can team with local watershed groups or water district partners to assess how best to utilize their monetary resources for installing new stormwater BMPs (e.g., vegetated swales) or retro-fitting existing stormwater BMPs.
- ***Nutrient management*** – These strategies involve reducing nutrient transport from fields and minimizing soil loss. Specific practices would include; erosion control through conservation tillage, reduction of winter spreading of fertilizers, elimination of fertilizer spreading near open inlets and sensitive areas, installation of stream and lake shore buffer strips, streambank stabilization practices (gully stabilization and installation of fencing near streams), and nutrient management planning.
- ***Pasture management and fencing*** - Reducing livestock access to stream environments will lower the opportunity for direct transport of ammonia and nutrients to surface waters. The installation of exclusion fencing near stream and river environments to prevent direct access for livestock, installing alternative water supplies, and installing stream crossings between pastures,

would work to reduce the influxes of ammonia and nutrients and improve water quality within the watershed. Additionally, introducing rotational grazing to increase grass coverage in pastures, and maintaining appropriate numbers of livestock per acre for grazing, can also aid in the reduction of ammonia and nutrient inputs.

- ***Phosphorus-based lawn fertilizer restrictions*** – Runoff from urban and suburban areas may include phosphorus-based fertilizers. Reducing stormwater input from residential lawns, golf courses and other urban/suburban surfaces will reduce the phosphorus inputs to surface waters. Some of these practices could include; rain gardens, municipal street sweeping efforts, lake shore buffer strips, vegetation management and water quality educational programs which aim to inform the general public on nutrient reduction efforts and their impact on water quality.
- ***Private septic system inspection and maintenance program*** - Septic systems are believed to be a source of nutrients to waters in the ULMRW. Failing systems are expected to be identified and addressed via upgrades to those septic systems not meeting local health ordinances. Septic system improvement priority should be given to those failing systems adjacent to surface waters (i.e., streams or lakes).
- ***In-lake phosphorus loading (internal loading)*** - Internal nutrient loads may be addressed to meet the TMDL allocations outlined in the Carthage Lake phosphorus TMDL.
    - *Hypolimnetic aeration:* Increasing oxygen at selected depths in a lake may enhance oxygen transfer efficiencies and reduce internal loading from phosphorus laden lake bottom sediments.
    - *Phosphorus inactivation from aluminum addition (i.e., aluminum sulfate or alum):* The addition of chemical reactants (e.g., aluminum sulfate) to Carthage Lake in order for those reactants to permanently bind phosphorus into the lake bottom sediments. This effort could decrease phosphorus releases from sediment into the lake water column during anoxic conditions.
    - *Dredging of lake bottom sediments:* IEPA explained that phosphorus release from lake bottom sediments is greatest from the recently deposited phosphorus rich layers of lake sediments. Removing this material, via dredging efforts, will contribute to reductions in internal loading.

<u>ULMRW chloride TMDL:</u> The potential BMPs which, if installed and maintained, would likely result in decreases in chloride to surface waters of the ULMRW are:

- ***More efficient use of salt resources:*** Improving winter maintenance practices (i.e., reducing the amount of salt used) of municipal and private applicators for smarter and more efficient use of salt resources. The key challenge in reducing salt usage is balancing the need for public safety with the growing expectation for clear, dry roads, parking lots, and sidewalks throughout the mix, severity, and duration of winter conditions in the ULMRW.

Education and Outreach Efforts - Increased education and outreach efforts to the general public bring greater awareness to the issues surrounding ammonia, chloride, oxygen demanding materials and phosphorus contamination and strategies for reducing loading and transport of these pollutants should be prioritized as part of the overall implementation strategy.

The EPA finds that this criterion has been adequately addressed. The EPA reviews but does not approve implementation plans.

11. Public Participation

EPA policy is that there should be full and meaningful public participation in the TMDL development process. The TMDL regulations require that each State/Tribe must subject calculations to establish TMDLs to public review consistent with its own continuing planning process (40 C.F.R. §130.7(c)(1)(ii)). In guidance, EPA has explained that final TMDLs submitted to EPA for review and approval should describe the State's/Tribe's public participation process, including a summary of significant comments and the State's/Tribe's responses to those comments. When EPA establishes a TMDL, EPA regulations require EPA to publish a notice seeking public comment (40 C.F.R. §130.7(d)(2)).

Provision of inadequate public participation may be a basis for disapproving a TMDL. If EPA determines that a State/Tribe has not provided adequate public participation, EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by EPA.

Comment:
The public participation section of the TMDL submittal is found in Section 3 of the final TMDL document. Throughout the development of the ULMRW TMDLs the public was given various opportunities to participate. IEPA and its TMDL contractor held a series of public meetings in the ULMRW during TMDL development, where IEPA described the watershed plan and TMDL process. The public comment period for the draft TMDL was held between November 18, 2020 and December 21, 2020. IEPA posted the draft TMDL online at (https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Pages/reports.aspx) for the public comment period.

IEPA received one public comment during the public comment period. IEPA developed a response summary to address the comments submitted. EPA reviewed IEPA's response to the comment and has determined that IEPA responded appropriately to the comment. IEPA submitted the comment received during the public notice period and its response with the final TMDL submittal packet received by the EPA on February 23, 2021.

The EPA finds that the TMDL document submitted by IEPA satisfies the requirements of this eleventh element.

12. Submittal Letter

A submittal letter should be included with the TMDL submittal, and should specify whether the TMDL is being submitted for a *technical review* or *final review and approval*. Each final TMDL submitted to EPA should be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for EPA review and approval. This clearly establishes the State's/Tribe's intent to submit, and EPA's duty to review, the TMDL under the statute. The submittal letter, whether for technical review or final review and approval, should contain such identifying information as the name and location of the water body, and the pollutant(s) of concern.

Comment:
The EPA received the final Upper La Moine River Watershed TMDL document, submittal letter and accompanying documentation from IEPA on February 23, 2021. The submittal letter explicitly stated that the final TMDLs referenced in Table 1 of this Decision Document were being submitted to EPA pursuant to Section 303(d) of the Clean Water Act for EPA review and approval. The submittal letter also included the name and location of the water bodies and the causes/pollutants of concern. This TMDL was submitted per the requirements under Section 303(d) of the Clean Water Act and 40 C.F.R. 130.

The EPA finds that the TMDL transmittal letter submitted for the Upper La Moine River Watershed TMDLs by IEPA satisfies the requirements of this twelfth element.

13. Conclusion

After a full and complete review, the EPA finds that the 1 ammonia TMDL, the 1 chloride TMDL, the 4 dissolved oxygen TMDLs and the 1 total phosphorus TMDL satisfy all elements for approvable TMDLs. This TMDL approval is for **seven (7) TMDLs**, addressing segments for aquatic life and aesthetic quality use impairments (Table 1 of this Decision Document).

The EPA's approval of these TMDLs extends to the water bodies which are identified above with the exception of any portions of the water bodies that are within Indian Country, as defined in 18 U.S.C. Section 1151. The EPA is taking no action to approve or disapprove TMDLs for those waters at this time. The EPA, or eligible Indian Tribes, as appropriate, will retain responsibilities under the CWA Section 303(d) for those waters.

ATTACHMENTS

Attachment #1: **Table 5: The Ammonia TMDL for the South Branch of the La Moine River (IL_DGZR) in the Upper La Moine River Watershed**

Attachment #2: **Table 6: The Chloride TMDL for the Drowning Fork Creek (IL-DLGC-01) segment in the Upper La Moine River Watershed**

Table 5: Ammonia TMDL for the South Branch of the La Moine River (IL_DGZR) in the Upper La Moine River Watershed

Allocation	Flow Zone	High Flows	Moist Flows			Mid-Range Flows	Dry Flows				Low Flows
	Flow Exceedance Range (%)	**0 - 10**	**10 - 20**	**20 - 30**	**30 - 40**	**40 - 50**	**50 - 60**	**60 - 70**	**70 - 80**	**80 - 90**	**90 - 100**
	Source	*Ammonia load (lbs/day)*									
South Branch of the La Moine River (IL_DGZR) - Summer (June to August) conditions											
Wasteload Allocation	WLA- La Harpe STP (ILG580093)	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30
	Wasteload Allocation Total	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30
Load Allocation		558.00	165.00	82.00	48.00	29.00	17.00	9.00	5.00	0.50	*
Margin of Safety (implicit)		*(Implicit)*									
Loading Capacity		**562.30**	**169.30**	**86.30**	**52.30**	**33.30**	**21.30**	**13.30**	**9.30**	**4.80**	**4.30**
Percent Reduction		--	--	--	--	--	--	--	--	--	57%
South Branch of the La Moine River (IL_DGZR) - Spring (March to May) and Fall (September to October) conditions											
Wasteload Allocation	WLA- La Harpe STP (ILG580093)	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	
	Wasteload Allocation Total	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	4.40	
Load Allocation		628.00	233.00	132.00	86.00	57.00	35.00	17.00	5.00	*	
Margin of Safety (implicit)		*(Implicit)*									
Loading Capacity		**632.40**	**237.40**	**136.40**	**90.40**	**61.40**	**39.40**	**21.40**	**9.00**	**4.40**	
Percent Reduction		--	--	--	--	--	--	--	--	45%	

South Branch of the La Moine River (IL_DGZR) - Winter (November to February)											
Wasteload Allocation	WLA- La Harpe STP (ILG580093)	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20
	Wasteload Allocation Total	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20	8.20
Load Allocation		825.00	277.00	158.00	97.00	63.00	36.00	18.00	7.00	0.80	0.80
Margin of Safety (implicit)		*(Implicit)*									
Loading Capacity		**833.20**	**285.20**	**166.20**	**105.20**	**71.20**	**44.20**	**26.20**	**15.20**	**9.00**	**9.00**
Percent Reduction		--	--	--	--	--	--	--	--	--	--

* = IEPA explained that nonpoint source/watershed contributions during the low flow regime are expected to be near zero

Table 6: Chloride TMDL for the Drowning Fork Creek (IL-DLGC-01) segment in the Upper La Moine River Watershed

Allocation	**Flow Zone**	**High Flows**	**Moist Flows**			**Mid-Range Flows**	**Dry Flows**				**Low Flows**
	Flow Exceedance Range (%)	**0 - 10**	**10 - 20**	**20 - 30**	**30 - 40**	**40 - 50**	**50 - 60**	**60 - 70**	**70 - 80**	**80 - 90**	**90 - 100**
	Source	*Chloride (lbs/day)*									
Drowning Fork Creek (IL_DLGC-01)											
Wasteload Allocation	WLA - Bushnell West STP (IL0024384)	1,043	1,043	1,043	1,043	1,043	1,043	1,043	1,043	1,043	752
Wasteload Allocation Total		1,043	1,043	1,043	1,043	1,043	1,043	1,043	1,043	1,043	752
Load Allocation		265,976	89,692	49,769	31,363	19,697	11,920	6,346	2,976	967	*
Margin of Safety (10%)		29,669	10,082	5,646	3,601	2,304	1,440	821	446	223	84
Loading Capacity		**296,688**	**100,817**	**56,458**	**36,007**	**23,044**	**14,403**	**8,210**	**4,465**	**2,233**	**836**
Percent Reduction		--	--	--	--	--	--	--	--	--	52.0%

* = IEPA explained that nonpoint source/watershed contributions during the low flow regime are expected to be near zero

FINAL REPORT

Upper La Moine River Watershed TMDL Final Report

Prepared for Illinois EPA

March 2021

CDM Smith

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Acronyms

BMPs	best management practices
CDL	Cropland Data Layer
cfs	cubic feet per second
CWA	Clean Water Act
DMR	discharge monitoring report
DO	dissolved oxygen
fIBI	fish Index of Biotic Integrity
GIS	geographic information system
IDA	Illinois Department of Agriculture
Illinois EPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
ISWS	Illinois State Water Survey
LA	Load Allocation
LC	Loading Capacity
LRS	load reduction strategy
MBI	Macroinvertebrate Biotic Index
mg/L	milligrams per liter
mIBI	macroinvertebrate Index of Biotic Integrity
µg/L	micrograms per liter
mL	milliliters
MOS	Margin of Safety
NA	not applicable
NASS	National Agricultural Statistics Service
NCDC	National Climatic Data Center
ND	non-detect
NED	National Elevation Dataset
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
RC	Reserve Capacity
SSURGO	Soil Survey Geographic
TMDL	total maximum daily load
TSS	total suspended solids
TVS	total volatile solids
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
USLE	Universal Soil Loss Equation
WLA	Waste Load Allocation

Section 1

Goals and Objectives for the Upper La Moine River Watershed

1.1 Total Maximum Daily Load Overview

A total maximum daily load, or TMDL, is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards. TMDLs are a requirement of Section 303(d) of the Clean Water Act (CWA). To meet this requirement, the Illinois Environmental Protection Agency (Illinois EPA) must identify water bodies not meeting water quality standards and then establish TMDLs for restoration of water quality. Illinois EPA develops a list known as the "303(d) list" of water bodies not meeting water quality standards every 2 years, and it is included in the Integrated Water Quality Report. Water bodies on the 303(d) list are then targeted for TMDL development. The Illinois EPA's most recent Integrated Water Quality Report was submitted to the United States Environmental Protection Agency (USEPA) in July 2016. In accordance with USEPA's guidance, the report assigns all waters of the state to one of five categories. 303(d) listed water bodies make up category five in the integrated report (**Appendix A** of the Integrated Report).

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

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

- Restore and maintain the chemical, physical, and biological integrity of the nation's waters
- 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 primary contact (swimming), protection of aquatic life, and public and food processing water supply. Water quality criteria describe the quality of water that will support a designated use. Water quality criteria can be expressed as numeric limits or as a narrative statement. Antidegradation policies are adopted so that water quality improvements are conserved, maintained, and protected.

1.2 TMDL Goals and Objectives for the Upper La Moine River Watershed

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

Stage 1 – Watershed Characterization, Data Analysis, Methodology Selection

Stage 2 – Data Collection (optional)

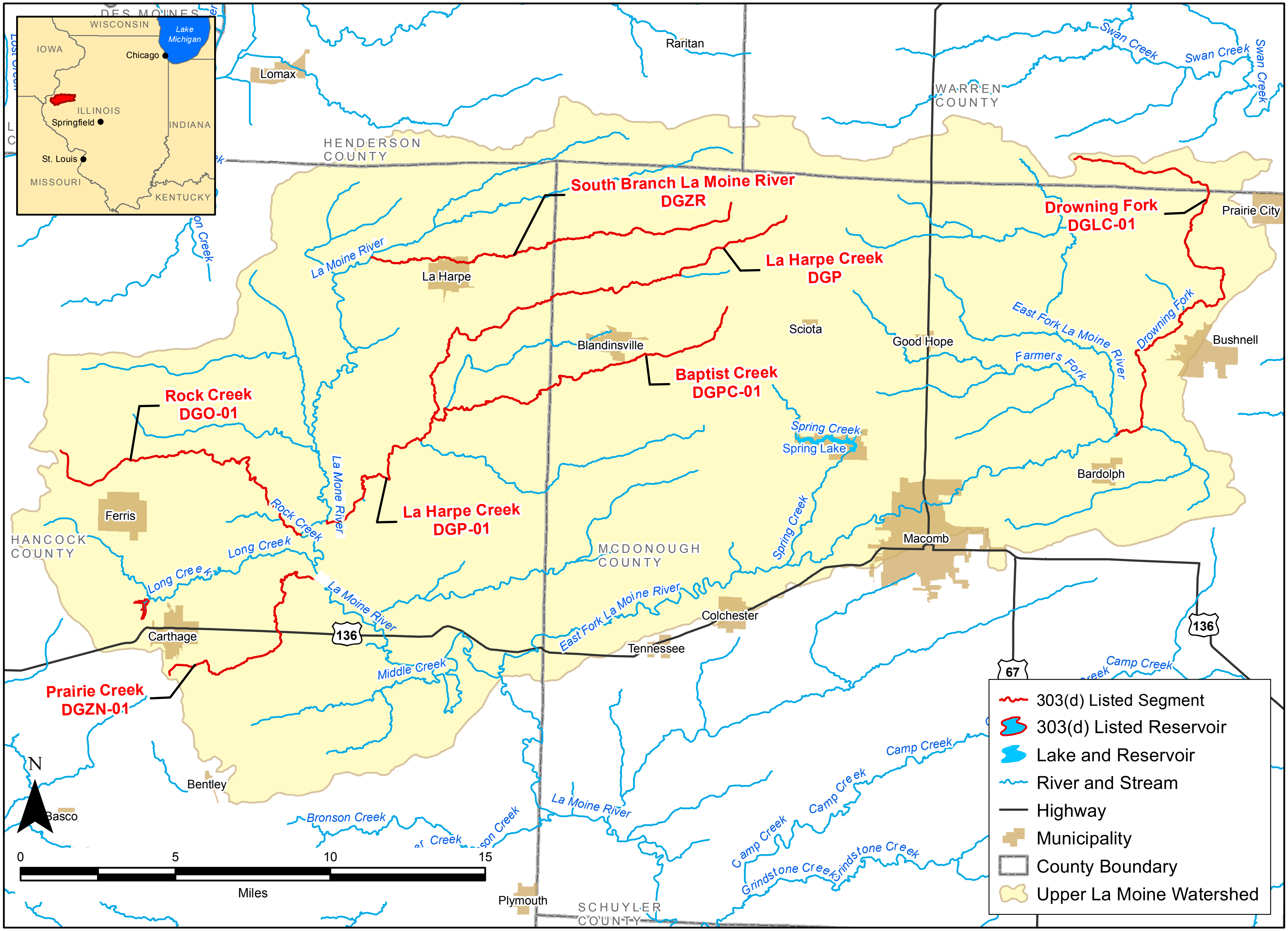
Stage 3 – Model Calibration, TMDL Scenarios, Implementation Plan

This report addresses all stages of TMDL development. The Stage 1 TMDL report for the Upper La Moine River watershed was finalized in 2017. Additional data were collected in 2017 during Stage 2 TMDL development. This document combines the reports for Stages 1 and 3.

The TMDL goals and objectives for the Upper La Moine River watershed included developing TMDLs for all impaired water bodies within the watershed, describing all 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 Upper La Moine River watershed:

- Drowning Fork (DGLC-01)
- Rock Creek (DGO-01)
- La Harpe Creek (DGP and DGP-01)
- Baptist Creek (DGPC-01)
- Prairie Creek (DGZN-01)
- South Branch La Moine River (DGZR)
- Carthage Lake (RLE)

The impaired water body segments are shown on **Figure 1-1**. There are seven impaired stream segments and one impaired reservoir within the Upper La Moine River watershed for which TMDLs and/or load reduction strategies (LRSs) were developed. **Table 1-1** lists the water body segment, potential causes of impairment, use description and potential sources of impairment for the water body.



CDM Smith

Upper La Moine River TMDL Watershed

FIGURE 1-1

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Table 1-1 Impaired Water Bodies in Upper La Moine River Watershed

Segment ID	Segment Name	Potential Causes of Impairment	Use Description	Potential Sources (as identified by the 2016 303(d) list)
DGLC-01	Drowning Fork	**Chloride**	Aquatic Life	Source Unknown
		Phosphorus (Total)	Aquatic Life	Crop Production (crop land or dry land), Municipal point source discharges
		Sedimentation/Siltation	Aquatic Life	Crop Production (crop land or dry land)
		Total Suspended Solids (TSS)	Aquatic Life	Crop Production (crop land or dry land), Municipal point source discharges
DGO-01	Rock Creek	**Dissolved Oxygen**	Aquatic Life	Source Unknown
DGP	La Harpe Creek	**Dissolved Oxygen**	Aquatic Life	Source Unknown
		Manganese	Aquatic Life	Source Unknown
DGP-01	La Harpe Creek	**Dissolved Oxygen**	Aquatic Life	Source Unknown
		Manganese	Aquatic Life	Source Unknown
DGPC-01	Baptist Creek	**Manganese**	Aquatic Life	Source Unknown
DGZN-01	Prairie Creek	**Dissolved Oxygen**	Aquatic Life	Municipal point source discharges
		Phosphorus (Total)	Aquatic Life	Crop Production (crop land or dry land), Municipal point source discharges
		Total Suspended Solids (TSS)	Aquatic Life	Crop Production (crop land or dry land)
DGZR	South Branch La Moine River	**Ammonia (Total)**	Aquatic Life	Municipal point source discharges
		Dissolved Oxygen	Aquatic Life	Municipal point source discharges
		Manganese	Aquatic Life	Source Unknown
		Phosphorus (Total)	Aquatic Life	Municipal point source discharges
RLE	Carthage Lake	**Phosphorus (Total)**	Aesthetic Quality	Agriculture, Internal nutrient recycling, Crop Production (crop land or dry land), Golf Courses, Other recreational pollution sources, Runoff from Forest/Grassland/Parkland
		Total Suspended Solids (TSS)	Aesthetic Quality	Crop Production (crop land or dry land), Impacts from hydrostructure flow regulation/modification, Littoral/shore area modifications (non-riverine), Other recreational pollution sources, Runoff from Forest/Grassland/Parkland, Site clearance (land development or redevelopment)

Bold Causes of Impairment have numeric water quality standards and TMDL analyses were performed where data were adequate (see Section 8 for final list of TMDLs). Italicized Causes of Impairment do not have numeric water quality standards and an LRS was developed where appropriate. Some italicized causes of impairment may not have an LRS developed as it is likely that implementing strategies to reduce the loading of other parameters of concern (e.g. reducing phosphorus loading to lakes) will result in reduced loading of additional parameters of concern (e.g. Total Suspended Solids and/or turbidity in lakes).

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

The TMDLs for the segments listed above specify the following elements:

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

These elements are combined into the following equation:

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

Where target criteria were available for parameters without established numeric criteria, LRSs were developed that include LC and reductions needed to meet the LC. LRSs differ from TMDLs in that the allowable load is not broken out between point and nonpoint sources. Both TMDL and LRS development also considered the seasonal variability of pollutant loads so that water quality standards are met during all seasons of the year. Also, reasonable assurance that the TMDLs and LRSs will be achieved is described in the implementation plan. The implementation plan for the Upper La Moine River watershed describes how water quality standards and targets will be met and attained. This implementation plan includes recommendations for implementing best management practices (BMPs), cost estimates, institutional needs to implement BMPs and controls throughout the watershed, and a timeframe for completion of implementation activities.

1.3 Report Overview

The remaining sections of this report contain:

- **Section 2 Upper La Moine River Watershed Characteristics** provides a description of the watershed's location, topography, geology, land use, soils, population, and hydrology.
- **Section 3 Public Participation and Involvement** discusses public participation activities that will occur throughout TMDL development.
- **Section 4 Upper La Moine River Watershed Water Quality Standards** defines the water quality standards and water quality guidelines for the impaired water bodies.
- **Section 5 Upper La Moine River Watershed Water Quality Data and Potential Sources** presents the available water quality data needed to develop TMDLs and LRSs, discusses the characteristics of the impaired stream segments in the watershed, and also describes the point and nonpoint sources with potential to contribute to the watershed load.

- **Section 6 Approach to Developing TMDL and Identification of Data Needs** makes recommendations for the models and analysis that are needed for TMDL and LRS development and also suggests segments for Stage 2 data collection.
- **Section 7 Methodology Development for the Upper La Moine River Watershed** details the development of the TMDL and LRS for the impaired segments.
- **Section 8 Total Maximum Daily Load for the Upper La Moine River Watershed** provides the results of the TMDL and LRS analyses for the impaired segments within the Upper La Moine River watershed.
- **Section 9 Implementation Plan for the Upper La Moine River Watershed** makes recommendations for implementation actions, point source controls, management measures, and BMPs that can be used to address water quality issues in the watershed.

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Section 2

Upper La Moine River Watershed Description

2.1 Upper La Moine River Watershed Location

The Upper La Moine River watershed (shown on **Figure 1-1**) is located in west-central Illinois and drains approximately 369,000 acres within the state of Illinois. Approximately 182,300 acres (49.4 percent of the total watershed) lie in McDonough County, 164,200 acres lie in Hancock County (44.5 percent of the total watershed), 12,600 acres lie in Warren County (3.4 percent of the total watershed), and 9,800 acres lie in Henderson County (2.7 percent of the total watershed).

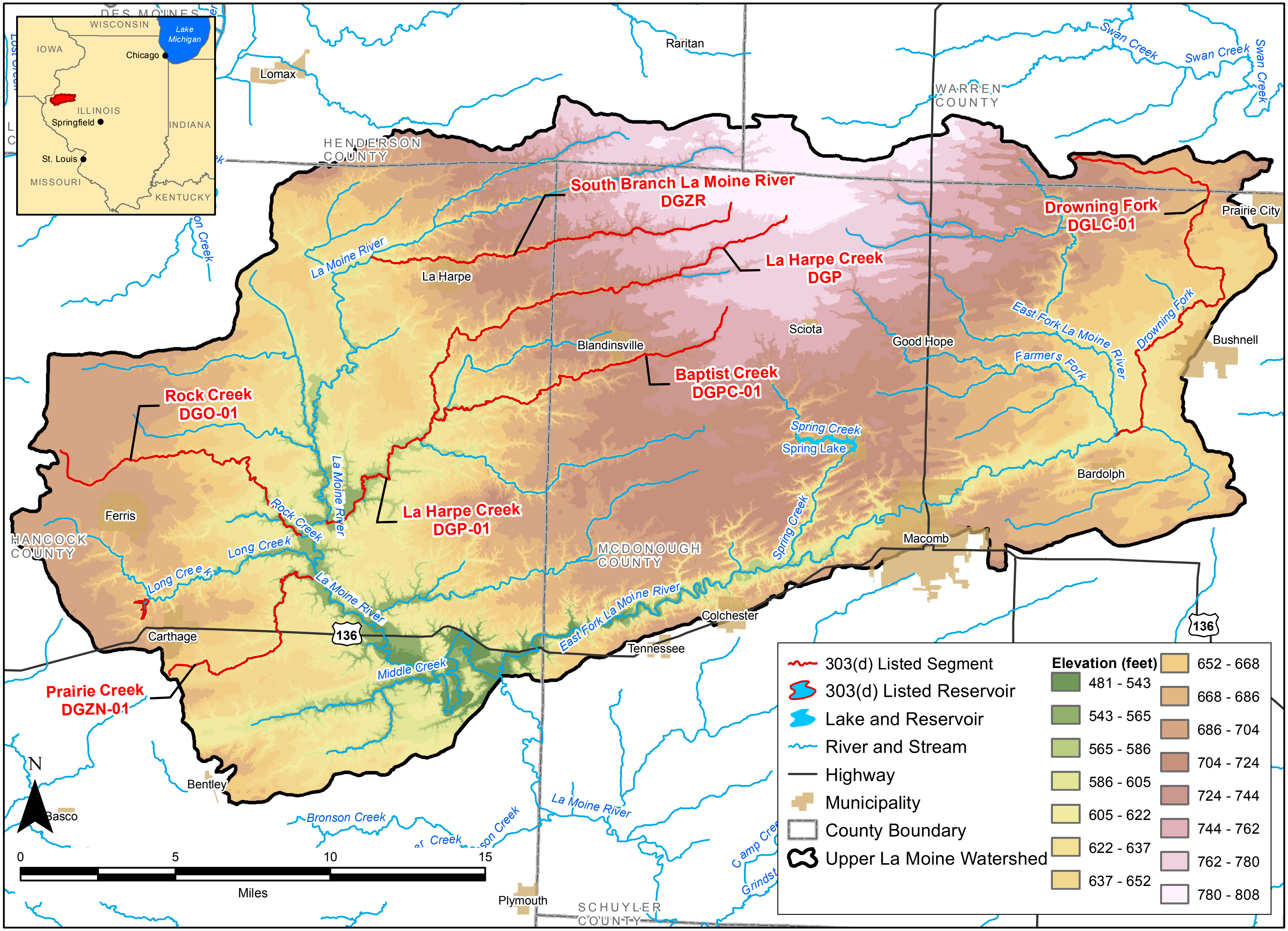
2.2 Topography

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 Upper La Moine River watershed were obtained by overlaying the NED grid onto the geographic information system (GIS)-delineated watershed. **Figure 2-1** shows the elevations found within the watershed. Elevation in the Upper La Moine River watershed ranges from approximately 800 feet above sea level in the north-central portion of the watershed to 480 feet above sea level where the East Fork La Moine River meets the Upper La Moine River.

2.3 Land Use

Land use data for the Upper La Moine River watershed were extracted from the U.S. Department of Agriculture's (USDA) National Agriculture Statistics Service (NASS) 2014 Cropland Data Layer (CDL) (USDA, 2016). The CDL is a raster based, geo-referenced, crop-specific land cover data layer created to provide acreage estimates to the Agricultural Statistics Board for the state's major commodities and to produce digital, crop-specific, categorized geo-referenced output products. This information is made available to all agencies and to the public free of charge and represents the most accurate and up-to-date land cover datasets available at a national scale. The most recent available CDL dataset was produced in 2014 and includes 32 separate land use classes applicable to the watershed. The available resolution of the land cover dataset is 30 square meters. The 2014 CDL and extensive metadata are available at http://www.nass.usda.gov/Research_and_Science/Cropland/SARS1a.php.

Land use characteristics of the watershed were determined by overlaying the Illinois Statewide 2014 CDL data layers onto the GIS-delineated watershed. **Table 2-1** contains the main categories of land uses contributing to the Upper La Moine River watershed, based on the 2014 CDL land cover categories, and also includes the area of each land cover category and percentage of the watershed area. **Figure 2-2** illustrates the land uses of the watershed. **Appendix A** contains a table of all land uses in the watershed.



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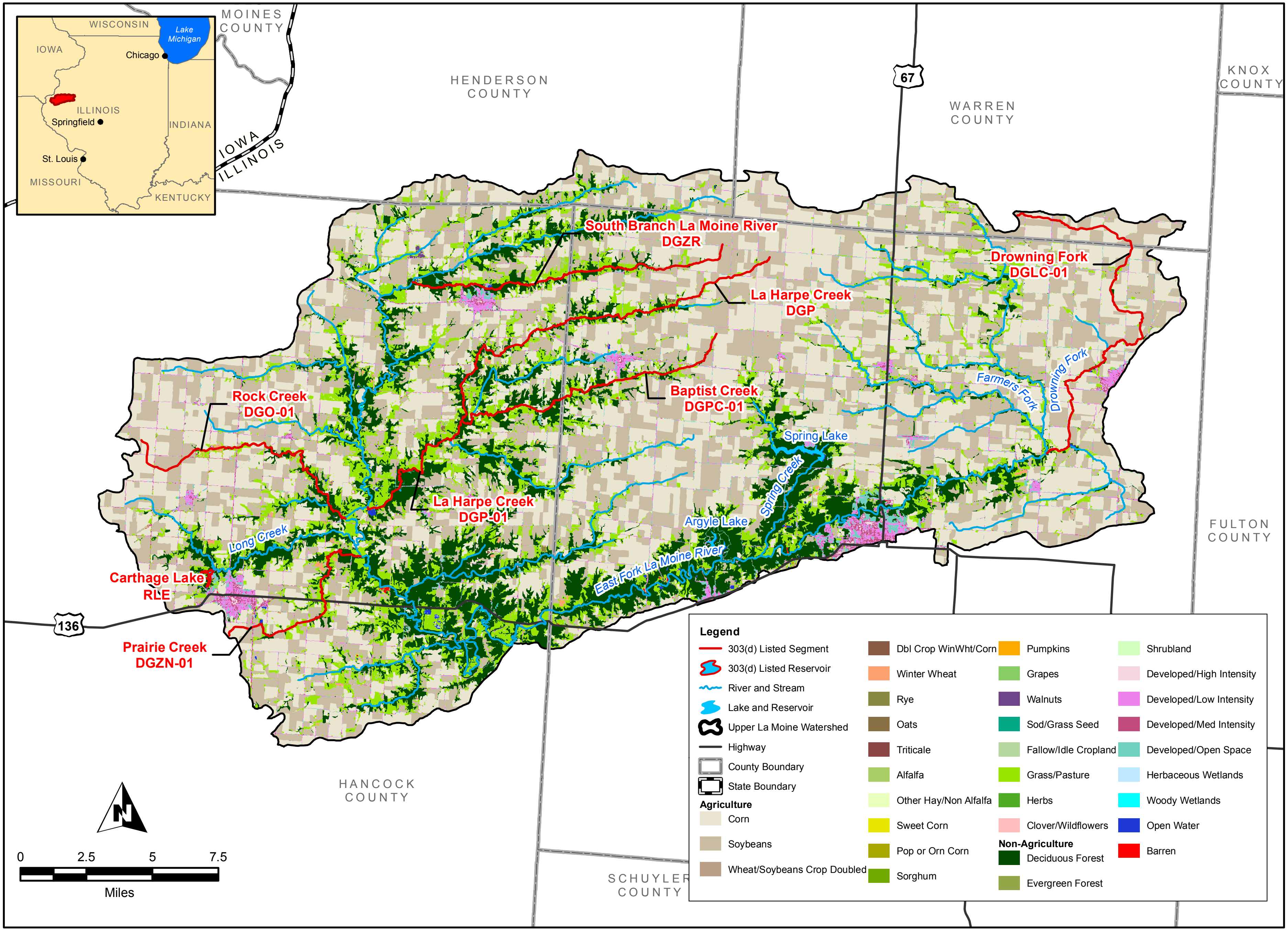
Upper La Moine River Watershed Elevation

FIGURE 2-1



CDM Smith

Upper La Moine River Watershed Land Use

FIGURE 2-2

Table 2-1 Land Cover and Land Use in Upper La Moine River Watershed

USDA/NASS Land Use Cropland Category	Acres	Percentage
Corn	137,055	37%
Soybeans	104,627	28%
Deciduous Forest	59,764	16%
Grass/Pasture	42,463	12%
Developed/Low Intensity	11,458	3%
Developed/Open Space	7,331	2%
All others	6,351	2%
Total	369,049	100%

The land cover data reveal that 243,829 acres, representing 66 percent of the total watershed area, are devoted to agricultural activities. Corn and soybean make up 99% of the agricultural land use within the watershed. Forests, woodland, grasslands, and shrubs cover 28 percent of the watershed (102,371 acres). Approximately 6 percent of the watershed area (21,764 acres) is developed, urbanized land. The remaining watershed is wetland or open water. Refer to Appendix A for the detailed breakdown of land cover data for the watershed.

2.4 Soils

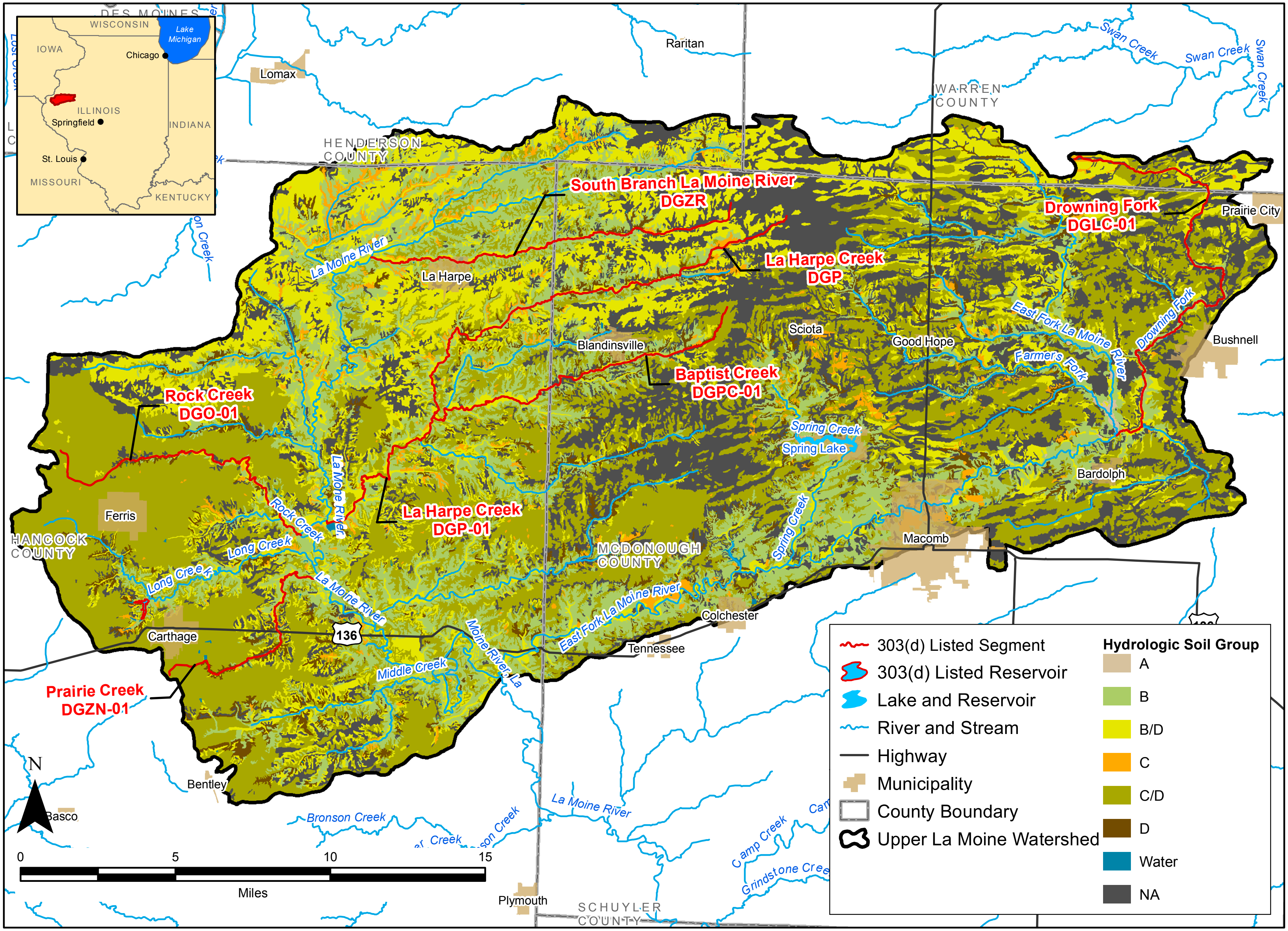
Soils data are available through the Soil Survey Geographic (SSURGO) database. For SSURGO data, field mapping methods using national standards are used to construct the soil maps. Mapping scales generally range from 1:12,000 to 1:63,360 making SSURGO the most detailed level of soil mapping done by the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

Attributes of the spatial coverage can be linked to the SSURGO databases, which 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 (USLE). The following sections describe and summarize the specified soil characteristics for the Upper La Moine River watershed.

2.4.1 Upper La Moine River Watershed Soil Characteristics

Appendix B contains a table of the SSURGO soil series for the Upper La Moine River watershed. A total of 123 soil types exist in the watershed. The most common type—Ipava silt loam (0 to 2 percent slopes) – covers 17 percent of the watershed. The second most common type – Sable silty clay loam (0 to 2 percent slopes) covers 11% of the watershed. Soils containing "clay" in some part of the classification name cover roughly 10% of the watershed area. All other individual soil types each represent less than 6 percent of the total watershed area. The table in **Appendix B** also contains the area, dominant hydrologic soil group, and k-factor range. Each of these characteristics is described in more detail in the following paragraphs.

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



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Upper La Moine River Watershed Soils

FIGURE 2-3

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

While hydrologic soil groups A, B, C, D, B/D, and C/D are all found within the Upper La Moine River watershed, group C/D soils are the most common type representing 35 percent of the watershed. Group C/D is a dual hydrologic soil group. Dual hydrologic soil groups can be adequately drained. The first letter applies to the drained condition and the second letter to the undrained condition. For the purpose of hydrologic soil group, adequately drained means that the seasonal high water table is kept at 24 inches below the surface[1].

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

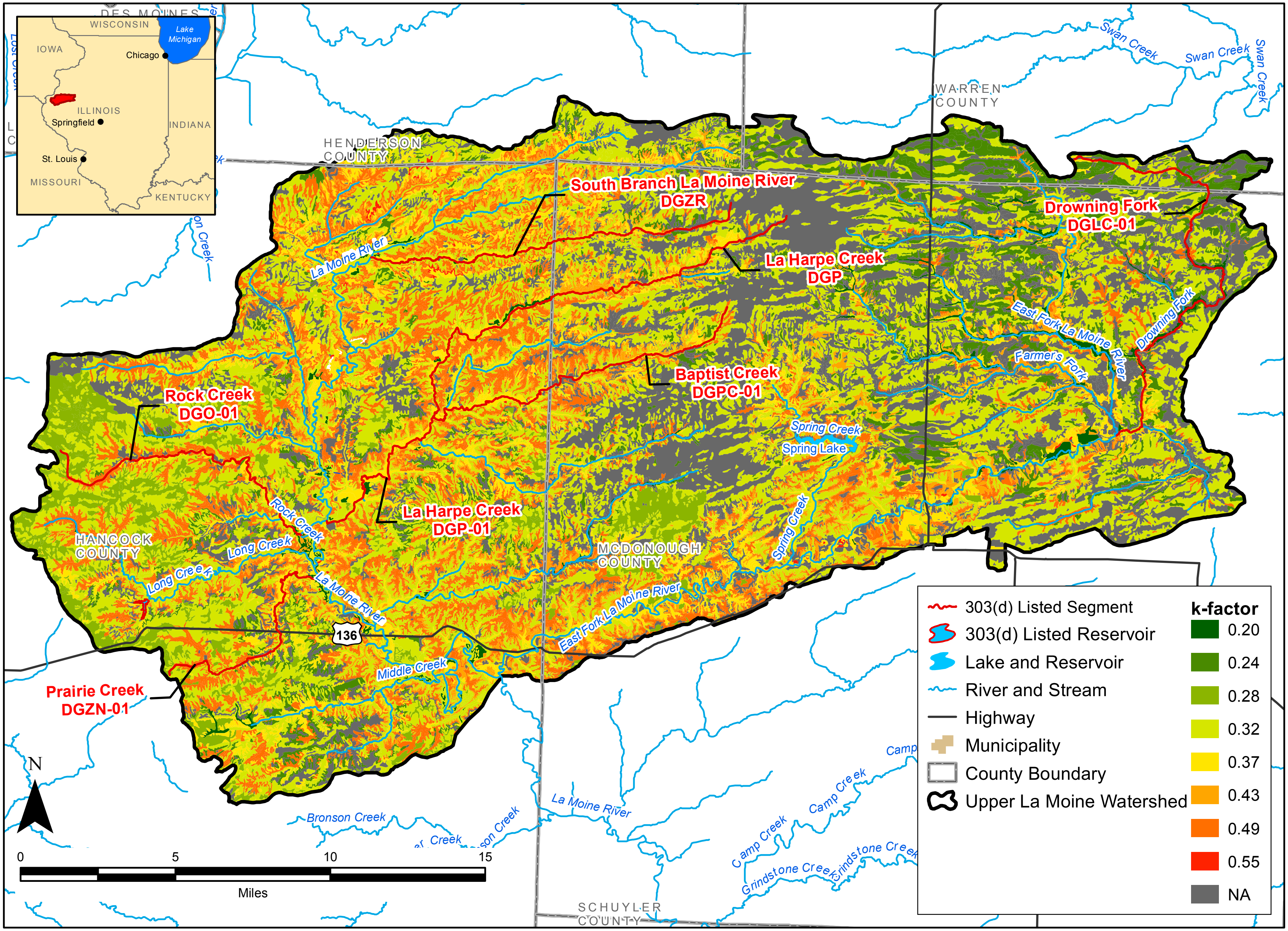
> *Indicates the susceptibility of a soil to sheet and rill erosion by water. (The K-factor) is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion. Losses are expressed in tons per acre per year. These estimates 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 Upper La Moine River watershed range from 0.20 to 0.55 (**Figure 2-4**).

2.5 Population

The Census 2010 TIGER/Line data from the U.S. Census Bureau were reviewed along with shapefiles of census blocks that are available for the entire state of Illinois. All census blocks that have geographic center points (centroids) within the watershed were selected and tallied in order to provide an estimate of populations in all census blocks both completely and partially contained by the watershed boundary. Approximately 25,700 people reside in the Upper La Moine River watershed. The major municipalities in the watershed are shown in **Figure 1-1**. The largest urban development in the watershed is the city of Macomb, which lies partially within the watershed and has an estimated population of approximately 11,949 people within the watershed. Large future growth is not anticipated in the area.

[1] Natural Resources Conservation Service. Part 360 Hydrology National Engineering Handbook. 2007.



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Upper La Moine River Watershed k-factor Ranges

FIGURE 2-4

2.6 Climate, Pan Evaporation, and Streamflow

2.6.1 Climate

Western Illinois has a temperate climate with hot summers and cold, moderately snowy winters. Monthly temperature and precipitation data from La Harpe, Illinois (station id USC00114823) were extracted from the National Climatic Data Center (NCDC) database for the years 1915 through 2015. This station was selected due to its location within the watershed and completeness of its dataset.

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 37 inches. May and June are historically the wettest months while January and February are the driest.

Table 2-2 Average Monthly Climate Data for La Harpe, Illinois

Month	Average Total Precipitation (inches)	Average Daily Maximum Temperature (degrees F)	Average Daily Minimum Temperature (degrees F)
January	1.6	33.7	14.9
February	1.5	38.1	18.9
March	2.7	50.2	28.9
April	3.8	63.5	40.0
May	4.2	74.1	50.6
June	5.0	83.0	60.1
July	3.9	87.4	63.9
August	3.6	85.4	61.9
September	3.9	78.4	53.8
October	2.9	67.0	42.6
November	2.4	50.9	30.7
December	2.0	37.5	19.9
Total	37.4*	62.4	40.5

*Total Annual Precipitation

2.6.2 Pan Evaporation

Through the Illinois State Water Survey (ISWS) website, pan evaporation data are available from nine locations across Illinois (ISWS 2009). The Perry, Illinois station was chosen to be representative of pan evaporation conditions for the Upper La Moine River watershed. The Perry station is located approximately 50 miles south of the Upper La Moine River watershed. This station was chosen due to being the closest pan evaporation station to the Upper La Moine River watershed. The average annual pan evaporation at the Perry station for the years 1996 to 2002 is 42.2 inches. Actual evaporation is typically less than pan evaporation, so the average annual pan evaporation was multiplied by 0.75 to calculate an average annual evaporation of 31.6 inches[2].

[2] Data provided by the Illinois State Climatologist's Office, a part of the Illinois State Water Survey (ISWS) located in Champaign and Peoria, Illinois, and on the web at www.isws.illinois.edu/atmos/statecli.

2.6.3 Streamflow

Analysis of the Upper La Moine River watershed requires an understanding of flow throughout the drainage area. There are no active USGS stream gages in the watershed and one stream gage is located approximately 5 miles south of the watershed on the La Moine River (**Figure 2-5**). **Table 2-3** summarizes the station information.

Table 2-3 USGS Stream Gages

Gage Number	Name	POR
USGS 05584500	La Moine River at Colmar, IL	1944-2015

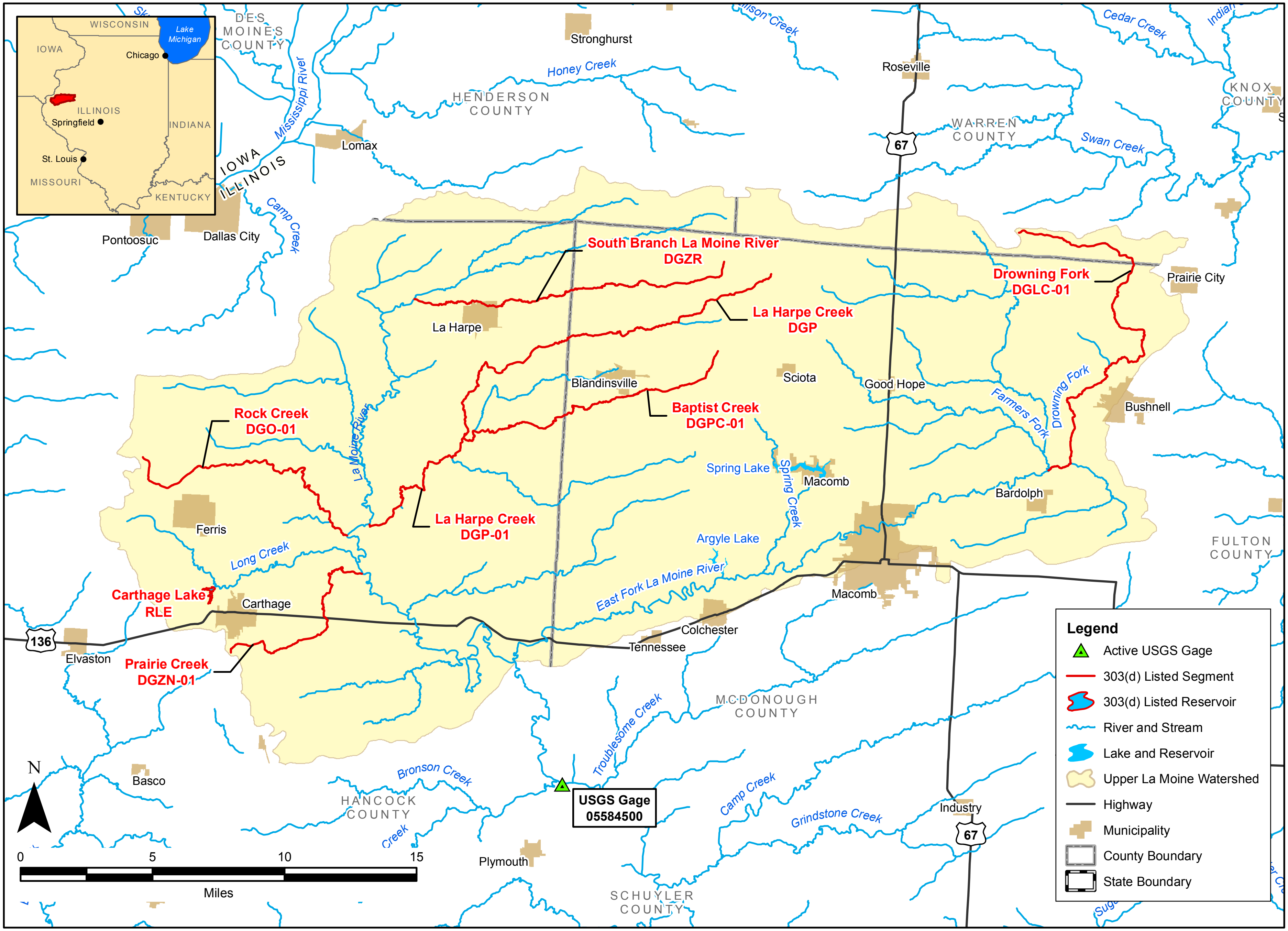
Based on the stream gage located on the La Moine River (USGS 05584500 La Moine River near Colmar, IL), the average monthly flows in the La Moine River range from 161 cubic feet per second (cfs) in August to 838 cfs in April (see **Figure 2-6**). The gage drains an area of 655 square miles. Historically, stream flows are highest in April and May and lowest in August and September.

Data from this gage will be used to estimate flow values for each impaired stream segment within the Upper La Moine River watershed. Estimates of flow values for impaired segments will be corrected for each segment's watershed size using the drainage area ratio method, represented by the following equation:

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

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

The assumption behind the equation is that the flow per unit area is equivalent in watersheds with similar characteristics. Therefore, the flow per unit area in the gaged watershed multiplied by the area of the ungaged watershed estimates the flow for the ungaged watershed. Daily discharge data are available from 1944 to 2015 and daily gage height data are available for this gage beginning in 1993.



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Upper La Moine River Active USGS Gages

FIGURE 2-5

Section 3

Upper La Moine River Watershed Public Participation

3.1 Upper La Moine River Watershed Public Participation and Involvement

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

Illinois EPA, along with CDM Smith, held a Stage 1 public meeting in the Upper La Moine River watershed in Macomb, Illinois on March 8, 2017. An additional public meeting was held virtually on Wednesday, November 18, 2020 to present the final TMDL results and implementation plan (Stage 3). Comments received through the public meeting process are included in **Appendix D**.

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Section 4

Upper La Moine Water Quality Standards and Guidelines

4.1 Illinois Water Quality Standards

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

Illinois EPA is also responsible for developing scientifically based water quality criteria and proposing them to the IPCB for adoption into state rules and regulations. The Illinois water quality standards are established in the Illinois Administrative Rules Title 35, Environmental Protection; Subtitle C, Water Pollution; Chapter I, Pollution Control Board; Part 302, Water Quality Standards (IPCP, 2015).

4.2 Designated Uses

The waters of Illinois are classified by designated uses, which include: General Use, Public and Food Processing Water Supplies, Lake Michigan Basin, and Secondary Contact and Indigenous Aquatic Life Use[1]. The designated use applicable to the impairments within the Upper La Moine River watershed is General 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.

4.3 Illinois Water Quality Standards

According to the Illinois EPA Integrated Report (IEPA, 2016), aquatic life use assessments in streams are typically based on the interpretation of biological information, physicochemical water data, and physical-habitat. The primary biological measures used are the fish Index of Biotic Integrity (fIBI), the macroinvertebrate Index of Biotic Integrity (mIBI) and the Macroinvertebrate Biotic Index (MBI). Physical-habitat information used in assessments includes quantitative or qualitative measures of stream-bottom composition and qualitative descriptors of channel and riparian conditions. Physicochemical water data used include

[1] Illinois EPA, 2016. Illinois Integrated Water Quality Report and Section 303(d) List. https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Pages/303d-list.aspx

Tables 4-1 and **4-2** present the numeric water quality standards of the potential causes of impairment for both lakes and rivers in the Upper La Moine River watershed. Only constituents with numeric water quality standards had TMDLs developed.

Table 4-1 Summary of Numeric Water Quality Standards for Potential Causes of Lake Impairments in Upper La Moine River Watershed

Parameter	Units	General Use Water Quality Standard	Regulatory Reference
Phosphorus (Total)	mg/L	0.05[(1)]	302.205

mg/L = milligrams per liter
(1) Standard applies to 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 Numeric Water Quality Standards for Potential Causes of Stream Impairments in Upper La Moine River Watershed

Parameter	Units	General Use Water Quality Standard	Regulatory Reference
Chloride (total)	mg/L	500	302.208(g)
Dissolved Oxygen	mg/L	*March through July* ≥5.0 minimum & ≥6.0 7-day daily mean averaged over 7 days *August through February* ≥3.5 minimum, ≥4.0 7-day minimum averaged over 7 days & ≥5.5 30-day daily mean[(1)]	302.206(b)
Manganese	µg/L	*Dissolved:* Acute = $e^{A+B\ln(H)}$ X 0.9812* where A = 4.9187 and B = 0.7467 Chronic = $e^{A+B\ln(H)}$ X 0.9812* where A = 4.0635 and B = 0.7467	302.208(e)
Ammonia (Total as N)	mg/L	15[1]	302.212(a)

µg/L = micrograms per liter
H = hardness
* = Conversion factor multiplier for dissolved metals
1 = 302.212(b) provides further information on detailed calculations for determining the acute and chronic standards for ammonia

4.4 Water Quality Guidelines

In addition to the water quality standards provided above, the Illinois EPA has also established water quality guidelines for several parameters. Water quality guidelines are target values used by Illinois EPA during assessments for parameters that do not have numerical water quality criteria. Load reduction strategies (LRSs) were developed using these watershed-specific targets as water quality goals. LRSs for the streams in the Upper La Moine River watershed are provided in **Table 4-3**. The guidelines are based on data from all stream segments within the HUC-10 basins of the watershed, as well as stream segments which closely border the watershed in neighboring HUC-10 basins, in order to best represent the land use, hydrologic, and geologic conditions unique to the watershed. Load reduction targets were calculated using data from stream segments whose most current assessment shows full support for aquatic life and data that has passed quality assurance and quality checks within Illinois EPA and are in accordance with state and federal laws.

Table 4-3 Summary of Water Quality Guidelines in Upper La Moine River Watershed

Parameter	Units	Load Reduction Target
Phosphorus (Total)	mg/L	0.17
Total Suspended Solids (TSS)	mg/L	50.9
Non Volatile Suspended Solids (NVSS)	mg/L	39.1

4.5 Potential Pollutant Sources

In order to properly address the conditions within the Upper La Moine River watershed, potential pollutant sources must be investigated for the pollutants where TMDLs were developed. The following is a summary of the potential sources associated with the listed potential causes for the 303(d) listed segments in this watershed.

Table 4-4 Impaired Water Bodies

Segment ID	Segment Name	Potential Causes of Impairment	Designated Use	Potential Sources (as identified by the 2016 303(d) list)
DGLC-01	Drowning Fork	**Chloride**	Aquatic Life	Source Unknown
		Phosphorus (Total)	Aquatic Life	Crop Production (crop land or dry land), Municipal point source discharges
		Sedimentation/Siltation	Aquatic Life	Crop Production (crop land or dry land)
		Total Suspended Solids (TSS)	Aquatic Life	Crop Production (crop land or dry land), Municipal point source discharges
DGO-01	Rock Creek	**Dissolved Oxygen**	Aquatic Life	Source Unknown
DGP	La Harpe Creek	**Dissolved Oxygen**	Aquatic Life	Source Unknown
		Manganese	Aquatic Life	Source Unknown
DGP-01	La Harpe Creek	**Dissolved Oxygen**	Aquatic Life	Source Unknown
		Manganese	Aquatic Life	Source Unknown
DGPC-01	Baptist Creek	**Manganese**	Aquatic Life	Source Unknown
DGZN-01	Prairie Creek	**Dissolved Oxygen**	Aquatic Life	Municipal point source discharges
		Phosphorus (Total)	Aquatic Life	Crop Production (crop land or dry land), Municipal point source discharges
		Total Suspended Solids (TSS)	Aquatic Life	Crop Production (crop land or dry land)
DGZR	South Branch La Moine River	**Ammonia (Total)**	Aquatic Life	Municipal point source discharges
		Dissolved Oxygen	Aquatic Life	Municipal point source discharges
		Manganese	Aquatic Life	Source Unknown
		Phosphorus (Total)	Aquatic Life	Municipal point source discharges
RLE	Carthage Lake	**Phosphorus (Total)**	Aesthetic Quality	Agriculture, Internal nutrient recycling, Crop Production (crop land or dry land), Golf Courses, Other recreational pollution sources, Runoff from Forest/Grassland/Parkland
		Total Suspended Solids (TSS)	Aesthetic Quality	Crop Production (crop land or dry land), Impacts from hydrostructure flow regulation/modification, Littoral/shore area modifications (non-riverine), Other recreational pollution sources, Runoff from Forest/Grassland/Parkland, Site clearance (land development or redevelopment)

Bold Causes of Impairment have numeric water quality standards and TMDL analyses were performed where data were adequate (see Section 8 for final list of TMDLs). Italicized Causes of Impairment do not have numeric water quality standards and an LRS was developed where water quality targets have been provided by Illinois EPA.

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Section 5

Upper La Moine River Watershed Water Quality Data and Potential Sources

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

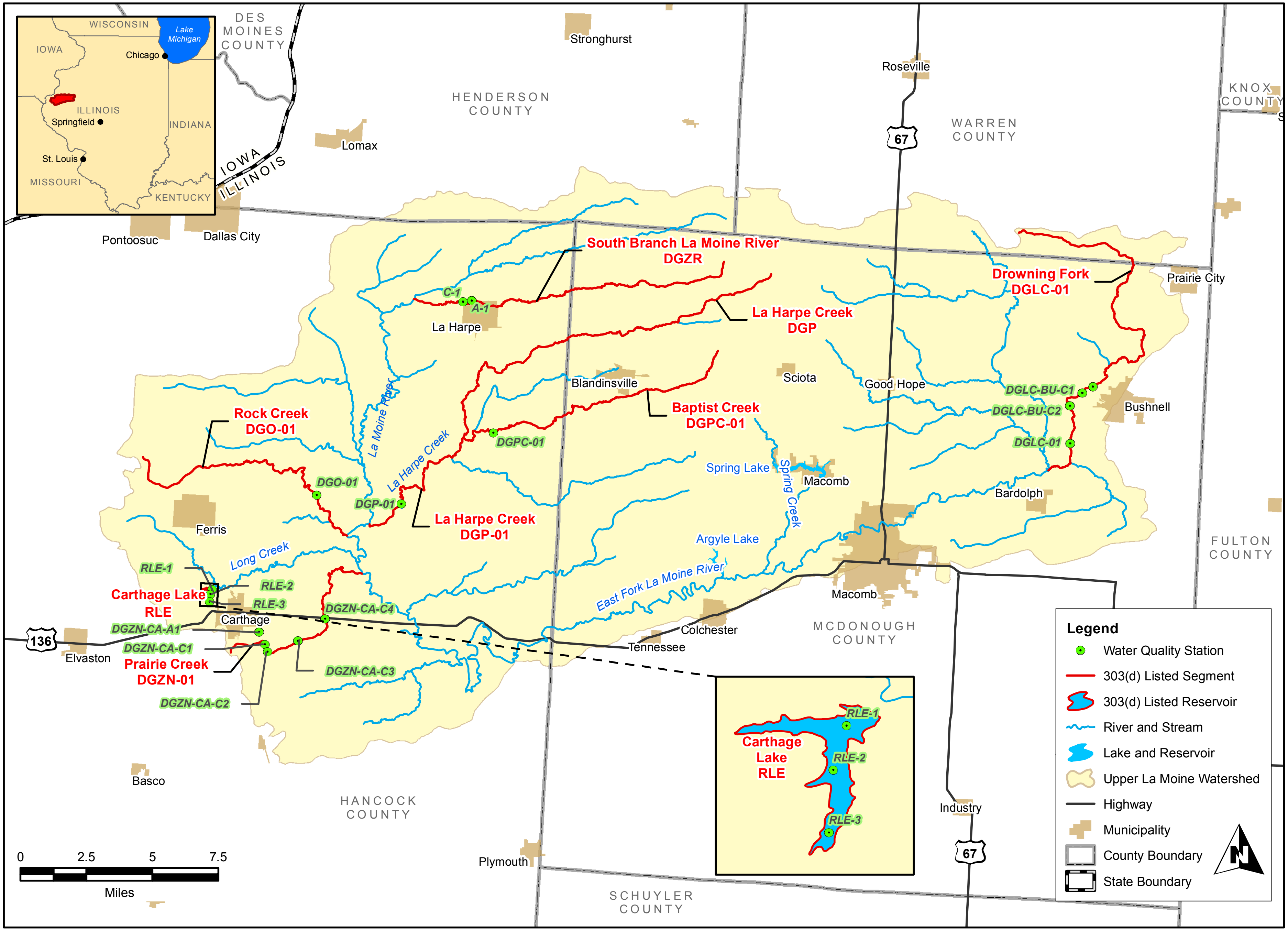
5.1 Water Quality Data

Data from historical water quality stations within the Upper La Moine River watershed were located and reviewed for the Stage 1 report (**Figure 5-1**). These water quality data were primarily provided by the Illinois EPA. Stations RLE-01, RLE-02 and RLE-03 on Carthage Lake are part of the Illinois EPA Ambient Lakes Program and were sampled four times a year in 2003, 2009 and 2012. Stations on the impaired stream segments are part of Illinois EPA's Intensive Basin Survey Program in which stations are monitored every 5 years (2002, 2007, 2012). In addition, Facility Related Stream Surveys were conducted in the 1980s on the South Branch La Moine River (DGZR) and Prairie Creek (DGZN-01). Data from these surveys were also reviewed during TMDL development. Limited additional data were collected by Illinois EPA as part of the 2017 Intensive Basin Survey and Stage 2 data collection. These data have also been incorporated into this section and

The impaired water body segments in the Upper La Moine River watershed were presented in Section 1. Refer to **Table 1-1** for impairment information specific to each segment. Recent and historical data are included in this section and document historical trends and observations. The following section addresses both stream and lake impairments. Data are summarized by impairment and discussed in relation to the relevant Illinois water quality standard. Data summaries provided in this section include all available date ranges of collected data. The following sections will first discuss data for the impaired stream segments in the Upper La Moine River watershed followed by data for the impaired lake in the watershed.

5.1.1 Stream Water Quality Data

Seven impaired stream segments exist within the Upper La Moine River watershed (Drowning Fork segment DGLC-01, Rock Creek segment DGO-01, La Harpe Creek segments DGP and DGP-01, Baptist Creek segment DGPC-01, Prairie Creek segment DGZN-01 and South Branch La Moine River segment DGZR). Data presented below relate to the parameters of concern that currently have numeric criteria as well as those with water quality targets designed to address narrative standards. As presented in Section 4.3, chloride, dissolved oxygen, manganese and ammonia have numeric criteria and impairment determinations can be confirmed through comparison of available historical data. Although sedimentation/siltation, TSS, and total phosphorus do not have numeric criteria for streams, the parameters have watershed-specific LRS target values that were presented in Section 4.4. These values were used to confirm impairment listings in the following sections. Historical water quality data for the impaired segments of the Upper La Moine River watershed are available in **Appendix C**.



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Upper La Moine River Water Quality Stations

FIGURE 5-1

5.1.1.1 Chloride

Drowning Fork segment DGLC-01 is listed for impairment of aquatic life use caused by elevated chloride concentrations. **Table 5-1** summarizes available historical chloride data for this segment. The current general use water quality standard for total chloride is 500 mg/L. The data summary presented in **Table 5-1** reflects chloride data from water quality stations DGLC-01, DGLC-BU-C1, and DGLC-BU-C2 located on segment DGLC-01 of the Drowning Fork. The combined dataset for segment DGLC-01 consists of 13 samples collected in 2002, 2007, and 2012. Five samples collected during this time period exceeded the currently applicable standard **Figure 5-2**. Data collected in 2007 at these sites were above the standard.

Table 5-1 Existing Chloride Data for Drowning Fork Segment DGLC-01

Stream Segment ID	Period of Record and Number of Data Points	Mean (mg/L)	Maximum (mg/L)	Minimum (mg/L)	Number of Exceedances
Drowning Fork Segment DGLC-01	2002-2012; 13	326	708	24	5

5.1.1.2 Dissolved Oxygen

Rock Creek segment DGO-01, La Harpe Creek segments DGP and DGP-01, Prairie Creek segment DGZN-01, and South Branch La Moine River segment DGZR are listed for impairment of aquatic life use caused by low dissolved oxygen concentrations. **Tables 5-2** and **5-3,** along with **Figures 5-3, 5-4,** and **5-5** summarize available dissolved oxygen data on these segments. The general use water quality standard for dissolved oxygen provides a seasonal instantaneous minimum standard and a minimum weekly (7-day) average concentration standard for dissolved oxygen in streams. Available data for Rock Creek segment DGO-01 and La Harpe Creek segment DGP-01 included continuous monitoring data for dissolved oxygen in 2012 and instantaneous data collected in 2002, 2007, 2012, and 2017. Both the minimum seasonal instantaneous and weekly general use standards were used to identify standard violations for these segments. Due to the limited dataset, only the instantaneous minimum standards of 5.0 mg/L for March through July and 3.5 mg/L for August through February were used to identify instances of low DO for segments DGZN-01 of Prairie Creek and DGZR of South Branch La Moine River.

The available datasets were not assessed for impairment of the weekly (7-day) minimum DO limits; however, future data analysis may take the weekly standards into account. The data presented in **Table 5-2** reflect single measurements from each segment compared to the applicable seasonal standard at the time of the field measurement. Note that Illinois EPA staff indicated that segments DGP and DGP-01 of La Harpe Creek were previously assessed as a single segment. Data collected and assessed for segment DGP-01 were used for the assessment of segment DGP for purposes of this report.

Table 5-2 Instantaneous Dissolved Oxygen Data for Impaired Stream Segments

Impaired Stream Segment Name & ID	Period of Record and Number of Data Points	Mean (mg/L)	Maximum (mg/L)	Minimum (mg/L)	Number of Exceedances
Rock Creek DGO-01	2002,2007,2012, 2017; 6	7.7	10.6	2.6	1
La Harpe Creek DGP-01 and DGP	2002,2007,2012, 2017; 10	7.1	10.8	1.5	1
Prairie Creek DGZN-01	1988;13	6.4	15.8	2.7	2
South Branch La Moine River DGZR	1988;3	7.8	12.1	2.7	1

Table 5-3 Continuous Dissolved Oxygen Data for Impaired Stream Segments

Impaired Stream Segment Name & ID	Period of Record and Number of Data Points	Mean (mg/L)	Maximum (mg/L)	Minimum (mg/L)	Number of Exceedances of Weekly Average Standard
Rock Creek DGO-01	July 2012; 672	7.4	14.6	2.1	0
La Harpe Creek DGP-01 and DGP	July and September 2012; 1439	4.4	6.8	2.0	2
Prairie Creek DGZN-01	*No data*				
South Branch La Moine River DGZR	*No data*				

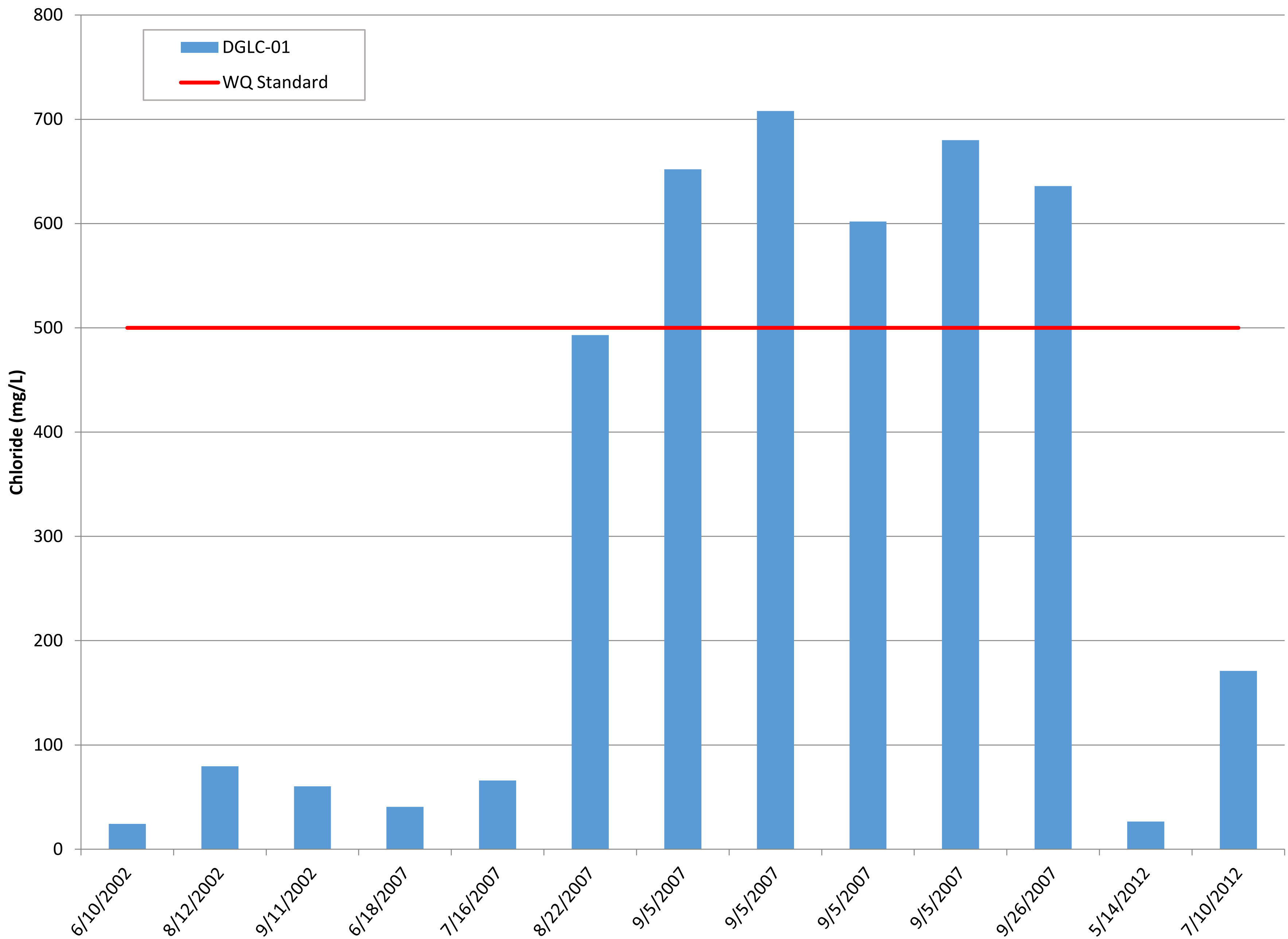

Figure 5-2
Chloride
Drowning Fork Segment DGLC

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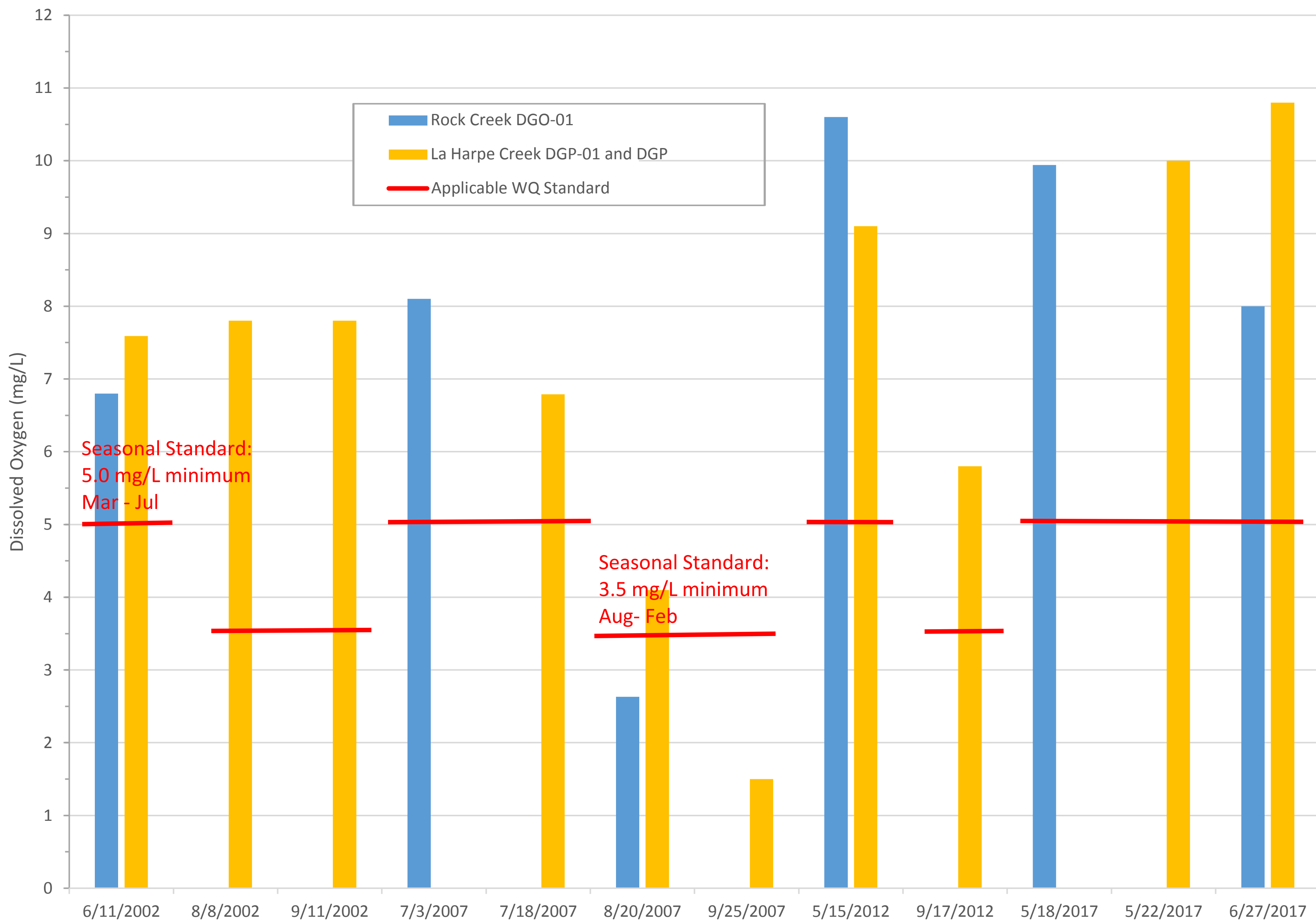

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FIgure 5-3
Dissolved Oxygen
Rock Creek Segment DGO-01 and La Harpe Creek Segments DGP/DGP-01

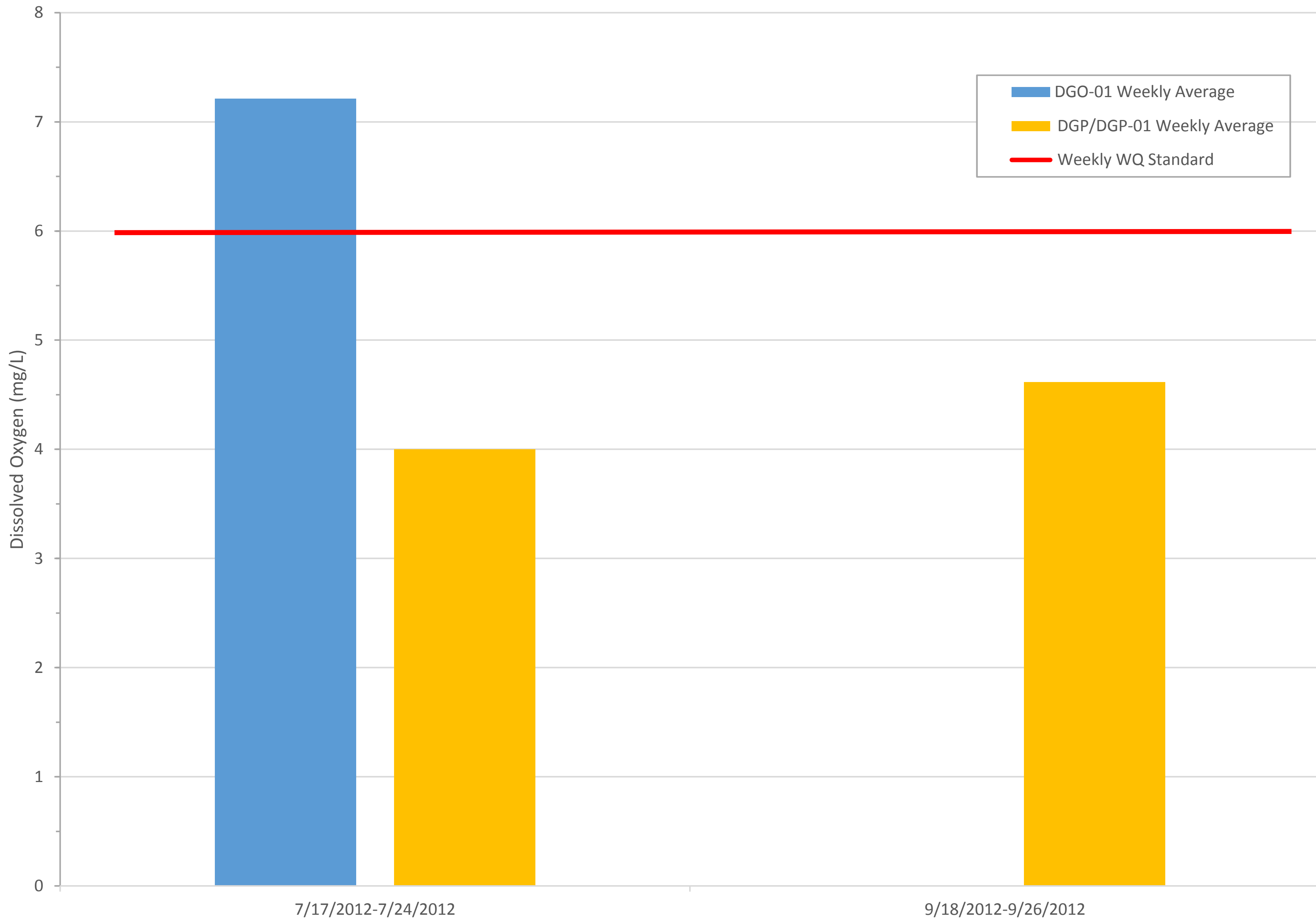

FIgure 5-3
Dissolved Oxygen
Rock Creek Segment DGO-01 and La Harpe Creek Segment DGP/DGP-01

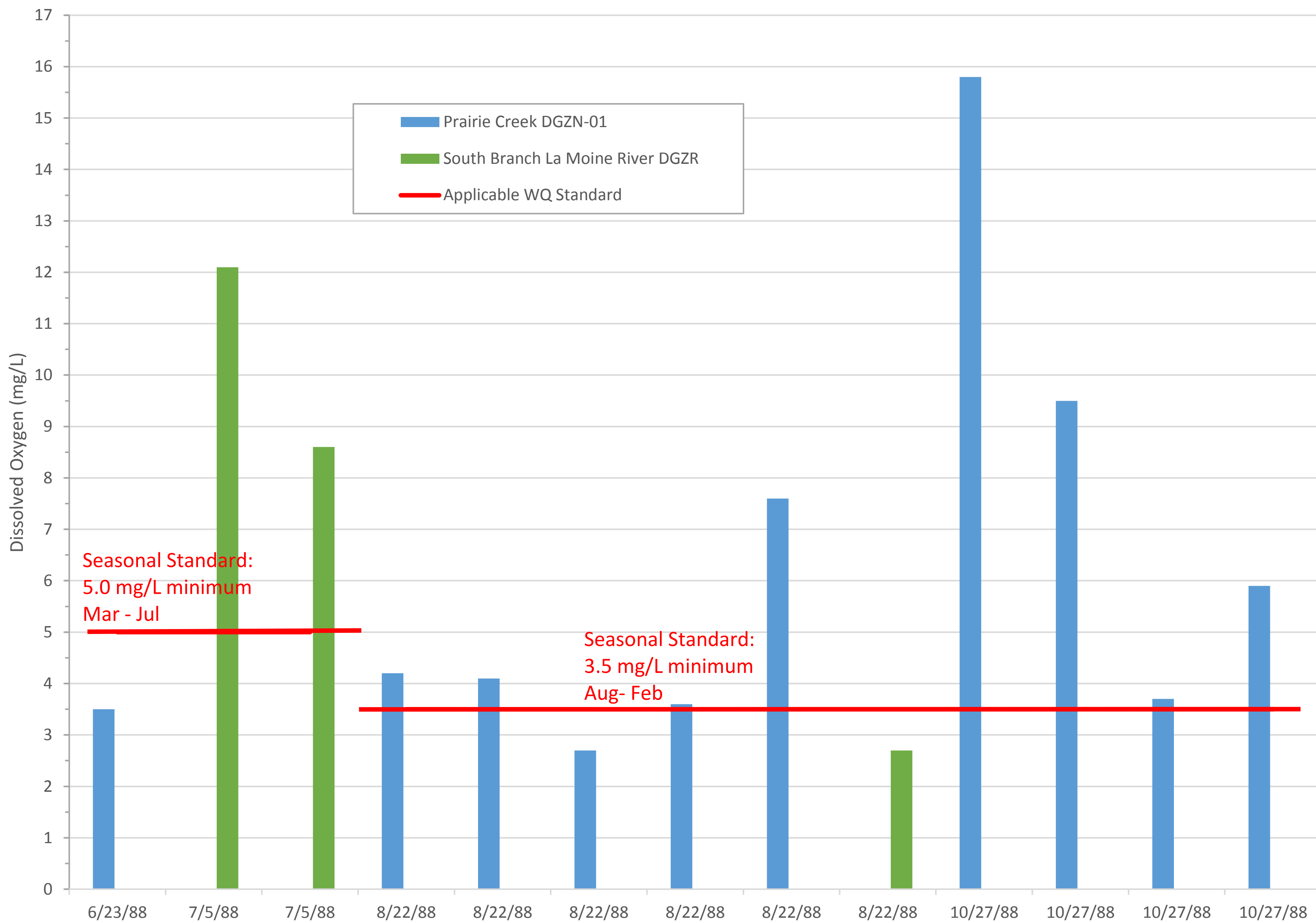

Figure 5-4
Dissolved Oxygen
Prairie Creek (DGZN-01) and South Branch La Moine River (DGZR)

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5.1.1.3 Manganese

La Harpe Creek segments DGP-01 and DGP, Baptist Creek segment DGPC-01 and South Branch La Moine River segment DGZR are listed for impairment of aquatic life use caused by elevated dissolved manganese concentrations. **Table 5-4** summarizes available historical dissolved manganese data for these segments. Both the acute and chronic general use water quality standards for dissolved manganese are calculated standards that vary with the total hardness of the sampled water.

Dissolved manganese data are not available for South Branch La Moine River segment DGZR and no exceedances of the acute or chronic water quality standards for dissolved manganese were reported in any of the available data from La Harpe Creek segments DGP-01/DGP or Baptist Creek segment DGPC-01 (**Figures 5-6** and **5-7**). The lack of available data and lack of reported exceedances where data exists, suggests that these segments were assessed as impaired due to elevated manganese concentrations based on a previous water quality standard for manganese. Prior to 2012, the applicable water quality standard for manganese to protect aquatic life used in Illinois was 1,000 ug/L of total manganese. This standard has since been replaced by the current hardness-dependent standards developed for the dissolved fraction of manganese in water. A review of the Intensive Survey of the La Moine River Basin 1988 study indicated that "One-third (19) of the 56 stations sampled exceeded the 1,000 ug/L standard for total manganese. Manganese concentrations ranged from 37 ug/L at DGJA-01 on Killjordan Creek to 3,301 ug/L at DGD-01 on Missouri Creek. The mean total manganese concentration in the La Moine basin was 812 ug/L. According to Zuehls (1987), elevated manganese concentrations are common in the area of the La Moine River basin. The highest concentration recorded was located on Missouri Creek (DGD-OI), adjacent to a reclaimed coal stripmine and downstream from extensive coal mining activities. Non-point sources of manganese in the La Moine basin include coal mining, agriculture and stream bank erosion." A facility-related stream survey (FRSS) completed in 1985 for the La Harpe Sanitary Treatment Plant (STP) included a total manganese sample result of 4,347 mg/L in very low flow above the plant effluent on South Branch La Moine River segment DGZR. This is likely the reason the segment was originally listed as impaired. The lack of reported recent exceedances for impaired segments in the watershed suggests that removal of these impairments from the Illinois 303(d) list may be warranted. Additional monitoring for these segments is suggested in the implementation section to help confirm that water quality standards for dissolved manganese are being met.

Table 5-4 Dissolved Manganese Data for Impaired Stream Segments

Impaired Stream Segment Name & ID	Period of Record and Number of Data Points	Mean (µg/L)	Maximum (µg/L)	Minimum (µg/L)	Number of Acute Exceedances	Number of Chronic Exceedances
La Harpe Creek DGP-01 and DGP	2002-2017; 9	336.8	1,000	14.6	0	0
Baptist Creek DGPC-01	2007; 3	724	1,400	61	0	0
South Branch La Moine River DGZR	No Dissolved Manganese Data – refer to discussion of impairment above					

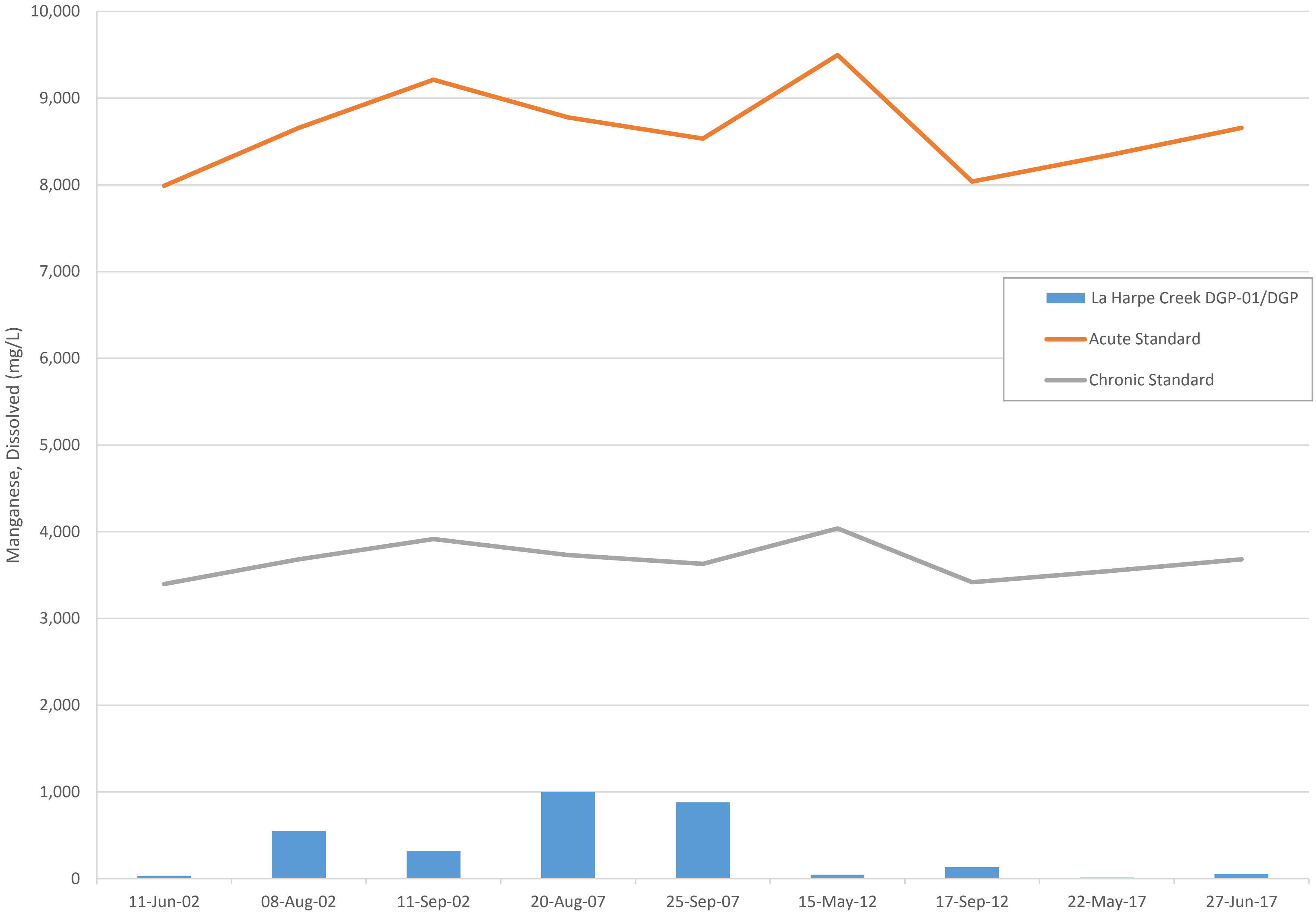

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Figure 5-6
Dissolved Manganese
La Harpe Creek Segment DGP/DGP-01

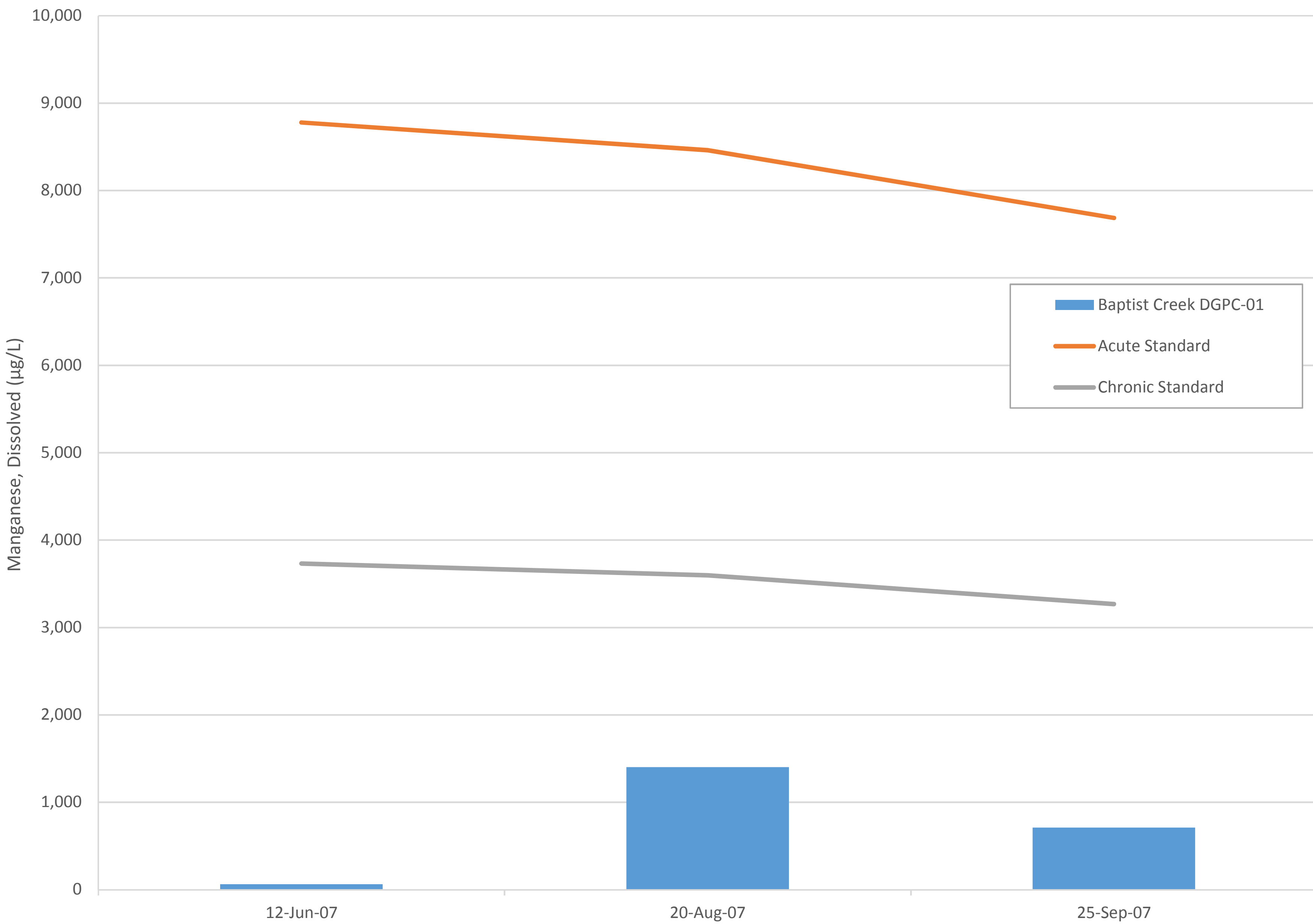

Figure 5-6
Dissolved Manganese
Baptist Creek Segment DGPC-01

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5.1.1.4 Ammonia

South Branch La Moine River segment DGZR is listed for impairment of aquatic life use caused by elevated total ammonia nitrogen concentrations. **Table 5-5** summarizes available historical total ammonia nitrogen data on this segment. Single-sample exceedances of both the calculated acute and chronic standards, as well as the 15 mg/L maximum standard were reported in this segment (**Figure 5-8**). However, the available dataset is limited to five total samples, two samples collected in October 1984 and three collected in the summer of 1988. No additional data were available to assess the current impairment.

Table 5-5 Total Ammonia as Nitrogen Data for South Branch La Moine River Segment DGZR

Impaired Stream Segment Name & ID	Period of Record and Number of Data Points	Mean (mg/L)	Maximum (mg/L)	Minimum (mg/L)	Exceedances		
					Acute	Chronic	Max (15 mg/L)
South Branch La Moine River DGZR	1984, 1988; 5	10.4	24	<0.1	2	3	2

5.1.1.5 Total Suspended Solids

Drowning Fork segment DGLC-01 and Prairie Creek segment DGZN-01 are listed for impairment of aquatic life use caused by elevated TSS concentrations. **Table 5-6** summarizes available historical TSS data for this segment. Note that there are multiple water quality stations located in the Drowning Fork segment DGLC-01 and Prairie Creek segment DGZN-01; as shown in **Figure 5-1**. The watershed-specific water quality target for TSS in streams is a maximum value of 50.9 mg/L. **Figure 5-9** shows the TSS data collected over time on Drowning Fork Segment DLGC-01 and **Figure 5-10** shows TSS data over time for Prairie Creek segment DGZN-01. Note that when multiple results are shown for a single date, the results are shown from upstream to downstream sites within the segment. Historical TSS concentrations have exceeded the watershed-specific target on both impaired segments, however, data from Prairie Creek are only available from 1988. No additional data were available for Prairie Creek to confirm that the impairment still exists.

Table 5-6 Total Suspended Solids Data for Impaired Stream Segments

Impaired Stream Segment Name & ID	Period of Record and Number of Data Points	Mean (mg/L)	Maximum (mg/L)	Minimum (mg/L)	Number of Exceedances
Drowning Fork segment DGLC-01	2007,2012;13	47.4	118	4.5	5
Prairie Creek segment DGZN-01	1988;10	91	246	12	6

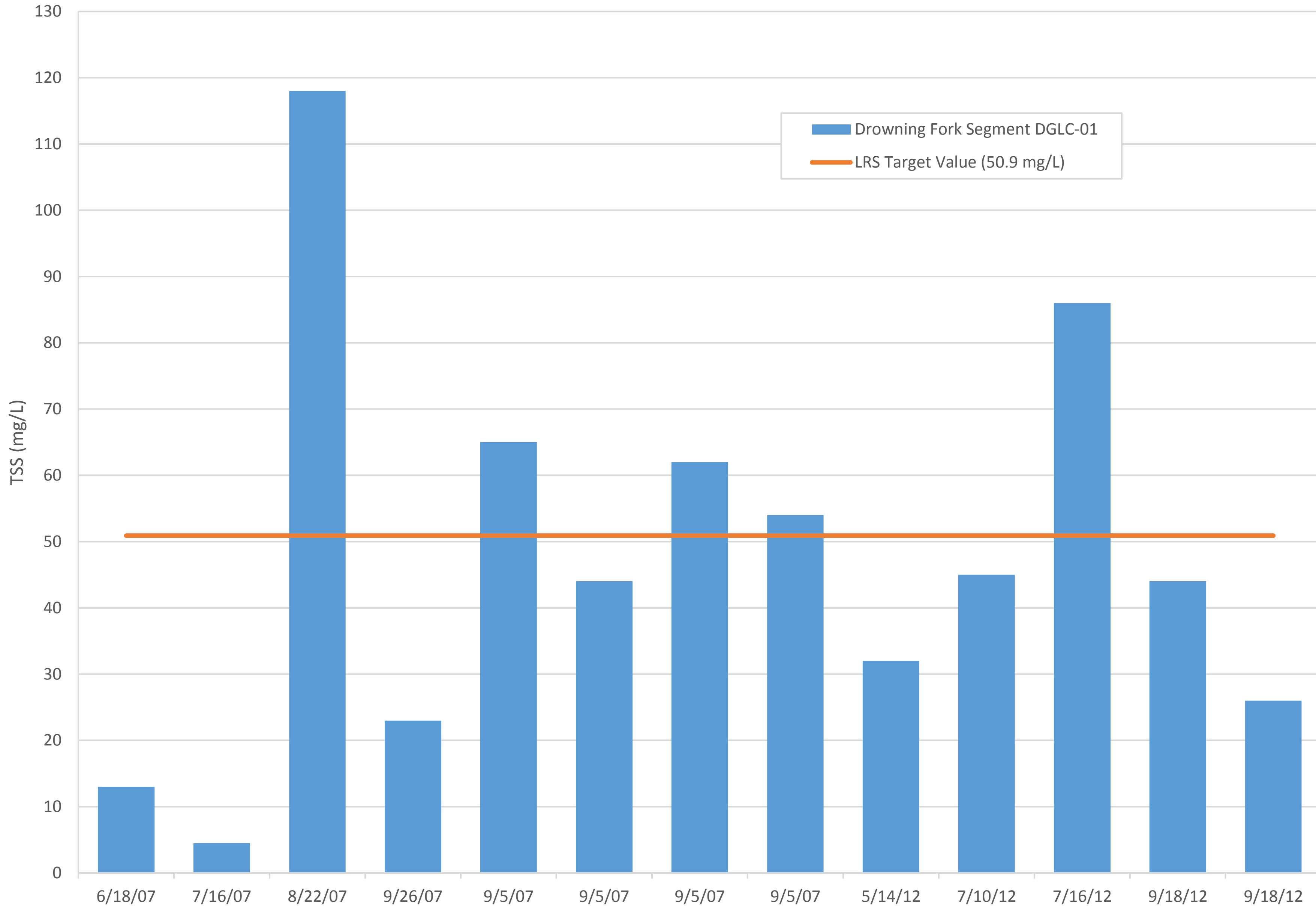

Figure 5-8
TSS
Drowning Fork Segment DGLC-01

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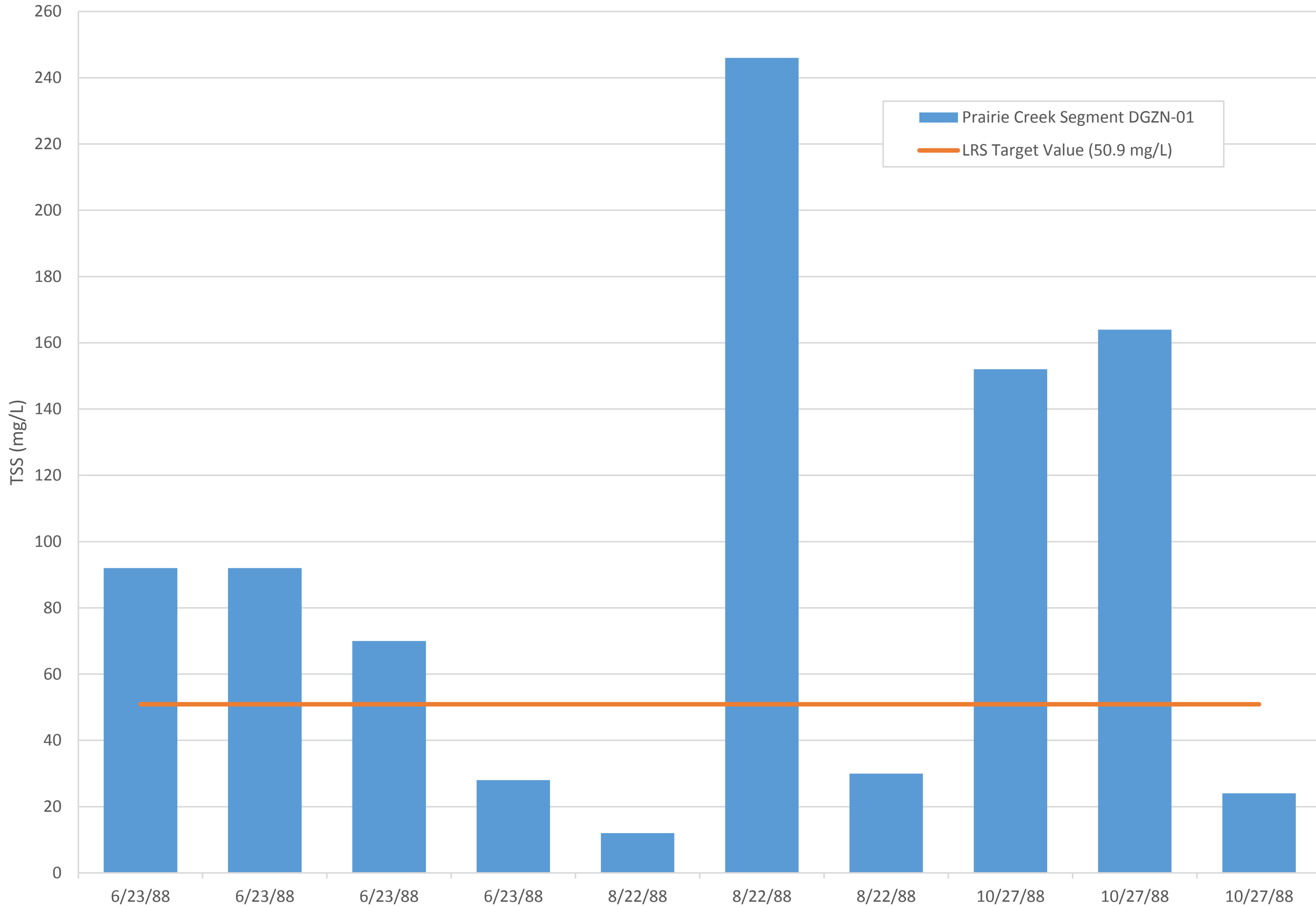

Figure 5-9
TSS
Prairie Creek Segment DGZN-01

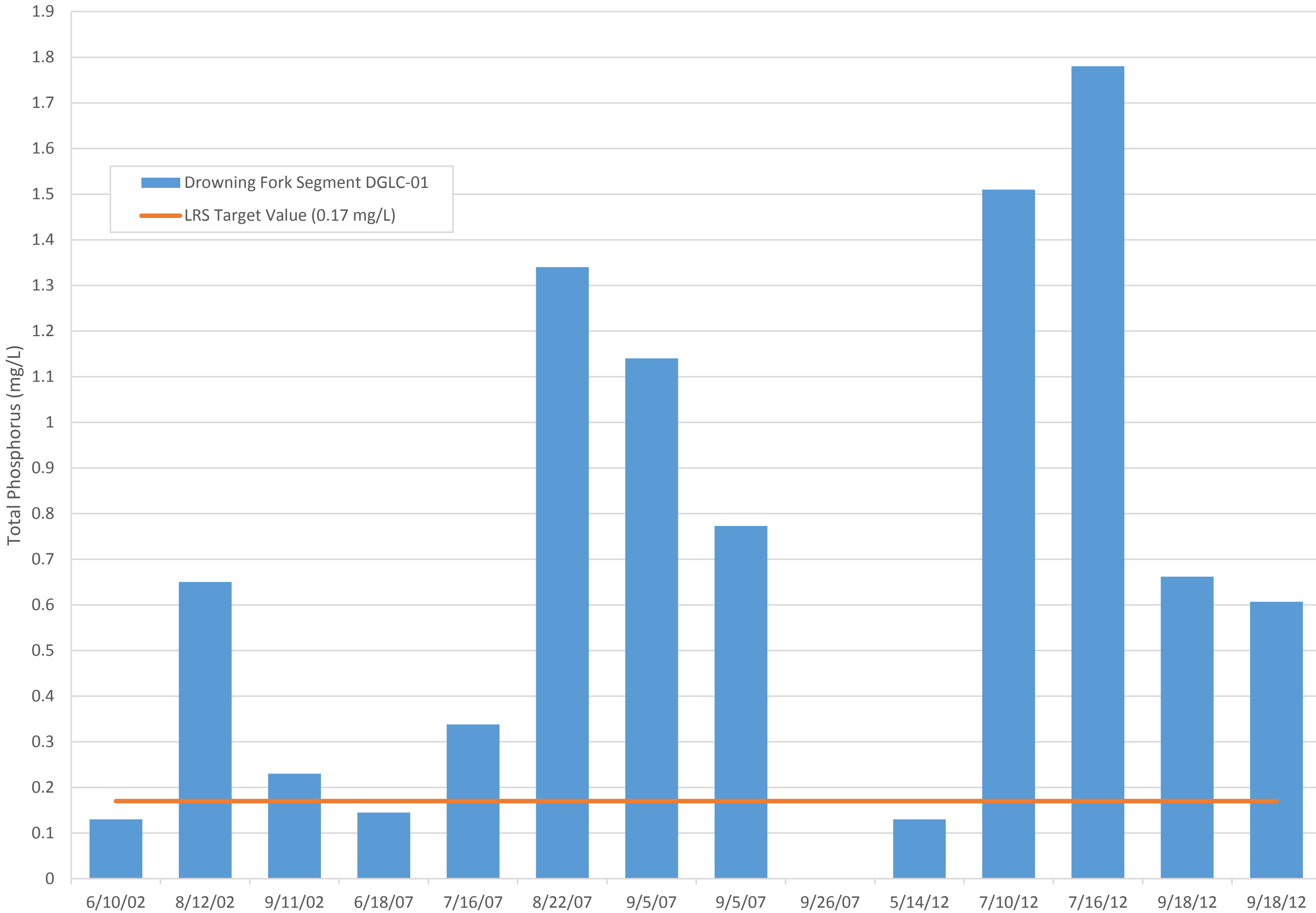

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Figure 5-10
Total Phosphorus
Drowning Fork Segment DGLC-01

5.1.1.6 Total Phosphorus

Drowning Fork segment DGLC, Prairie Creek segment DGZN, and South Branch La Moine River segment DGZR are listed for impairment of the aquatic life use due to elevated total phosphorus concentrations. **Table 5-7** summarizes historical phosphorus data collected on the impaired segments. The watershed-specific water quality target for total phosphorus in streams is a maximum value of 0.17 mg/l. **Figure 5-11** shows that concentrations in Drowning Fork regularly exceed the water quality target and are typically highest in mid to late summer. **Figure 5-12** shows that in the late 1980s, total phosphorus concentrations on Prairie Creek and South Branch La Moine River regularly exceeded the water quality target. Due to a lack of recently collected data, it is unknown if total phosphorus concentrations on these two segments still exceed the target value.

Table 5-7 Total Phosphorus Data for Impaired Stream Segments

Impaired Stream Segment Name & ID	Period of Record and Number of Data Points	Mean (mg/L)	Maximum (mg/L)	Minimum (mg/L)	Number of Exceedances
Drowning Fork segment DGLC-01	2002-2012;13	0.73	1.78	0.13	10
Prairie Creek segment DGZN-01	1988;10	3.71	6.90	0.98	10
South Branch La Moine River segment DGZR	1984,1988;5	1.82	5.00	0.06	3

5.1.1.7 Sedimentation/Siltation

Drowning Fork segment DGLC-01 is listed for impairment of the aquatic life use by sedimentation and siltation. Streams have historically been listed for impairment caused by sedimentation/siltation when over 34 percent siltation was observed (prior to 2006), or over 75 percent siltation was observed (2008 to 2010). Illinois EPA now addresses sedimentation and siltation impairments through assessment of NVSS concentrations. Illinois EPA has developed a watershed-specific LRS target value for NVSS concentrations in streams of the Upper La Moine River watershed of 39.1 mg/L of NVSS.

NVSS concentrations are calculated as the difference of total suspended solids (TSS) and total volatile solids (TVS) in a single sample. Only paired TSS and TVS results from the same sampling event and location were used to calculate NVSS concentrations. The available NVSS data for this segment is presented in **Table 5-8** and shown on **Figure 5-13.** Three of the historical samples have exceeded the target value.

Table 5-8 NVSS Data for Impaired Stream Segments

Impaired Stream Segment Name & ID	Period of Record and Number of Data Points	Mean (mg/L)	Maximum (mg/L)	Minimum (mg/L)	Number of Exceedances
Drowning Fork segment DGLC-01	2002-2012; 14	30.6	92	3	3

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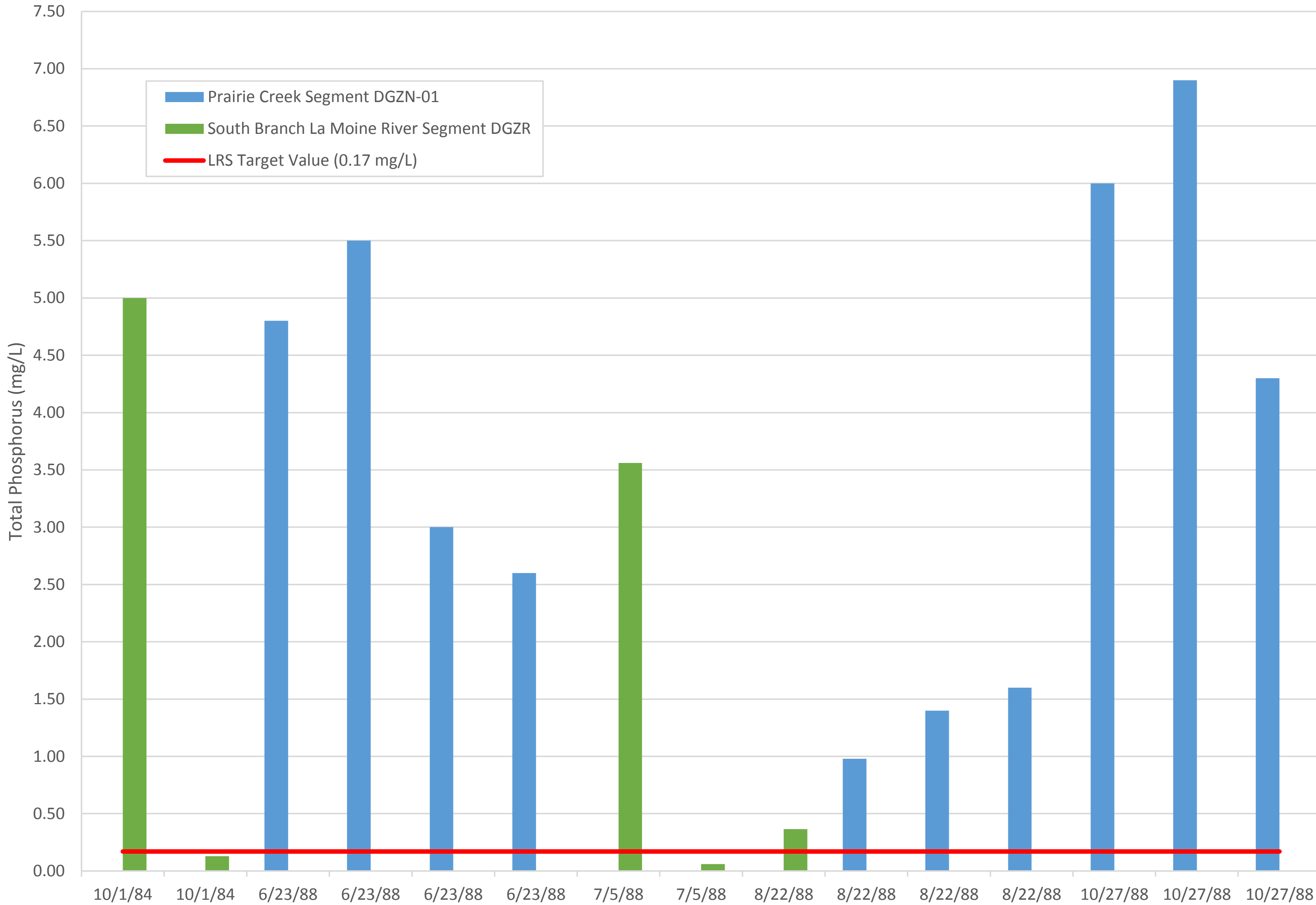

Figure 5-11
Total Phosphorus
Prairie Creek Segment DGZN-01 and South Branch La Moine River Segment DGZR

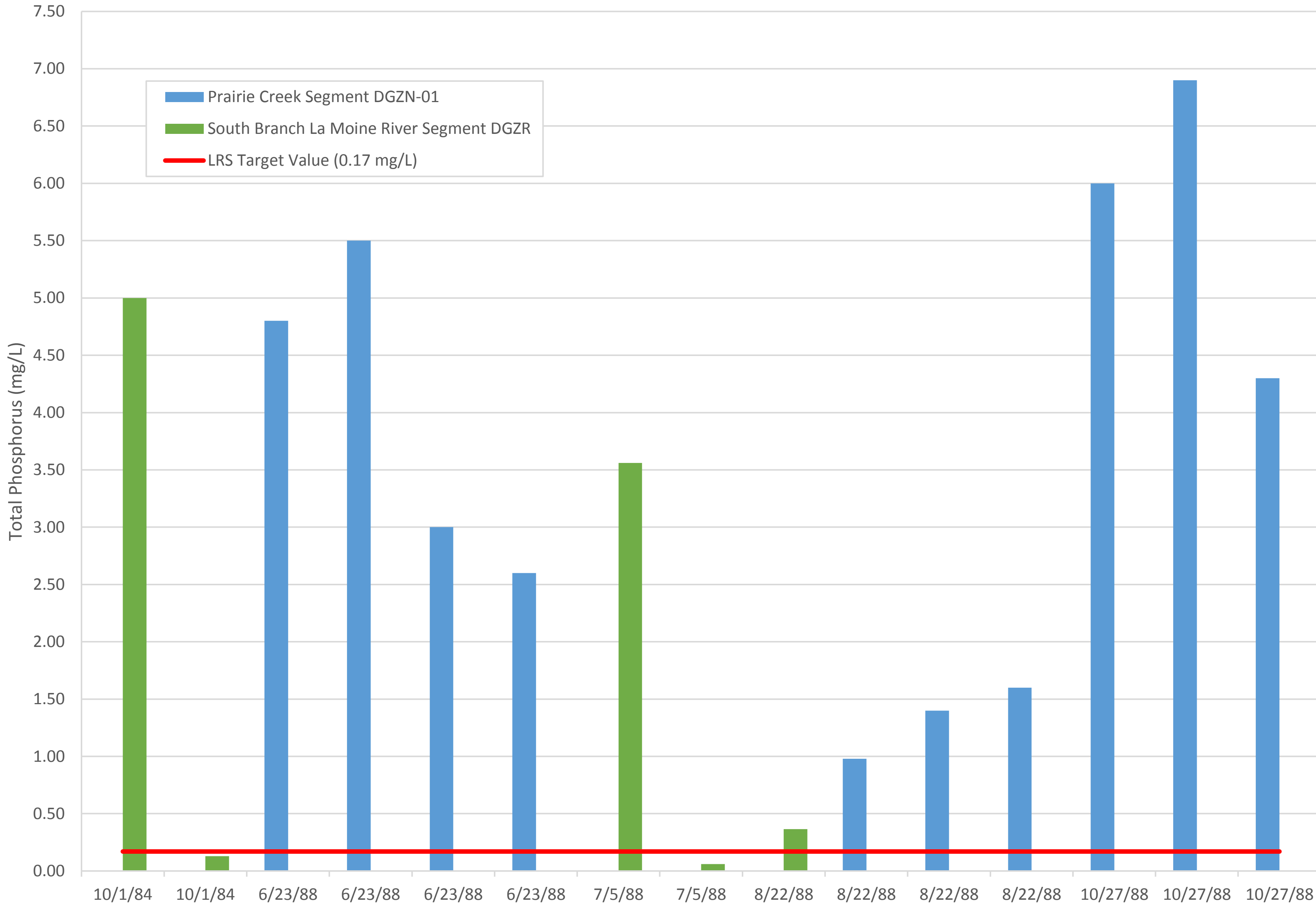

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Figure 5-11
Total Phosphorus
Prairie Creek Segment DGZN-01 and South Branch La Moine River Segment DGZR

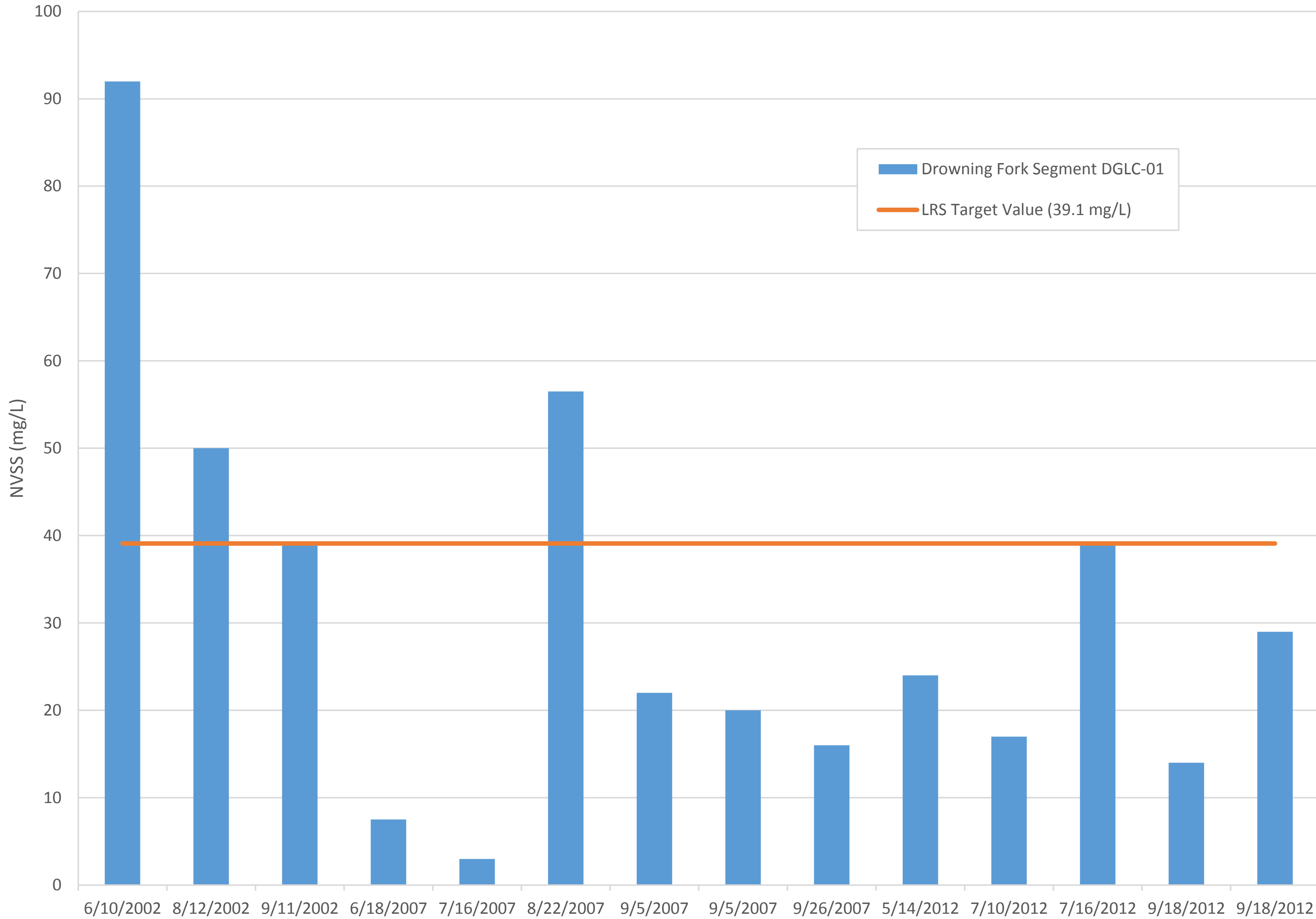

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Figure 5-12
Non-Volatile Suspended Solids (NVSS)
Drowning Fork Segment DGLC-01

5.1.2 Carthage Lake Water Quality Data

Carthage Lake is listed for impairment of aesthetic quality use caused by elevated total phosphorus and total suspended solids concentrations. Data are available from three separate water quality monitoring locations within Carthage Lake. An inventory of all available data associated with the impairments in Carthage Lake is presented in **Table 5-9**.

Table 5-9 Data Inventory for Impairment at Carthage Lake

Carthage Lake Segment RLE; Sample locations RLE-01, RLE-02, RLE-03		
RLE-01	**Period of Record**	**Number of Samples**
Phosphorus, Total	2003,2009,2012	13
Phosphorus, Dissolved	2003,2009,2012	13
Phosphorus in Bottom Deposits	2003,2009	2
Total Suspended Solids	2012	4
RLE-02		
Phosphorus, Total	2003	4
Phosphorus, Dissolved	2003	4
Phosphorus in Bottom Deposits	-	-
Total Suspended Solids	2003	5
RLE-03		
Phosphorus, Total	2003	4
Phosphorus, Dissolved	2003	4
Phosphorus in Bottom Deposits	-	-
Total Suspended Solids	2003	5

5.1.2.1 Total Phosphorus in Carthage Lake

The applicable water quality standard for total phosphorus in Carthage Lake is 0.05 mg/L. Compliance with the total phosphorus standard is assessed using samples collected at a 1-foot depth from the lake surface. The number of samples, a count of exceedances, and the average total phosphorus concentrations at a 1-foot depth for each year of available data at each monitoring location in Carthage Lake are presented in **Table 5-10** and shown on **Figure 5-14**. Based on the limited available dataset, total phosphorus concentrations collected at a 1-foot depth in Carthage Lake are consistently above the 0.05 mg/L water quality standard. Annual average phosphorus concentrations at sampling station RLE-01 increased from 2003 to 2012. Phosphorus data from sampling stations RLE-02 and RLE-03 are only available for year 2003, therefore no trend information can be documented.

Table 5-10 Total Phosphorus at 1-ft Depth in Carthage Lake (RLE)

Station ID	Period of Record and Number of Data Points	Mean (mg/L)	Maximum (mg/L)	Minimum (mg/L)	Number of Exceedances
RLE-1	2003-2012; 13	0.095	0.282	0.039	11
RLE-2	2003; 4	0.055	0.062	0.038	3
RLE-3	2003; 4	0.057	0.073	0.041	3

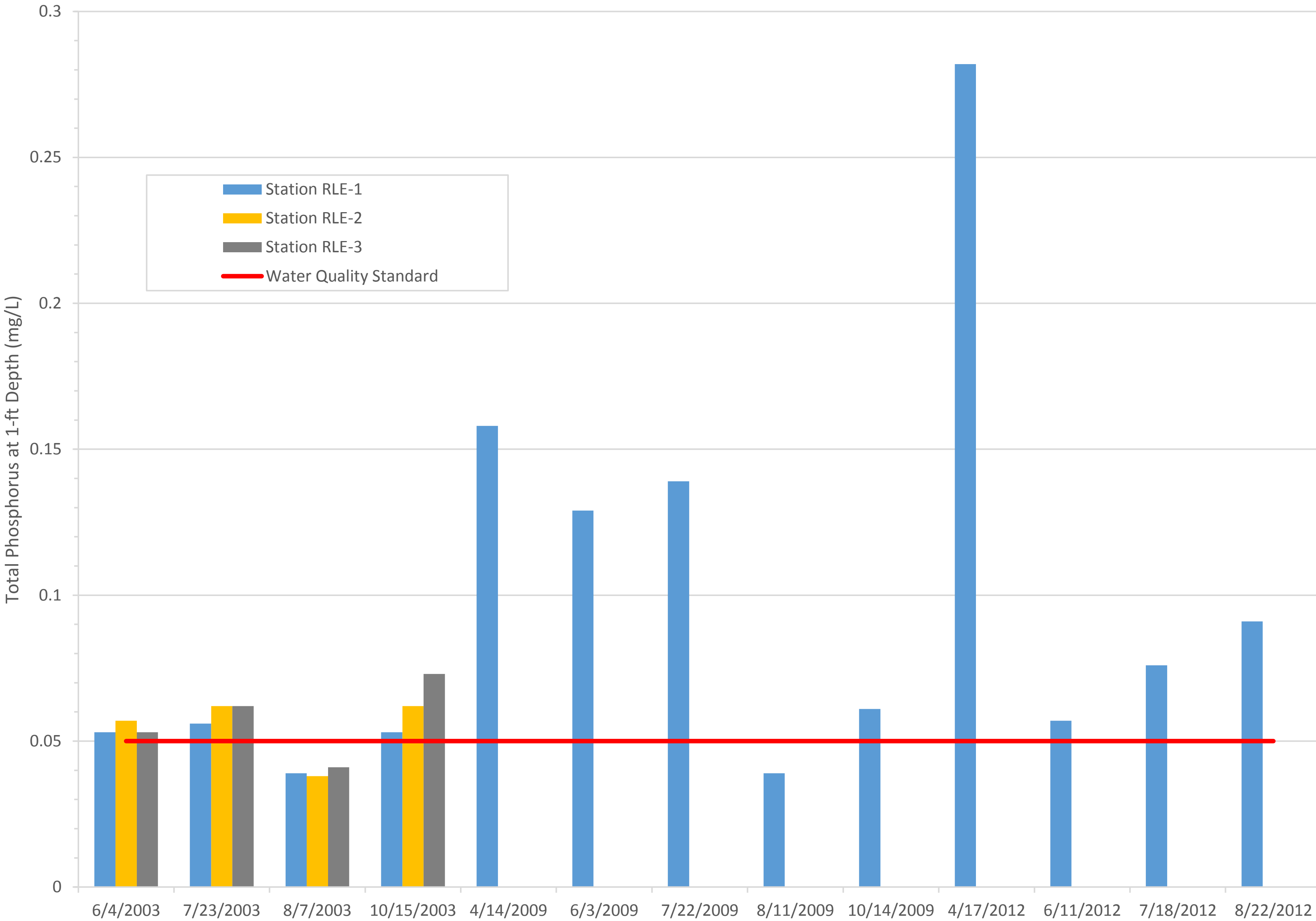

Figure 5-13
Total Phosphorus
Carthage Lake (RLE)

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5.1.2.2 Total Suspended Solids in Carthage Lake

The LRS target value for TSS in the Upper La Moine River watershed is 50.9 mg/L. TSS data in Carthage Lake are available for samples collected at various depths from 2003-2012 at RLE-1 and from 2003 at RLE-2 and RLE-3. Exceedances of the LRS target value have been recorded 4 times at station RLE-1, most recently in 2012 (**Figure 5-15**). It should be noted that the samples collected above the 50.9 mg/L threshold were collected near the lake bottom in 2003 and 2009 and at a depth of 9 feet in 2009. The number of exceedances and average TSS concentrations for each year of available data at each monitoring site in Carthage Lake are presented in **Table 5-11**.

Table 5-11 Total Suspended Solids Data for Carthage Lake (RLE)

Station ID	Period of Record and Number of Data Points	Mean (mg/L)	Maximum (mg/L)	Minimum (mg/L)	Number of Exceedances
RLE-1	2003-2012; 42	24	161	4	4
RLE-2	2003; 5	12	19	6	0
RLE-3	2003; 5	16	19	11	0

5.2 Lake Characteristics

5.2.1 Carthage Lake

Carthage Lake is located within Hancock County, approximately 0.5 miles northwest of the City of Carthage, Illinois. Carthage Lake is fed by a tributary of Long Creek and has historically provided drinking water to the City of Carthage. It should be noted that Carthage is currently constructing a deep well and a reverse osmosis treatment plant to replace its intake source from the lake. Stakeholders indicated that the lake has been an unreliable source of drinking water during periods of drought.

Carthage Lake has a surface area of 40 acres and a reported maximum depth of 19 feet. The overland watershed draining into Carthage Lake is approximately 1,900 acres. The lake is located in a park setting and is adjacent to a golf course. The areas immediately adjacent to the lake are primarily grass and forest land. Further to the east of the lake there is low and medium density development, while additional surrounding areas are primarily farmland. In addition to historically serving as a public water source, the lake is utilized for boating and fishing.

5.3 Point Sources

There are 18 permitted point sources (10 individual permits and 8 general permits) within the Upper La Moine River watershed. **Table 5-12** contains permit information for each discharger while **Figure 5-16** shows the locations of each facility. Note that not all facilities within the watershed discharge upstream of impaired segments. In general, facilities discharging treated domestic wastewater have the potential to affect dissolved oxygen concentrations (through the discharge of nutrients and other oxygen-demanding materials), chloride, and nutrient levels in their receiving waters. Potential pollutants discharged from industrial facilities vary by industry and may or may not contain metals and/or sediments, but industry is typically less likely to impact dissolved oxygen and nutrient concentrations. National Pollutant Discharge Elimination System (NPDES) facilities with permit limits are required to submit discharge monitoring reports (DMRs) to Illinois EPA. Treatment processes, permits and associated discharge monitoring reports (DMRs) were reviewed and relevant data have been included in TMDL development.

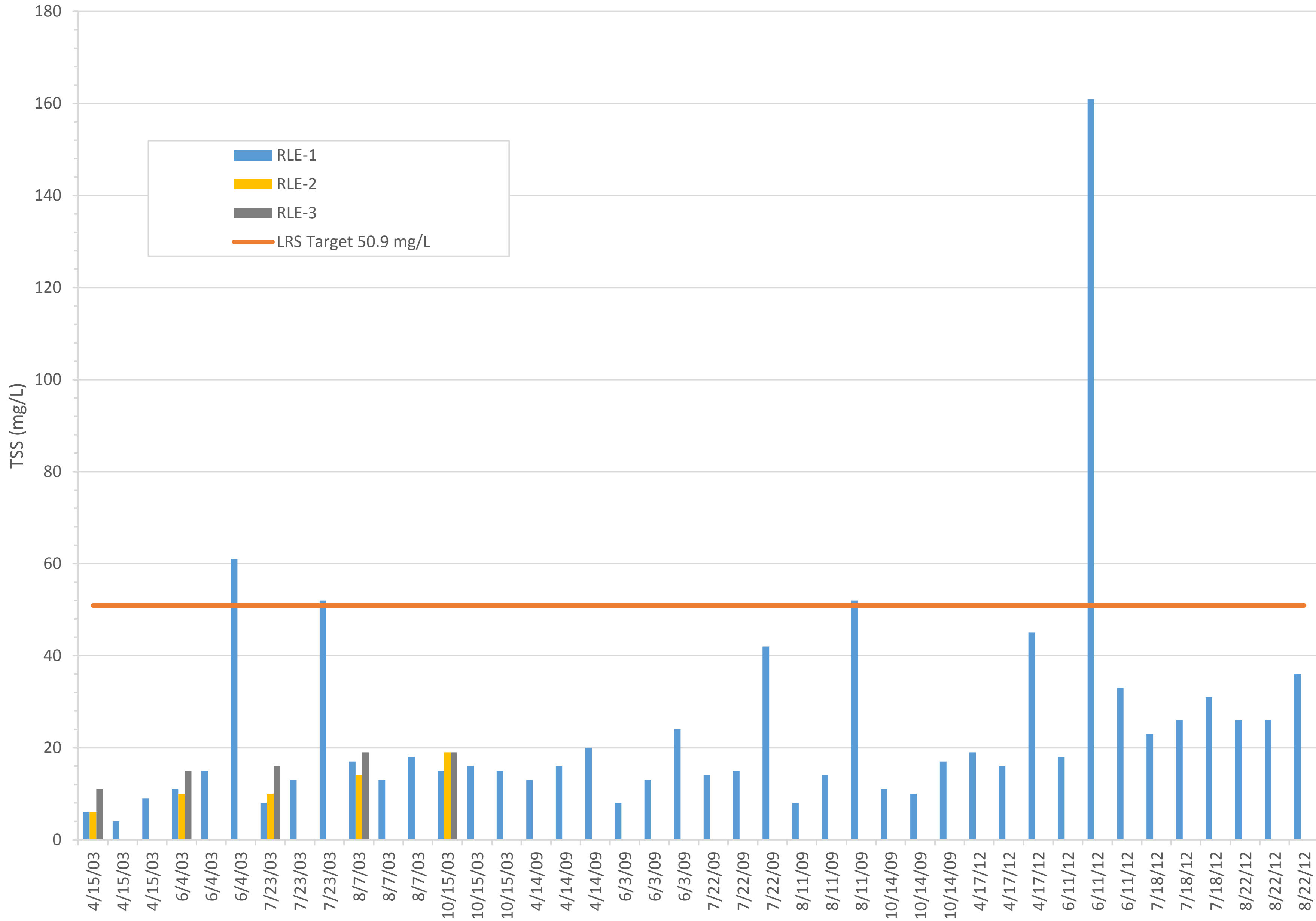

Figure 5-14
TSS
Carthage Lake (RLE)

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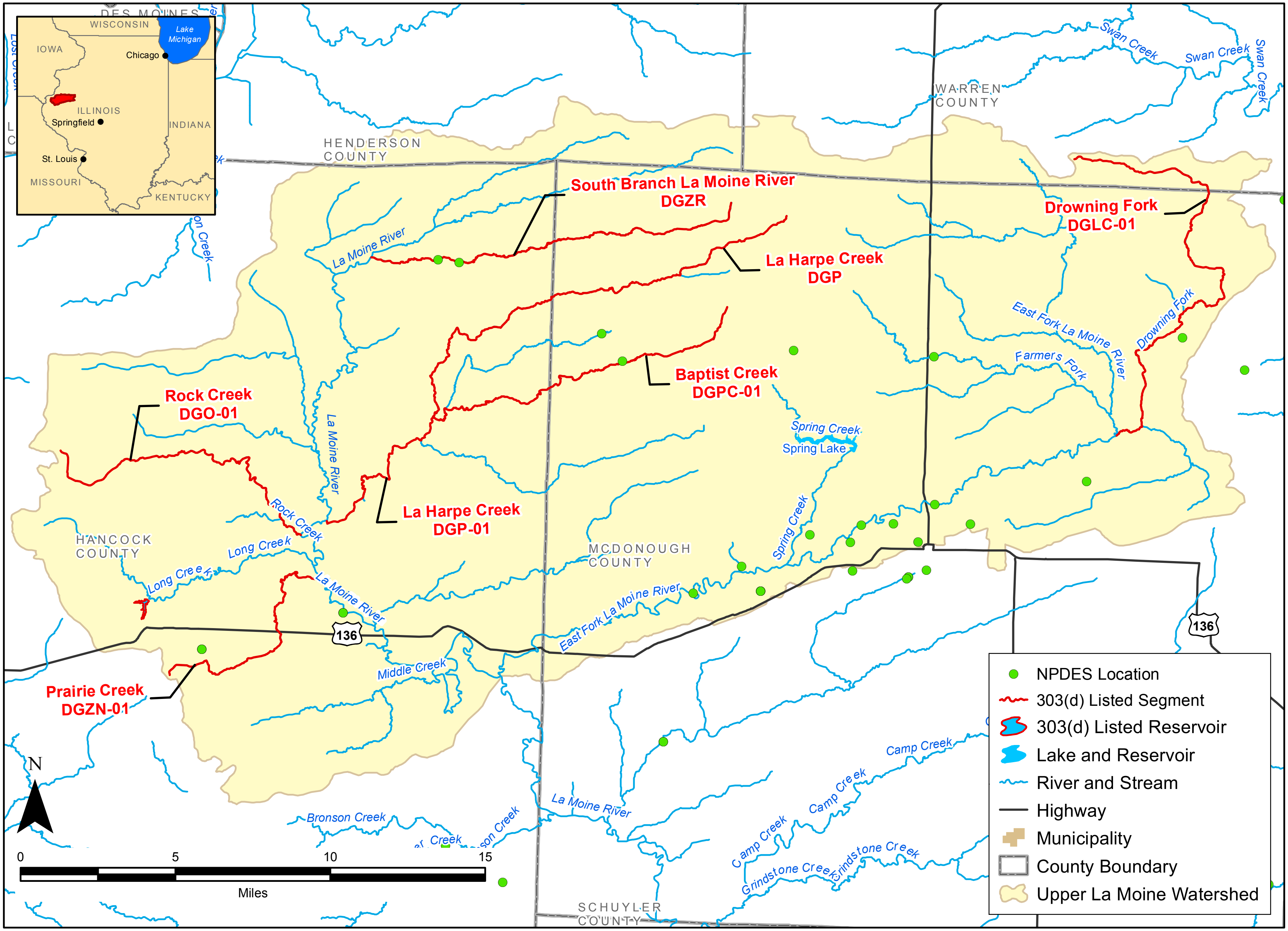

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Upper La Moine River NPDES Locations

FIGURE 5-15

Table 5-12 Permitted Facilities Discharging within the Upper La Moine River Watershed

Facility ID	Facility Name	Design Average/ Maximum Flow (mgd)	Receiving Water
ILG840080	Central Stone Carthage Quarry	ND	La Moine River
IL0021229	Carthage STP	0.5/5	Prairie Creek
IL0054887	IL DNR- Argyle Lake State Park	0.00155/0.0048	Unnamed ditch, tributary to Argyle Lake
IL0028177	Colchester STP	0.17/0.47	Unnamed tributary of east fork of the La Moine River
IL0071030	Stratford West Apartments (previously Emmett Utilities INC). STP	0.0045/0.005265	Unnamed tributary of east fork of the La Moine River
ILG551005	Georgetown Home Assoc STP	0.15[1]	La Moine River
ILG551029	Meadowbrook Subdivision	0.0188[1]	East fork of La Moine River
IL0029688	Macomb STP	3.0/7.5	Kiljordan Creek
ILG640189	Macomb WTP	ND	East branch of La Moine River
IL0074161	Waste Management of Illinois	ND	Unnamed tributary of East Fork La Moine River
ILG580020	Bardolph STP	0.175[1]	La Moine River
IL0024384	Bushnell West STP	0.25/0.625	Drowning Fork Creek
ILG580194	Good Hope STP	0.075[1]	Town Fork
IL0053619	West Prairie High School	0.002/0.005	Unnamed tributary of Spring Creek
IL0072672	Blandinsville STP	0.093/0.2325	Unnamed tributary to Baptist Creek
IL0050997	Blandinsville WTP	ND	Little Creek
ILG640100	La Harpe WTP	ND	South Branch of La Moine River
ILG580093	La Harpe STP	0.245/0.613	South Branch of La Moine River

ND = No Data

5.4 Nonpoint Sources

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

5.4.1 Crop Information

Approximately 66 percent of the land within the Upper La Moine River watershed is devoted to agriculture. Because much of the watershed is under cultivation, soil loss from fields is likely the primary source of sediment and any pollutant attached to the sediment (nutrients and potentially naturally occurring metals). Agricultural runoff can also contribute chlorides to receiving waters.

Tillage practices for crops such as corn, soybeans, and grains can be categorized as conventional till, reduced till, mulch till, and no till. The percentage of each tillage practice for corn, soybeans, and small grains by county are generated from County Transect Surveys by the Illinois Department of Agriculture (IDA) (IDA, 2015). Data from the 2004 and 2015 survey are presented in **Tables 5-13** through **5-16** for Hancock, McDonough, Henderson and Warren Counties, respectively.

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

Table 5-13 Tillage Practices in Hancock County, Illinois

Tillage System	Corn		Soybean		Small Grain	
	2004	2015	2004	2015	2004	2015
Conventional	62%	57%	14%	5%	0%	0%
Reduced - Till	22%	30%	15%	31%	0%	0%
Mulch – Till	5%	12%	14%	39%	0%	67%
No - Till	11%	1%	56%	25%	100%	33%

Table 5-14 Tillage Practices in McDonough County, Illinois

Tillage System	Corn		Soybean		Small Grain	
	2004	2015	2004	2015	2004	2015
Conventional	43%	24%	9%	10%	0%	67%
Reduced - Till	29%	22%	22%	8%	100%	0%
Mulch – Till	16%	40%	37%	48%	0%	0%
No - Till	12%	14%	31%	34%	0%	33%

Table 5-15 Tillage Practices in Henderson County, Illinois

Tillage System	Corn		Soybean		Small Grain	
	2004	2015	2004	2015	2004	2015
Conventional	7%	11%	0%	3%	33%	100%
Reduced - Till	44%	30%	15%	5%	67%	0%
Mulch – Till	34%	43%	25%	46%	0%	0%
No - Till	15%	16%	60%	46%	0%	0%

Table 5-16 Tillage Practices in Warren County, Illinois

Tillage System	Corn		Soybean		Small Grain	
	2004	2015	2004	2015	2004	2015
Conventional	6%	3%	0%	0%	0%	100%
Reduced - Till	37%	25%	5%	1%	0%	0%
Mulch – Till	30%	34%	29%	25%	0%	0%
No - Till	27%	38%	66%	74%	100%	0%

Information on field tiling practices was also sought as field drains can influence the timing and amounts of water delivered to area streams and reservoirs as well as deliver dissolved nutrients from fields to receiving waters. Tile drains can also help chlorides from fertilizers migrate quickly from field to stream. Local NRCS offices reported that they currently do not keep records on which farms use tile drainage. The NRCS office in McDonough County said the use of drain tile is common but they did not have exact numbers, and that tile drainage tends to be more common north of Macomb, due to flatter elevations in that portion of the watershed.

5.4.2 Animal Operations and Wildlife

Information on commercial animal operations is available from the NASS. Knowing the number of animal units in a watershed is useful in TMDL development as grazing animals have the potential to increase erosion and contribute nutrients through manure. Although watershed-specific data are not available, countywide data for Hancock, McDonough, Henderson and Warren Counties are presented in **Tables 5-17** through **5-20**, respectively. Data from 2007 and 2012 have been published on the USDA website.

Table 5-17 Hancock County Animal Population (2007 and 2012 Census of Agriculture)

Livestock Type	2007	2012	Percent Change
Cattle and Calves	25,491	23,264	-9%
Beef	ND	9,953	-
Dairy	ND	13	-
Hogs and Pigs	166,252	186,678	12%
Poultry(1)	1,733	1,321	-24%
Sheep and Lambs	252	471	87%
Horses and Ponies	644	573	-11%

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

Table 5-18 McDonough County Animal Population (2007 and 2012 Census of Agriculture)

Livestock Type	2007	2012	Percent Change
Cattle and Calves	17,545	13,312	-24%
Beef	ND	6,834	-
Dairy	ND	30	-
Hogs and Pigs	10,198	42,680	319%
Poultry(1)	613	954	56%
Sheep and Lambs	1,020	1,038	2%
Horses and Ponies	647	496	-23%

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

Table 5-19 Henderson County Animal Population (2007 and 2012 Census of Agriculture)

Livestock Type	2007	2012	Percent Change
Cattle and Calves	14,284	15,558	9%
Beef	ND	ND	-
Dairy	ND	ND	-
Hogs and Pigs	23,100	20,018	-13%
Poultry(1)	193	224	16%
Sheep and Lambs	761	509	-33%
Horses and Ponies	347	285	-18%

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

Table 5-20 Warren County Animal Population (2007 and 2012 Census of Agriculture)

Livestock Type	2007	2012	Percent Change
Cattle and Calves	16,751	15,520	-7%
Beef	8,589	5,079	-41%
Dairy	275	235	-15%
Hogs and Pigs	73,036	67,665	-7%
Poultry(1)	595	1,400	135%
Sheep and Lambs	3,539	3,566	1%
Horses and Ponies	426	330	-23%

(1) Poultry census data inclusive of broilers, layers, pullets, roosters and turkeys

The tables above show significant cattle, hog and pig populations within the watershed counties. There are no known concentrated animal feeding operations (CAFOs) within the watershed. Communications with local NRCS officials have provided limited additional watershed-specific details although stakeholders indicated that animal populations and manure spreading may be a growing issue throughout the watershed.

Wildlife throughout the watershed may also contribute nutrients as waste from duck, geese, deer, raccoons, and other animals washes into area stream and reservoirs following precipitation.

5.4.3 Septic Systems

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

Information on the extent of sewered and non-sewered municipalities in the Upper La Moine River watershed was obtained from the county health departments. Health department officials in Hancock County, stated that the town of Carthage is served by sewer, but most county residents within the watershed rely on private septic systems. Additionally, health department officials in McDonough County reported that residents within Macomb city limits are served by sewer and most residents in the county rely on private systems or wildcat sewer/collection systems that discharge untreated or partially treated wastewater to the surface of the ground, such as ditches or yards.

5.4.4 Internal Phosphorus Loading in Lakes

An additional potential nonpoint source of pollutants for Carthage Lake is lake sediments. Nutrients can be bound to soils and as soils erode throughout the drainage area, they accumulate at the bottom of receiving lakes. Internal phosphorus loading can occur when the water above the sediments becomes anoxic causing the release of phosphorus from the sediment in a form which is available for plant uptake. The addition of bioavailable phosphorus in the water column stimulates more plant growth and die-off, which may perpetuate or create anoxic conditions and enhance the subsequent release of phosphorus into the water. Internal phosphorus loading can also occur in shallow lakes through release from sediments by the physical mixing and reintroduction of sediments into the water column as a result of wave action, winds, boating activity, and other means.

5.4.5 Other Nonpoint Sources of Chloride

Additional potential nonpoint sources of chloride in the Drowning Fork subbasin include elevated background concentrations in area soils. Chloride is naturally occurring in mineral deposits in soils throughout the United States. Erosion of soils with high levels of chloride can contribute to elevated concentrations in surface waters. Chloride is also associated with dust suppressant used on rural dirt roads as well as road-deicers applied in winter months.

5.5 Watershed Studies and Other Watershed Information

A number of efforts have been performed in Upper La Moine River watershed, as described in the following timeline:

2004 - Illinois State Water Survey Water Contract Report 2004-13, December 2004 – The Sediment Budget of the Illinois River – Report finds that the tributary stream of the La Moine Rivers had the highest sediment yield rates.

2005 – Social Profile: La Moine River Ecosystem Partnership. This report documents socioeconomic issues of importance and citizens' concerns for the La Moine River watershed. The report provides data on the socioeconomics of the watershed, the use of natural resources in the watershed, and citizen suggestions for BMPs. A survey distributed to land owners within the watershed found that serious problems include soil deposits in streams, drinking water quality, and groundwater quality. Similarly, streambank erosion and siltation of streams were found to be some of the greatest concerns for the watershed. The report was intended to assist in the development of the La Moine River Watershed Plan.

2006 – La Moine River Ecosystem Partnership Watershed Plan. This report was completed to address local stakeholder concerns related to water quality, wildlife habitat, and erosion in the watershed. Potential BMPs were also identified. The northeast portion of the Upper La Moine River watershed in the Drowning Fork subbasin was identified as a priority area for BMPs to reduce erosion and restore water quality.

2008 – Update to the La Moine River Watershed Implementation Plan. This update was completed to determine sediment loadings, locations, and load reductions; to verify BMPs within critical subwatershed areas identified in the original plan; and to identify specific priority gully repair projects. The report also includes a field collected assessment of livestock inventory which identified high numbers of livestock operations (39-52) located west of the Drowning Fork impaired segment, and 26-38 livestock operations in the subwatersheds where the South Branch La Moine River, La Harpe Creek, Baptist Creek, and Rock Creek impaired segments are located. Of over 1,500 operations surveyed in the entire watershed, less than 50 were observed to be limiting livestock access to streams. A streambank erosion survey found several sites within the Drowning Fork impaired segment which required streambank stabilization as well as in-stream grade control.

2009 - Prairie Creek, Hancock County, (La Moine River Watershed) and Indian Creek and Dago Slough, Knox County, (Spoon River Watershed), Quality Assurance Project Plan, Prepared for the Illinois Environmental Protection Agency. The assessment report describes geomorphologic and habitat assessment information and concludes that unstable stream channel segments exist in the majority of the assessment area.

2009 - La Moine River Watershed Targeting for NPS Control, University of Illinois 319 Grant

2009 – La Moine River Outreach Program, Purdue University 319 Grant

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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 causing impairment in the Upper La Moine River watershed; chloride, DO, manganese, ammonia and total phosphorus (Carthage Lake) are the parameters for which numeric water quality standards currently exist. In addition, LRSs were developed for TSS, sedimentation, and total phosphorus (Drowning Fork, Prairie Creek, and South Branch La Moine River) which currently do not have numeric water quality standards. Watershed-specific water quality targets have been developed for these parameters by Illinois EPA. Refer to **Table 1-1** for a full list of potential causes of impairment. Illinois EPA believes that addressing the parameters with numeric standards through TMDLs will lead to an overall improvement in water quality due to the interrelated nature of the other listed pollutants. Recommended technical approaches for developing TMDLs and LRSs are presented in this section. Additional data needs are also discussed.

6.1 Simple and Detailed Approaches for Developing TMDLs

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

6.2 Additional Data Needs for TMDL and LRS Development in the Upper La Moine River Watershed

Table 6-1 contains summary information regarding data availability for all impairments that were addressed by TMDLs and LRSs in the Upper La Moine River watershed. The available datasets for impairments on Drowning Fork and in Carthage Lake were generally sufficient for basic TMDL and LRS calculations and model development. Although the available dissolved manganese data for La Harpe Creek (DGP-01 and DGP) and Baptist Creek show that these segments were once impaired based on a previous standard, they are no longer impaired when compared to the currently applicable water quality standard. It has been recommended that these segments be removed from the 2018 303(d) list for aquatic life use impairment by dissolved manganese.

Additional data were collected in 2017 for segments DGP-01 of La Harpe Creek and DGO-01 of Rock Creek for TMDL development. However, additional data is necessary for Prairie Creek segment DGZN-01 and the South Branch La Moine River segment DGZR as a lack of recent data limits the assessment of current impairments for those segments.

Table 6-1 Data Availability and Data Needs for TMDL/LRS Development in the Upper La Moine River Watershed

Stream (Segment ID)	Impairment Parameter	Period of Record	Data Count	Additional Data Needs
Drowning Fork (DGLC-01)	Chloride	2002-2012	13	none
	Phosphorus (Total)	2002-2012	17	none
	Sedimentation/Siltation	2002-2012	13	none
	Total Suspended Solids	2002-2012	14	none
Rock Creek (DGO-01)	Dissolved Oxygen	2002-2017 2012[1]	6 672[1]	none
La Harpe Creek (DGP)	Dissolved Oxygen	-	0	none – assessed with DGP-01
	Manganese	-	0	none – recommend delisting
La Harpe Creek (DGP-01)	Dissolved Oxygen	2002-2017 2012[1]	10 1439[1]	none
	Manganese	2002-2017	9	none - recommend delisting
Baptist Creek (DGPC-01)	Manganese	2007	3	none - recommend delisting
Prairie Creek (DGZN-01)	Dissolved Oxygen	1988	13	additional data collection necessary to confirm current impairment
	Phosphorus (Total)	1988	10	
	Total Suspended Solids (TSS)	1988	10	
South Branch La Moine River (DGZR)	Ammonia (Total)	1984, 1988	5	additional data collection necessary to confirm current impairment
	Dissolved Oxygen	1988	3	
	Manganese	1985	1*	
	Phosphorus (Total)	1984, 1988	5	
Carthage Lake (RLE)	Phosphorus (Total)	2003-2012	13	none
	Total Suspended Solids (TSS)	2003-2012	24	none

[1]Continuous monitoring data *Total Manganese sample available from 1985 that exceeded previous standard

6.3 Approaches for Developing TMDLs and LRSs for Stream Segments in Upper La Moine Watershed

6.3.1 Recommended Approach for Ammonia, Chloride, Total Phosphorus, Manganese, Sedimentation/Siltation, and Total Suspended Solids in Impaired Stream Segments

The recommended approach for developing TMDLs/LRSs for chloride, ammonia, total phosphorus, dissolved manganese, sedimentation/siltation and TSS in streams in the Upper La Moine River watershed is the load-duration curve method. The load-duration methodology uses the cumulative frequency distribution of stream flow and pollutant concentration data to estimate the allowable loads for a waterbody. As shown in **Table 6-1**, additional data collection was recommended to confirm impairment and/or to provide more recent information for the following segments and parameters:

- Prairie Creek (DGZN-01) – total phosphorus and TSS
- South Branch La Moine River (DGZR) – total ammonia, dissolved manganese, and total phosphorus

The data review performed for Baptist Creek and La Harpe Creek (DPG-01/DGP) showed that dissolved manganese concentrations in both segments support the general use and removal from the 2018 303(d) list was recommended.

6.3.2 Recommended Approach for Dissolved Oxygen TMDLs in Impaired Stream Segments

The recommended approach to TMDL development for DO impairments in streams is the development and parameterization of a series of QUAL2K models. QUAL2K is an updated spreadsheet-based version of the well-known and USEPA-supported QUAL2E model (Brown and Barnwell, 1987). The model simulates DO dynamics as a function of nitrogenous and CBOD, atmospheric re-aeration, SOD, and phytoplankton photosynthesis and respiration. The model also simulates the fate and transport of nutrients and BOD and the presence and abundance of phytoplankton (as chlorophyll-*a*). Stream hydrodynamics and temperature are important controlling parameters in the model. The model is suited to steady-state simulations. It is not anticipated that an additional watershed model will be needed to develop DO TMDLs for these streams.

6.4 Approaches for Developing TMDL and LRS for Carthage Lake

6.4.1 Recommended Approach for Total Phosphorus TMDL

Carthage Lake is listed for impairment of the aesthetic quality use, caused by total phosphorus. The BATHTUB model (Walker, 1996) is typically recommended for TMDL development for lake and reservoir impairments such as those in Carthage Lake. The BATHTUB model performs steady-state water and nutrient balance calculations in a spatially segmented hydraulic network that account 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. Oxygen conditions in the model are simulated as meta- and hypolimnetic depletion rates, rather than explicit concentrations. Watershed loadings to the lakes will be estimated using event mean concentration data, precipitation data, and estimated flows within the watershed.

Another option for the total phosphorus TMDL for Carthage Lake is CDM Smith's Simplified Lake Analysis Model (SLAM). SLAM was developed specifically to address an identified need for a practical and low cost water quality model focused on lake eutrophication that could be easily and simply applied in planning studies by a wide range of end-users. The model was originally developed as an enhanced version of the BATHTUB model and retains many of the core algorithms of that model.

SLAM calculates lake mass and flow balances on a daily time step assuming one or more well-mixed lake zones. Each zone follows the conceptual model often referred to as a "continuously stirred tank reactor" (CSTR), whereby complete and immediate mixing is assumed for each zone in both the vertical and horizontal directions. The model targets the key parameters important for eutrophic lakes: phytoplankton (as chl-*a*), phosphorus (P), and nitrogen (N), and can be easily modified to aid in assessment of unrelated conservative parameters such as TSS.

SLAM also includes a state-of-the-art dynamic sediment nutrient flux module. This module calculates internal nutrient loads from the sediments to the water column as a function of shallow sediment nutrient dynamics and diffusive exchanges between sediment pore water and the overlying water column. Internal nutrient loads are a key component of many eutrophic lakes, particularly small and/or shallow lakes with large catchment areas. The inclusion of dynamic and rigorous sediment nutrient calculations within a practical planning level water quality model distinguishes SLAM from the majority of other published lake water quality models and is a particularly appealing feature for this application.

6.4.2 Recommended Approach for Total Suspended Solids LRS

A simple spreadsheet approach is recommended to calculate the reduction in TSS loading required to meet the watershed-specific LRS target value established by Illinois EPA. The calculations will utilize the watershed flow estimates similar to those developed as part of the SLAM model, the relative proportion of the lake watershed made up by each subbasin, measured in-lake TSS concentrations, and the target value developed by Illinois EPA to calculate the current daily load of TSS into the lake (lbs/day), the target load (lbs/day), and the percent reduction needed in order to meet the LRS target. This simplified approach is appropriate for LRS development as it does not require the explicit assessment of WLA and LA.

CDM Smith

Section 7

Methodology Development for the Upper La Moine River Watershed

7.1 Methodology Overview

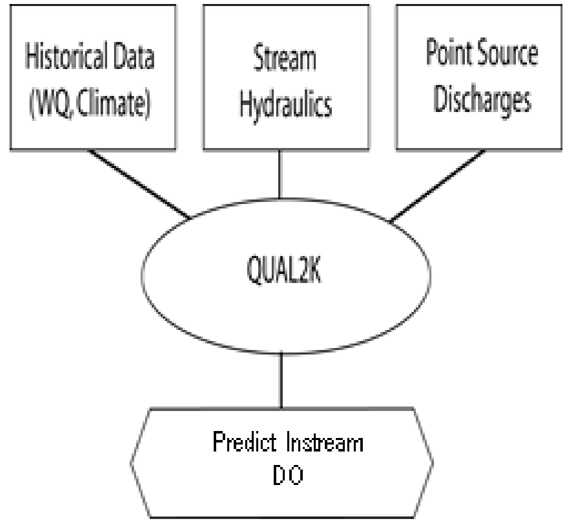
Table 7-1 contains information on the methodologies selected and used to develop TMDLs and LRSs for impaired segments within the Upper La Moine River watershed.

Table 7-1 Methodologies Used to Develop TMDLs and LRSs in the Upper La Moine River Watershed

Segment Name/ID	Causes of Impairment	Assessment Type	Methodology
Drowning Fork (DGLC-01)	Chloride	TMDL	Load Duration Curve
	Total Phosphorus	LRS	Load Duration Curve
	Total Suspended Solids (TSS)	LRS	Load Duration Curve
	Sedimentation/Siltation	LRS	Load Duration Curve
Rock Creek (DGO-01)	Dissolved Oxygen	TMDL	Qual2K
La Harpe Creek (DGP)	Manganese	No TMDL developed - delisting recommended	
	Dissolved Oxygen	TMDL	Qual2K – combined with segment DGP-01
La Harpe Creek (DGP-01)	Manganese	No TMDL developed - delisting recommended	
	Dissolved Oxygen	TMDL	Qual2K – combined with segment DGP
Baptist Creek (DGPC-01)	Manganese	No TMDL developed - delisting recommended	
Prairie Creek (DGZN-01)	Dissolved Oxygen	TMDL	Qual2K
	Total Phosphorus	LRS	Load Duration Curve
	TSS	LRS	Load Duration Curve
South Branch La Moine River (DGZR)	Ammonia (Total)	TMDL	Seasonal Load Duration Curve
	Dissolved Oxygen	TMDL	Qual2K
	Manganese	No TMDL developed - New Standard	
	Total Phosphorus	LRS	Load Duration Curve
Carthage Lake (RLE)	Total Phosphorus	TMDL	SLAM Model
	TSS	LRS	Spreadsheet model for target reductions

7.1.1 QUAL2K Overview

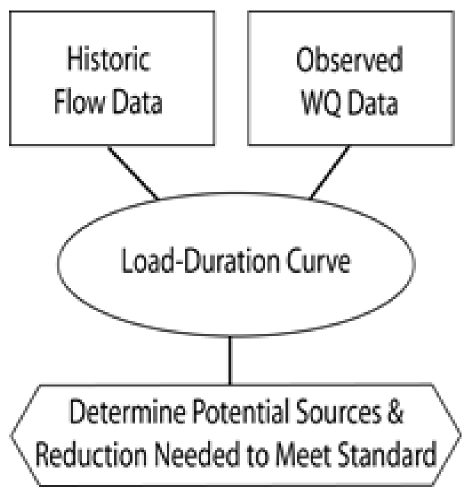
The QUAL2K model was used to develop TMDLs for oxygen-demanding materials in the impaired segments. The model was ultimately used to calculate reductions in oxygen-demanding materials, algal respiration, and/or SOD needed for each of the DO-impaired stream segments in the Upper La Moine River watershed (Rock Creek DGO-01; La Harpe Creek DGP-01/DPG; Prairie Creek DGZN-01; and South Branch La Moine River DGZR). QUAL2K is a one-dimensional stream water quality model applicable to well-mixed streams. The model assumes steady state hydraulics and allows for point source inputs, diffuse loading and tributary flows. In general, QUAL2K incorporates historical water quality data, observed hydraulic information, and point source discharge data, along with model kinetic rates and constants, to predict the resulting instream DO concentrations (see Schematic 1).



Schematic 1

7.1.2 Load-Duration Curve Overview

Loading capacity analyses were performed for each of the stream segments in this watershed impaired by ammonia, chloride, manganese, total phosphorus, or TSS through the development of a series of load-duration curves. A load-duration curve is a graphical representation of the maximum load of a pollutant that a stream segment can assimilate over a range of flow scenarios while still meeting the instream water quality standard. The load-duration curve approach utilizes historical flow data and observed water quality data to assess the magnitude and frequency of exceedances as well as to determine the flow scenarios when exceedances occur most often (see Schematic 2). In the Upper La Moine River watershed, load duration curves were constructed for ammonia (South Branch La Moine River DGZR), total phosphorus (Drowning Fork DGLC-01, Prairie Creek DGZN-01; and South Branch La Moine River DGZR)), TSS (Drowning Fork DGLC-01; and Prairie Creek DGZN-01), and sedimentation/siltation (Drowning Fork DGLC-01).



Schematic 2

7.1.3 Simplified Lake Assessment Model (SLAM) Overview

CDM Smith's SLAM was used to develop the TMDL for total phosphorous in Carthage Lake. SLAM was originally developed as an enhanced version of the USEPA's Bathtub model but provides more explicit modeling of lake/sediment interactions than is available in the Bathtub model and has streamlined functionality and data requirements while still providing for a robust simulation of small lake nutrient and phytoplankton dynamics. SLAM requires inputs from several data sources including online databases and GIS-compatible data.

SLAM calculates lake mass and flow balances on a daily time step assuming one or more well-mixed lake zones. Each zone follows the conceptual model often referred to as a "continuously stirred tank reactor", whereby complete and immediate mixing is assumed for each zone in both the vertical and horizontal directions. This assumption makes the model well suited for Carthage Lake, which is generally well-mixed and can justifiably be divided into a limited number of small and/or shallow zones. The model targets the key parameters important for eutrophic lakes, including phytoplankton (as chl-*a*), phosphorus (P), and nitrogen (N), and can be easily modified to aid in assessment of unrelated conservative parameters such as TSS.

SLAM also includes a state-of-the-art dynamic sediment nutrient flux module. This module calculates internal nutrient loads from the sediments to the water column as a function of shallow sediment nutrient dynamics and diffusive exchanges between sediment pore water and the overlying water column. Internal nutrient loads are a key component of many eutrophic lakes, particularly small and/or shallow lakes with large catchment areas, as is the case with Carthage Lake.

Watershed loadings to the lake were estimated using event mean concentration data, precipitation data, and estimated runoff flows within the watershed. Subbasin flows were estimated using the area ratio method, and phosphorus loadings to the lake from the surrounding watershed was estimated using the unit area load method, also known as the "export coefficient" method (USEPA 2001). This method is based on the assumption that, on an annual basis and normalized to area, a roughly constant runoff pollutant loading can be expected for a given land use type. This method also requires that unit area loads are not applied to watersheds that differ greatly in climate, hydrology, soils, or ecology from those from which the parameters were derived (USGS 1997).

7.1.4 Load Reduction Strategy Overview for TSS and Sedimentation/Siltation in Lakes

A simple spreadsheet approach was used to calculate the reductions in TSS loading into Carthage Lake required to meet the watershed-specific target value established by Illinois EPA of 50.9 mg/L. The calculations utilize the watershed flow estimates similar to those developed as part of the SLAM model, the relative proportion of the lake watershed made up by each subbasin, measured in-lake TSS concentrations, and the target value developed by Illinois EPA to calculate the current daily load of TSS into the lake (pounds [lbs]/day), the target load (lbs/day), and the percent reduction needed in order to meet the LRS target. This simplified approach is appropriate for LRS development as it does not require the explicit assessment of WLA and LA.

7.2 Methodology Development

The following sections further discuss and describe the methodologies utilized to examine ammonia, chloride, total phosphorus, TSS, and dissolved oxygen levels in the stream segments of the Upper La Moine River watershed as well as total phosphorous and TSS levels in Carthage Lake.

7.2.1 QUAL2K Model Development

QUAL2K (Q2K) is a river and stream water quality model that is intended to represent a modernized version of the QUAL2E (Q2E) model (Brown and Barnwell 1987). The original Q2E model is well-known and USEPA-supported. The modernized version has been updated to use Microsoft Excel as the user interface and has expanded the options for stream segmentation as well as a number of other model inputs. Q2K simulates DO dynamics as a function of nitrogenous and carbonaceous oxygen demand, atmospheric reaeration, SOD, and plant photosynthesis and respiration. The model also simulates the fate and transport of nutrients and biological oxygen demand (BOD) and the growth and abundance of floating (phytoplankton) and attached (periphyton) algae (as chlorophyll-*a*). Stream hydrodynamics and temperature are important controlling parameters in the model. Headwater, point source, and non-point source loadings and flows are explicitly input by the user. The model simulates steady-state diurnal cycles. Model parameter default values are provided in the model based on past studies and are recommended in the absence of site-specific information. Along with its capability to aid in DO assessment, Q2K can also be used to model nutrient and pH fluctuations within a stream segment.

Separate Q2K models were developed for the DO impaired segments in the Upper La Moine River watershed. La Harpe Creek segment DGP and La Harpe Creek segment DGP-01 are contiguous segments with compatible datasets and were combined into a single model. Rock Creek segment DGO-01, Prairie Creek segment DGZN-01, and South Branch La Moine River segment DGZR did not include contiguous stream segments and each segment required an individual Q2K model.

A combination of 7-day and 30-day daily minimum and mean DO concentrations were used as endpoints for each TMDL analysis. The use of extended period (7-day and 30-day) standards, rather than instantaneous minimum standards, serves as a conservative measure in the calculations (see further discussion in Section 8). Depending on the critical period modeled, either the March – July standard or the August – February standard was used.

For all of the models developed, a highly simplified modeling structure was employed due to the lack of supporting data. Short, uniform 1-km length reach segments were constructed for each impaired reach, representing the general vicinity of the observed impairment (DO violation). Upstream boundary conditions of each isolated reach segment were set based on known or measured data at the point of impairment. The short reach segment was then simulated as an isolated control volume to assess near-field impacts of periphyton growth, SOD, and rapid CBOD oxidation. This approach was employed for both a baseline model of existing impairment and a TMDL simulation to quantify load reduction requirements. For the baseline model, a single critical period simulation day was selected based on historical water quality data. In other words, the baseline model was used to approximately replicate known impairment conditions. QUAL2K Model files can be found in **Appendix E.**

7.2.1.1 QUAL2K Inputs

Table 7-2 contains the categories of data required for the Q2K models along with the sources of data used to analyze each of the impaired stream segments in the Upper La Moine River watershed.

CDM Smith

Table 7-2 Q2K Data Inputs

Input Category	Data Source
Stream Segmentation	GIS data
Hydraulic characteristics	GIS data; professional estimations
Headwater conditions	Historical water quality data collected by Illinois EPA
Point Source contributions	Illinois EPA, USEPA's Permit Compliance System (PCS) and Integrated Compliance Information System (ICIS)

Empirical data amassed during Stage 1 of TMDL development were used to build the Q2K models along with physical data obtained from GIS.

7.2.1.2 La Harpe Creek Combined Q2K Model

La Harpe Creek (DGP) is the upstream segment of La Harpe Creek (DGP-01), and the impaired segments are contiguous. Both segments also have reasonably comparable and compatible datasets allowing for a single Q2K model to be developed to encompass the impaired segments of both the La Harpe Creek segments.

7.2.1.2.1 Stream Segmentation – La Harpe Creek Model

The Q2K model represents a river as a series of reaches. Each reach shares constant channel geometry and hydraulic characteristics. La Harpe Creek was simulated as a single short reach, focusing on the area of known impairment. **Figure 7-1** shows the location of the simulated stream segment used for the La Harpe Creek Q2K model.

7.2.1.2.2 Hydraulic Characteristics – La Harpe Creek Model

No hydraulic data were available for the modeled portions of La Harpe Creek. Manning's Equation was used to set initial hydraulic parameters for this segment based on estimated channel width from aerial photographs, estimated channel slope from the NED, and an estimated Manning's roughness coefficient.

7.2.1.2.3 Baseline Simulation Day – La Harpe Creek Model

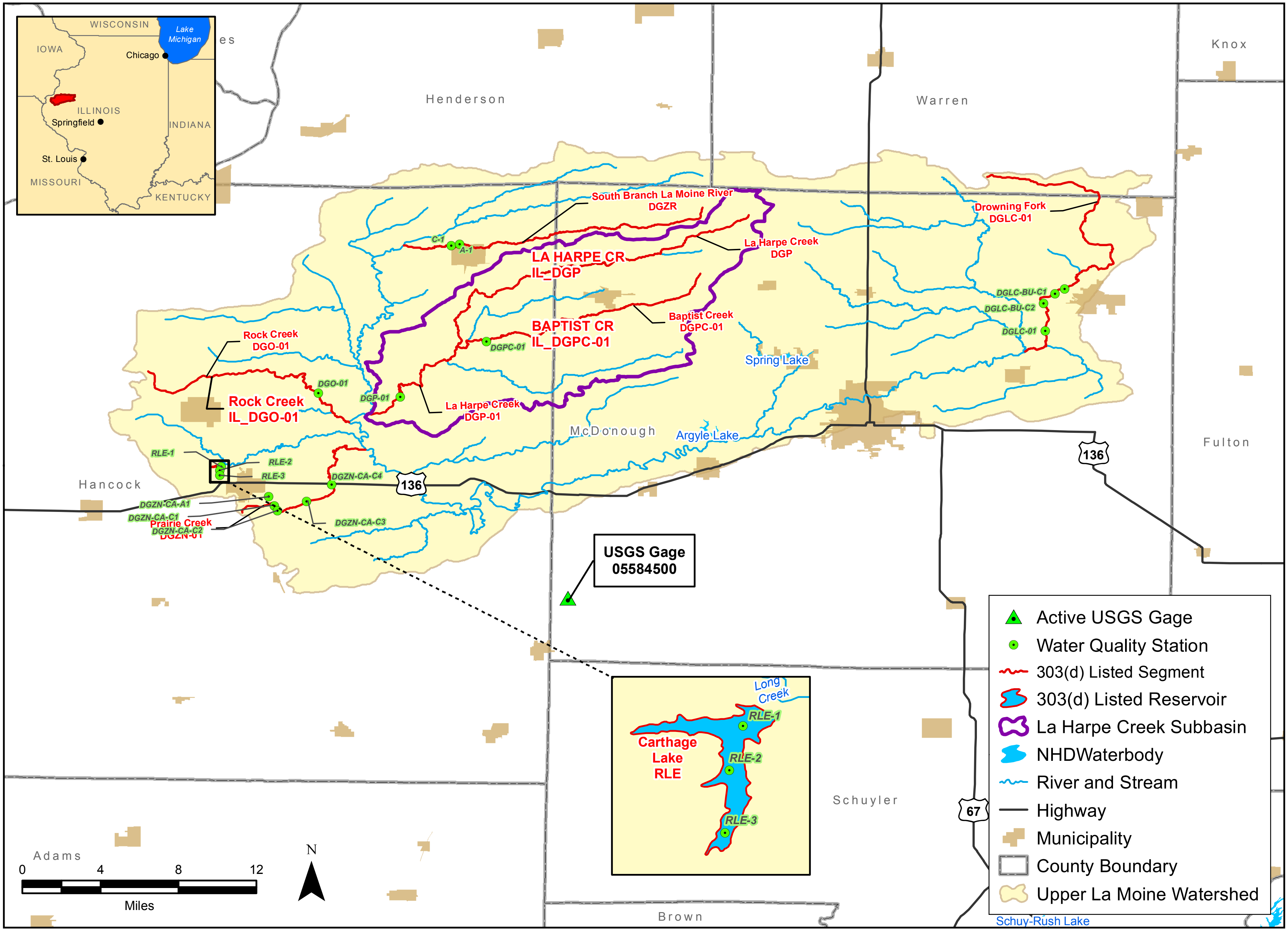
The noted dissolved oxygen violation on July 18, 2012 in this reach was used as the baseline simulation day. The measured average DO on this day was 4 mg/L, with a minimum observed value of 2.5 mg/L. Water quality conditions of this day were replicated, to the extent possible, in the baseline QUAL2K model.

7.2.1.2.4 Headwater Conditions – La Harpe Creek Model

Headwater flow for the modeled reach segment and simulation day was set based on an area-weighting of available stream gauge data at the downstream USGS gauge 5584500 (La Moine River at Colmar). Headwater nutrient and CBOD concentrations were set based on measured data for the simulation day.

7.2.1.2.5 Diffuse Flow – La Harpe Creek Model

Diffuse nutrient loads were added to the model in order to achieve observed diurnal DO variability, via benthic algae growth, as described below.



Upper La Moine River
La Harpe Creek Q2K Stream Segmentation

CDM Smith

FIGURE 7-1

7.2.1.2.6 Climate – La Harpe Creek Model

Climate inputs do not play a significant role in the modeled condition and therefore were maintained at model default values.

7.2.1.2.7 Point Sources – La Harpe Creek Model

Two NPDES permitted point sources, the Bladinsville Water Treatment Plant (WTP) and the Bladinsville Sanitary Treatment Plant (STP), discharge within the La Harpe Creek subbasin and contribute effluent to impaired segments DPG and DPG-01. Q2K allows user input of point source locations, flow, and water quality data. Permit records were reviewed and permitted discharge data were used for model input. Flow information was available for each discharger; however, permit limit concentration data are available only for parameters that are sampled per permit requirements. Based on the review of DMR water quality data from both dischargers, only the Blandinsville STP facility has reasonable potential to impact DO levels instream and was included in this modeling exercise. **Table 7-3** contains model input information for the Blandinsville STP facility while the locations of both facilities are shown in **Figure 7-2**.

Table 7-3 Point Source Discharge Data for La Harpe Creek QUAL2K Models

Facility Name	Permit Number	DMF (MGD)	DAF (MGD)	Receiving Water	DO (mg/L)	CBOD (mg of O_2/L)
Blandinsville STP	IL0072672	0.2325	0.093	Unnamed tributary to Baptist Creek	≥5.5[1]	25[2]

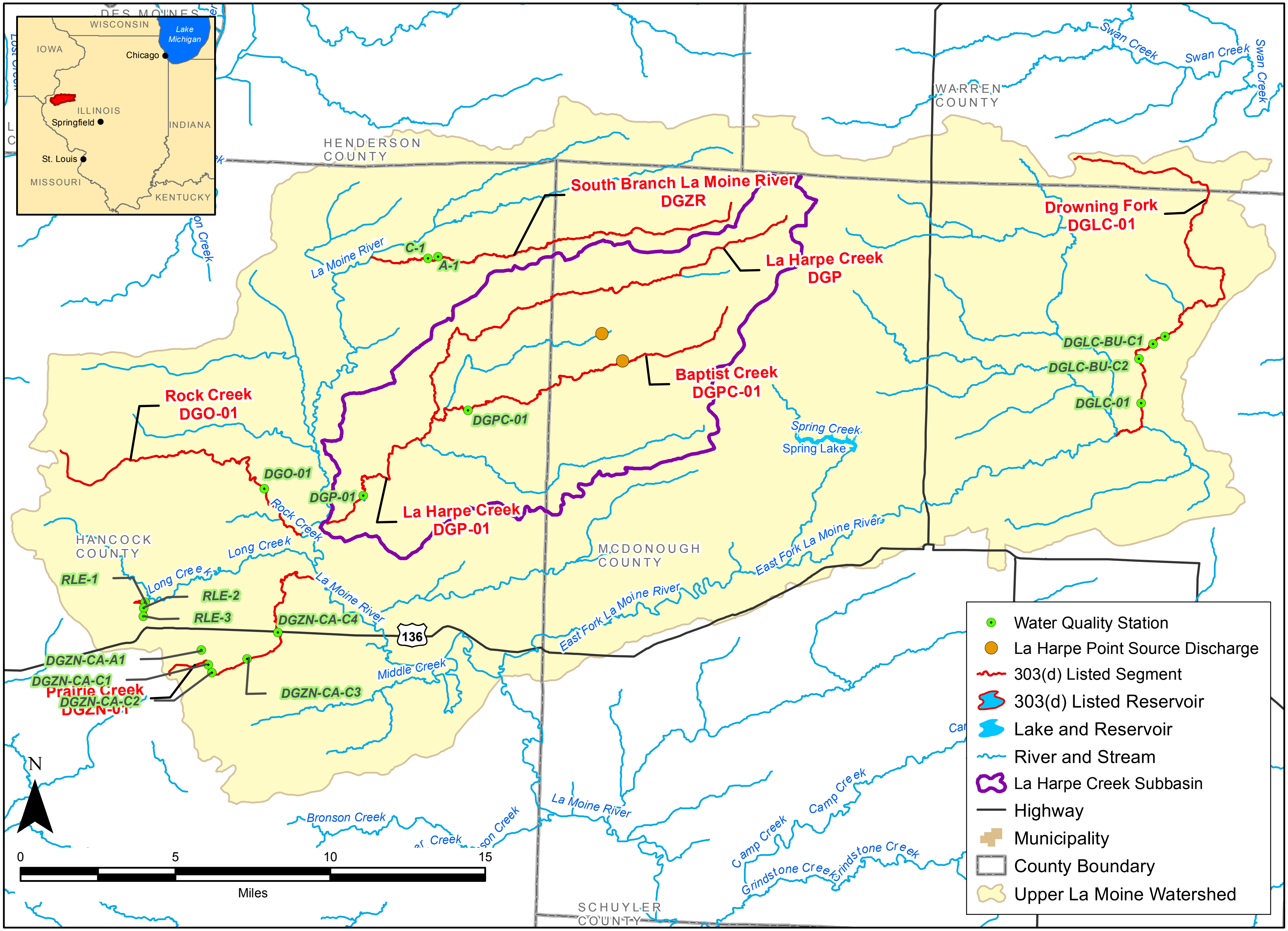
MGD = million gallons per day
DAF = Design Average Flow
ND = No Data
[1] Aug-Feb monthly average as per NPDES permit limit requirement
[2] Monthly average as per NPDES permit limit requirement

Note that point sources were not explicitly included in the model, as they are located outside of the model domain. Their impacts are only indirectly included via the prescribed conditions at the point of impairment (headwater concentrations) and in the parameterized sediment oxygen demand (see below).

7.2.1.2.8 QUAL2K Baseline Parameterization – La Harpe Creek Model

La Harpe Creek is a small riverine system located within a heavily cultivated (agricultural) watershed. Measured data strongly indicate high levels of plant primary productivity resulting from excessive nutrient loads, characterized by large diurnal DO swings (+- 1.5 mg/L on simulation day). These loads are almost certainly attributable to nonpoint agricultural runoff. Two point sources exist upstream and likely also contribute to observed low daily mean DO levels (via SOD and/or water column CBOD oxidation). The focus of the constructed baseline model was therefore on replicating the observed diurnal DO swing with high benthic algae growth and achieving the observed low mean DO value with high sediment oxygen demand.

As described above, model headwater flow and water quality were set based on observed data for the simulation day (July 18, 2012). Diffuse nutrient (nitrogen and phosphorus) loads were incrementally added to the model until a reasonable representation of the inferred benthic algae growth was achieved. Simultaneous to this, benthic algae maximum growth rates were also adjusted in the model to achieve the inferred biomass. Adjustments were made to the model SOD and benthic algae growth rates until an adequate agreement between modeled and measured DO profiles was achieved. SOD rate adjustments were used to achieve the observed mean DO concentration, while algae growth rate adjustments were used to achieve the observed diurnal swing. In the end, a reasonable balance between diffuse source nutrient loads, benthic algae growth rates, and sediment oxygen demand was simulated, through input parameter adjustment, resulting in a close replication of the observed DO profile and nutrient levels at the modeled site.



CDM Smith

Upper La Moine River
La Harpe Creek Q2K Point Source Discharge

FIGURE 7-2

7.2.1.3 Rock Creek Q2K Model

Rock Creek consists of a single segment (DGO-01) which is impaired by low DO. Grab samples on this segment were collected by Illinois EPA on a total of six occasions in 2002, 2007, 2012 and 2017. Additionally, Illinois EPA collected continuous monitoring data at this location in 2012. These datasets were the primary source of data used to setup and calibrate the Q2K model.

7.2.1.3.1 Stream Segmentation – Rock Creek Model

The Q2K model represents a river as a series of reaches. Each reach shares constant channel geometry and hydraulic characteristics. Rock Creek was simulated as a single short reach, focusing on the area of known impairment. **Figure 7-3** shows the location of the simulated stream segment used for the Rock Creek Q2K model.

7.2.1.3.2 Hydraulic Characteristics – Rock Creek Model

No hydraulic data were available for the modeled portions of Rock Creek. Manning's Equation was used to set initial hydraulic parameters for this segment based on estimated channel width from aerial photographs, estimated channel slope from the NED, and an estimated Manning's roughness coefficient.

7.2.1.3.3 Baseline Simulation Day – Rock Creek Model

The noted dissolved oxygen violation on July 17, 2012 in this reach was used as the baseline simulation day. The measured average DO on this day was approximately 5 mg/L, with a minimum observed value of 2.5 mg/L. Water quality conditions of this day were replicated, to the extent possible, in the baseline QUAL2K model.

7.2.1.3.4 Diffuse Flow – Rock Creek Model

Diffuse nutrient loads were added to the model in order to achieve observed diurnal DO variability, via benthic algae growth, as described below.

7.2.1.3.5 Headwater Conditions – Rock Creek Model

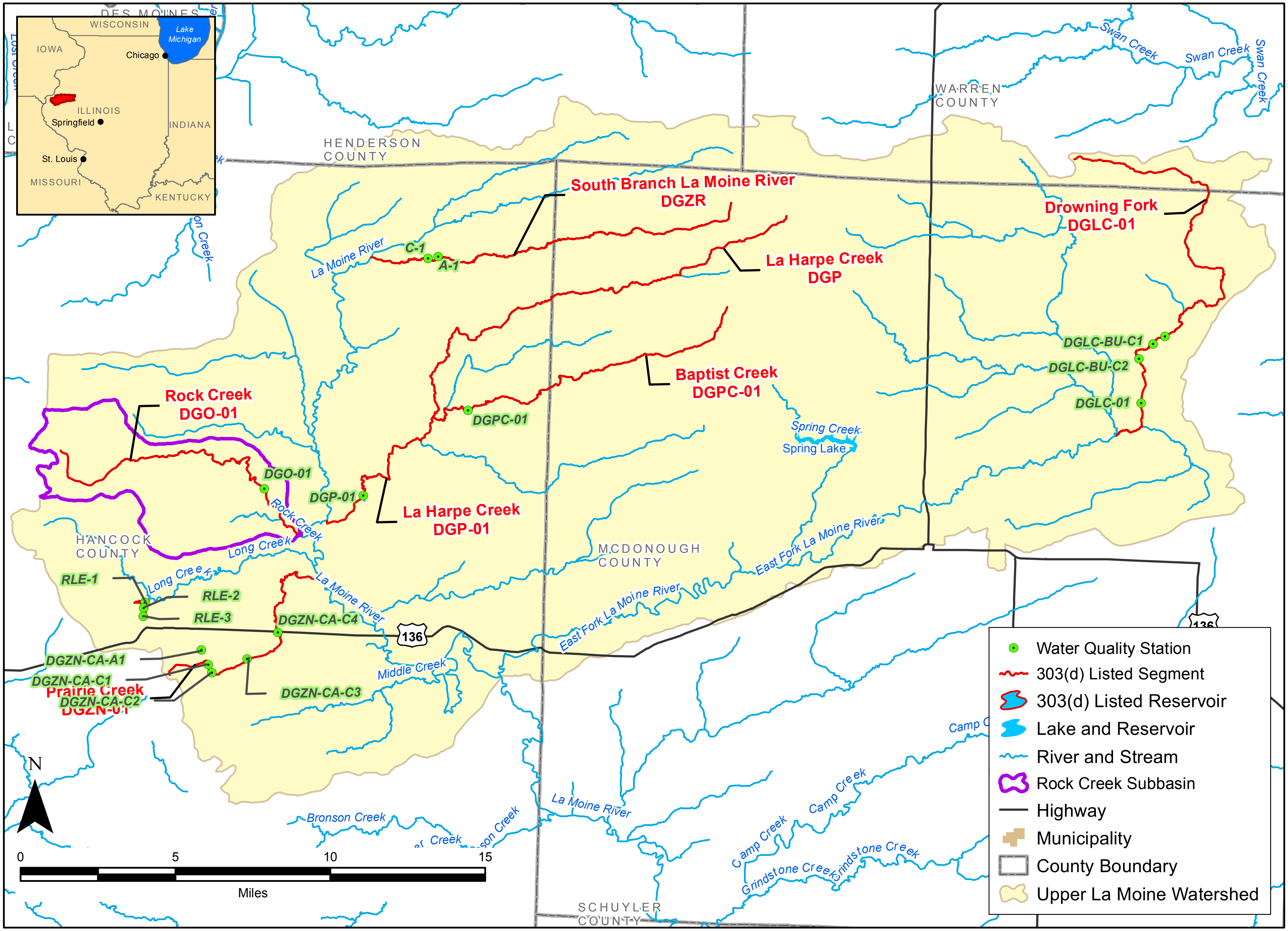
Headwater flow for the modeled reach segment and simulation day was set based on an area-weighting of available stream gauge data at the downstream USGS gauge 5584500 (La Moine River at Colmar). Headwater nutrient and CBOD concentrations were set based on measured data for the simulation day.

7.2.1.3.6 Climate – Rock Creek Model

Climate inputs do not play a significant role in the modeled condition and therefore were maintained at model default values.

7.2.1.3.7 Point Sources – Rock Creek Model

There are no NPDES permitted point sources that discharge within the Rock Creek watershed.



CDM Smith

Upper La Moine River
Rock Creek Q2K Model Segmentation

FIGURE 7-3

7.2.1.3.8 QUAL2K Baseline Parameterization – Rock Creek Model

Rock Creek is a small riverine system located within a heavily cultivated (agricultural) watershed. Measured data strongly indicate high levels of plant primary productivity resulting from excessive nutrient loads, characterized by large diurnal DO swings (+- 2.5 mg/L on simulation day). These loads are almost certainly attributable to nonpoint agricultural runoff. No point sources exist in the watershed. The focus of the constructed baseline model was therefore on replicating the observed diurnal DO swing with high benthic algae growth and achieving the observed low mean DO value with high sediment oxygen demand.

As described above, model headwater flow and water quality were set based on observed data for the simulation day (July 17, 2012). Diffuse nutrient (nitrogen and phosphorus) loads were incrementally added to the model until a reasonable representation of the inferred benthic algae growth was achieved. Simultaneous to this, benthic algae maximum growth rates were also adjusted in the model to achieve the inferred biomass. Adjustments were made to the model SOD and benthic algae growth rates until an adequate agreement between modeled and measured DO profiles was achieved. SOD rate adjustments were used to achieve the observed mean DO concentration, while algae growth rate adjustments were used to achieve the observed diurnal swing. In the end, a reasonable balance between diffuse source nutrient loads, benthic algae growth rates, and sediment oxygen demand was simulated, through input parameter adjustment, resulting in a close replication of the observed DO profile and nutrient levels at the modeled site.

7.2.1.4 Prairie Creek Q2K Model

Prairie Creek segment DGZN-01 which is impaired by low DO consists of 5 monitoring stations. A total of 10 grab samples were collected from stations on this segment by Illinois EPA in 1988. These datasets were the primary source of data used to setup and calibrate the Q2K model developed for Prairie Creek.

7.2.1.4.1 Stream Segmentation – Prairie Creek Model

The Q2K model represents a river as a series of reaches. Each reach shares constant channel geometry and hydraulic characteristics. Prairie Creek was simulated as a single short reach, focusing on the area of known impairment. **Figure 7-4** shows the location of the simulated stream segment used for the Prairie Creek Q2K model.

7.2.1.4.2 Hydraulic Characteristics – Prairie Creek Model

No hydraulic data were available for the modeled portions of Prairie Creek. Manning's Equation was used to set initial hydraulic parameters for this segment based on estimated channel width from aerial photographs, estimated channel slope from the NED, and an estimated Manning's roughness coefficient.

7.2.1.4.3 Baseline Simulation Day

The noted dissolved oxygen violation on August 22, 1988 in this reach was used as the baseline simulation day. The measured average DO on this day was approximately 4 mg/L, with an observed minimum of 2.7 mg/L. Water quality conditions of this day were replicated, to the extent possible, in the baseline QUAL2K model.

7.2.1.4.4 Diffuse Flow – Prairie Creek Model

No diffuse flows or loads were included in the Prairie Creek model.

7.2.1.4.5 Headwater Conditions – Prairie Creek Model

Headwater flow for the modeled reach segment and simulation day was set based on an area-weighting of available stream gauge data at the downstream USGS gauge 5584500 (La Moine River at Colmar). Headwater nutrient and CBOD concentrations were set based on limited available measured data for the simulation day.

7.2.1.4.6 Climate – Prairie Creek Model

Climate inputs do not play a significant role in the modeled condition and therefore were maintained at model default values.

7.2.1.4.7 Point Sources – Prairie Creek Model

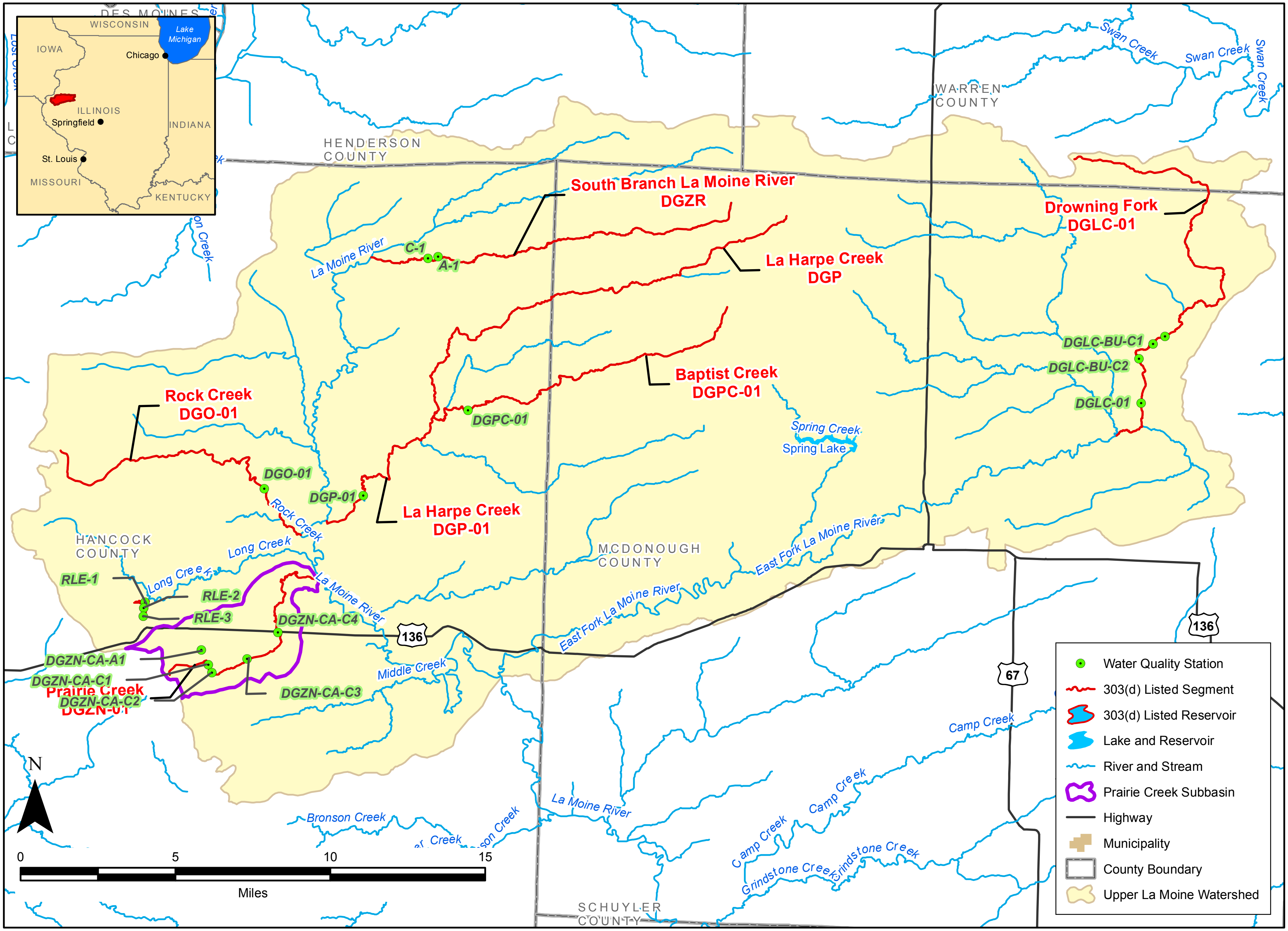
A single NPDES permitted point source discharges within the Prairie Creek subbasin impacting the impaired segment. Q2K allows user input of point source locations, flow, and water quality data. Permit records were reviewed and permitted discharge data were used for model input. Flow information was available for each discharger; however, permit limit concentration data are available only for parameters that are sampled per permit requirements. Where necessary concentration data were not available, estimates based on other facilities in the watershed and waterbody data were used to develop approximated model inputs. **Table 7-4** contains model input information for the facility and the location of the facility is shown in **Figure 7-5**.

Table 7-4 Point Source Discharge Data for Prairie Creek QUAL2K Model

Facility Name	Permit Number	DMF (MGD)	DAF (MGD)	Receiving Water	DO (mg/L)	CBOD (mg of O_2/L)
Carthage STP	IL0021229	5.0	0.5	Prairie Creek	≥5.5[1]	25[2]

MGD = million gallons per day
DAF = Design Average Flow
[1] Aug-Feb monthly average as per NPDES permit limit requirement[2] Monthly average as per NPDES permit limit requirement

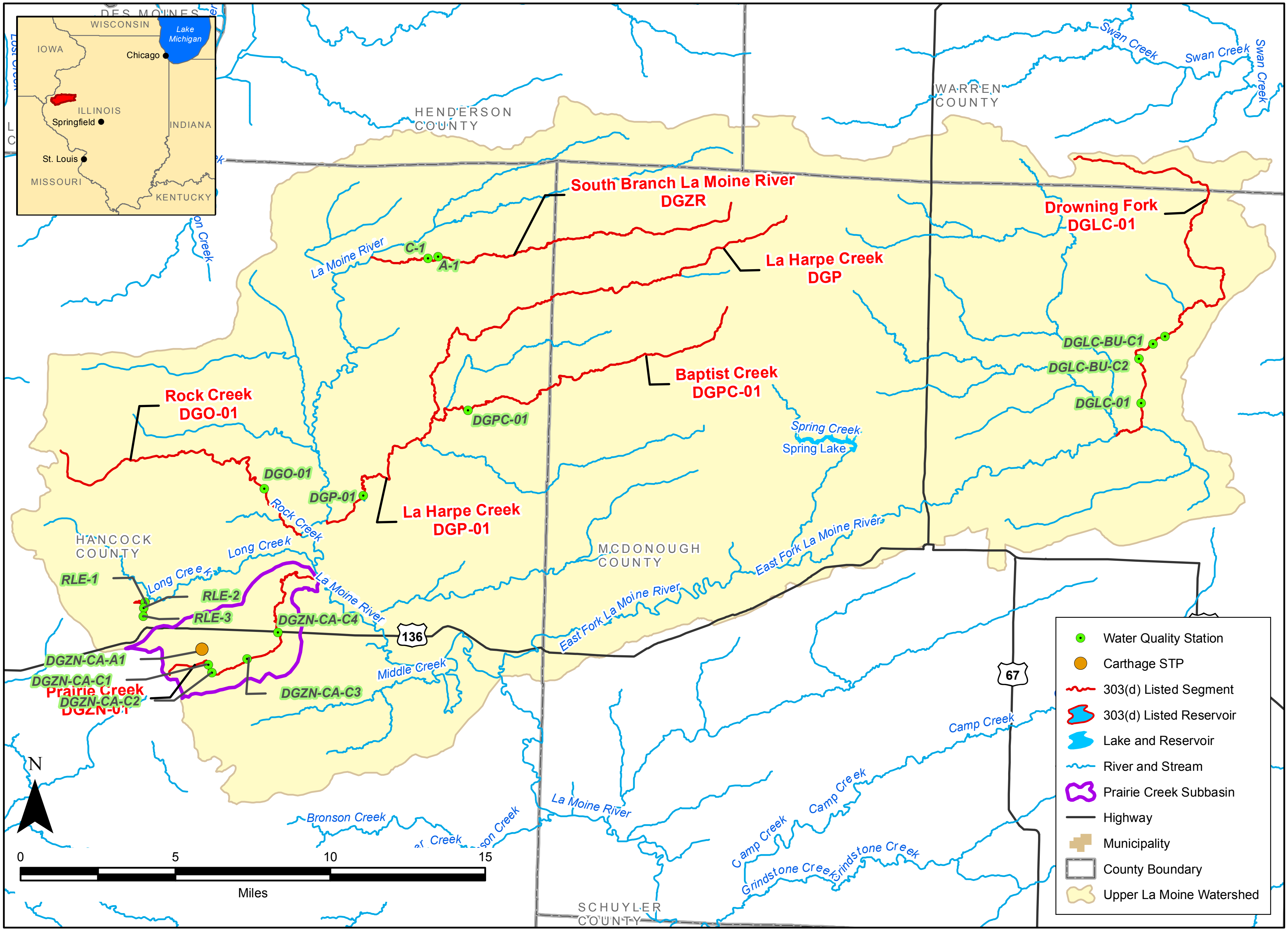
This point source was added to the model at the top of the short, modeled reach.



CDM Smith

Upper La Moine River
Prairie Creek Q2K Model Segmentation

FIGURE 7-4



CDM Smith

Upper La Moine River
Prairie Creek Q2K Point Source Discharge

FIGURE 7-5

7.2.1.4.8 QUAL2K Baseline Parameterization – Prairie Creek Model

Prairie Creek is a small riverine system located within an agricultural watershed. There is a single point source discharge a short distance above the measured point of DO impairment. Measured data indicate DO impairment due largely to the discharge of oxidizing organic matter from this point source. The focus of the constructed baseline model was therefore on replicating the observed DO levels through oxidation of the point source discharge load and associated sediment oxygen demand.

As described above, model headwater flow and water quality were set based on observed data for the simulation day (August 22, 1988). Point source nutrient loads were set based on available permit data. The point source CBOD load, and associated oxidation rate, were adjusted iteratively in the model until a reasonable replication of observed conditions was achieved, including the observed DO concentration on the targeted sampling day. The sediment oxygen demand was set based on values derived for other sites. Benthic algae rates were maintained at default values and did not play a significant role in the model simulation. In the end, a reasonable balance between point source CBOD loads, oxidation rates, and sediment oxygen demand was simulated, through input parameter adjustment, resulting in a close replication of the observed DO profile at the modeled site.

7.2.1.5 South Branch La Moine River Q2K Model

The South Brach La Moine River segment DGZR which is impaired by low DO consists of 2 monitoring stations. A total of 3 grab samples were collected from stations on this segment by Illinois EPA in 1988. These datasets were the primary source of data used to setup and calibrate the Q2K model developed for the South Branch La Moine River.

7.2.1.5.1 Stream Segmentation – South Branch La Moine River Model

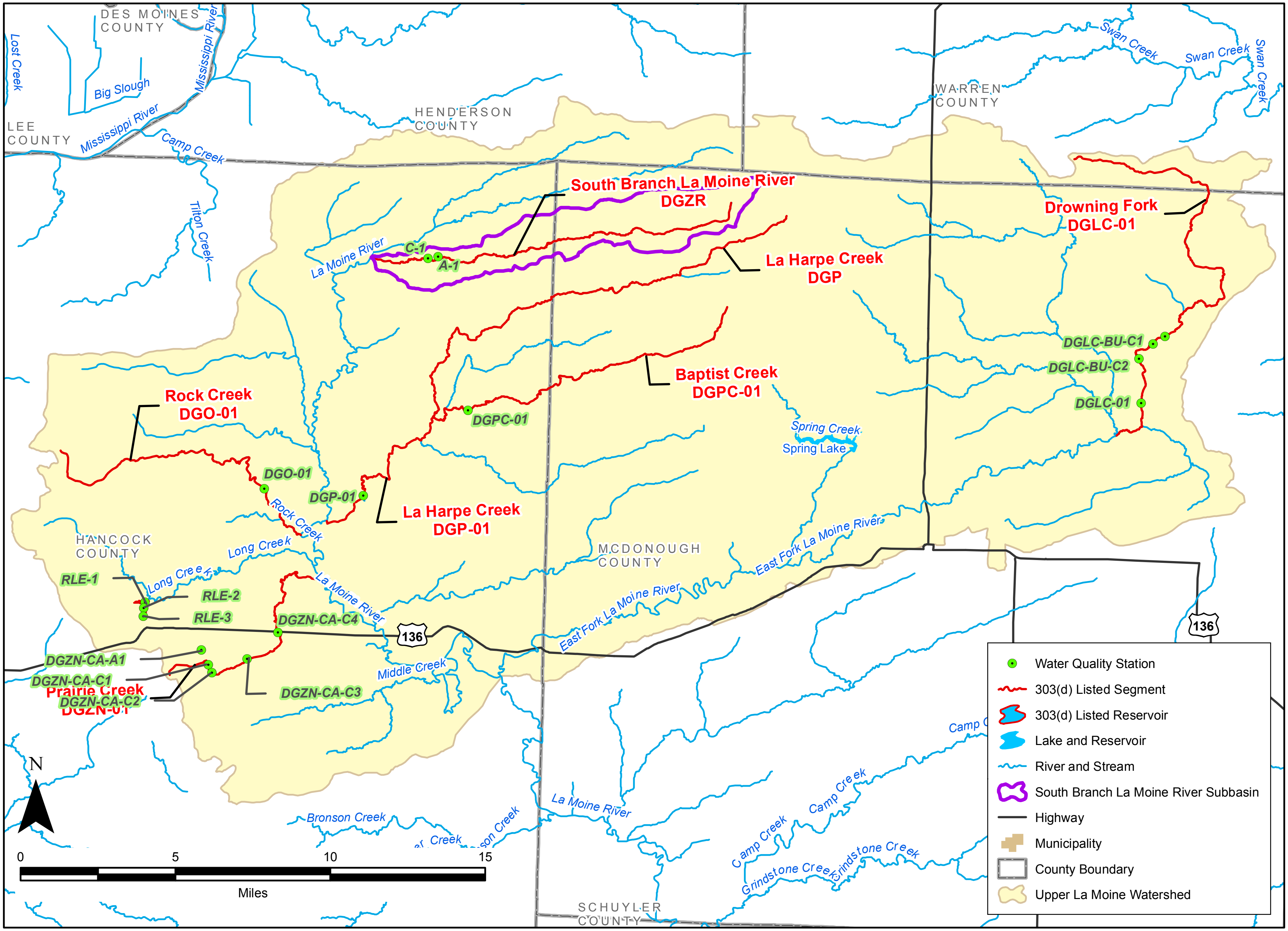
The Q2K model represents a river as a series of reaches. Each reach shares constant channel geometry and hydraulic characteristics. The South Branch La Moine River was simulated as a single short reach, focusing on the area of known impairment. **Figure 7-6** shows the location of the simulated stream segment used for the S. Branch La Moine River Q2K model.

7.2.1.5.2 Hydraulic Characteristics – South Branch La Moine River Model

No hydraulic data were available for the modeled portions of the South Branch La Moine River. Manning's Equation was used to set initial hydraulic parameters for this segment based on estimated channel width from aerial photographs, estimated channel slope from the NED, and an estimated Manning's roughness coefficient.

7.2.1.5.3 Baseline Simulation Day

The noted dissolved oxygen violation on August 22, 1988 in this reach was used as the baseline simulation day. The single DO measurement on this day was 2.7 mg/L. As a single grab sample, with no time stamp, it is impossible to know whether this value represents a daily minimum or is close to the daily average. Water quality conditions of this day were replicated, to the extent possible, in the baseline QUAL2K model.



Upper La Moine River
South Branch La Moine River Q2K Model Segmentation

CDM Smith

FIGURE 7-6

7.2.1.5.4 Diffuse Flow – South Branch La Moine River Model

No diffuse flows or loads were included in the S. Branch La Moine model.

7.2.1.5.5 Headwater Conditions – South Branch La Moine River Model

Headwater flow for the modeled reach segment and simulation day was set based on an area-weighting of available stream gauge data at the downstream USGS gauge 5584500 (La Moine River at Colmar). Headwater nutrient and CBOD concentrations were set based on limited available measured data for the simulation day.

7.2.1.5.6 Climate – South Branch La Moine River Model

Climate inputs do not play a significant role in the modeled condition and therefore were maintained at model default values.

7.2.1.5.7 Point Sources – South Branch La Moine River Model

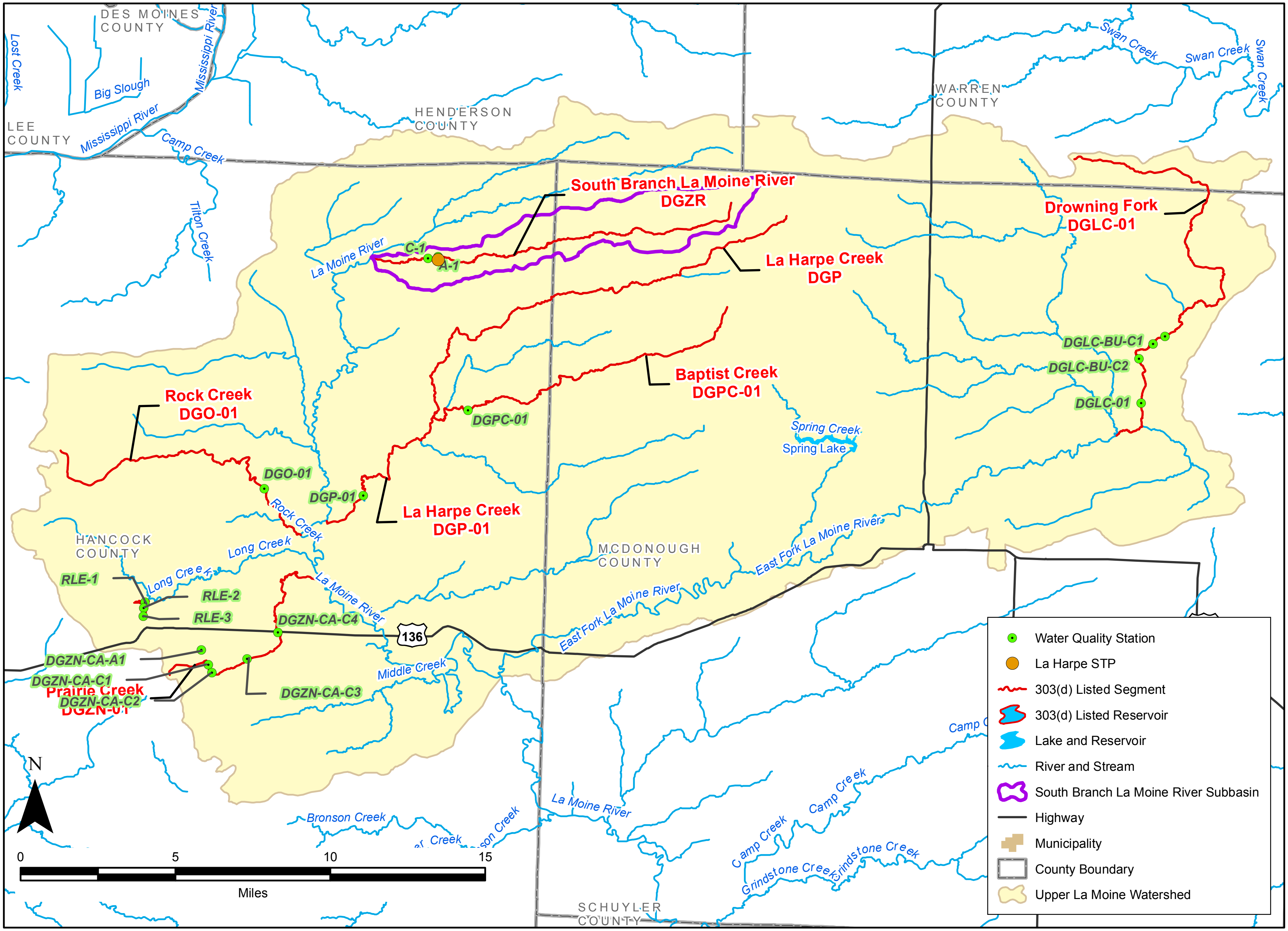
A single NPDES permitted point source discharges within the S. Branch La Moine River subbasin impacting the impaired segment. Q2K allows user input of point source locations, flow, and water quality data. Permit records were reviewed and permitted discharge data were used for model input. Flow information was available for each discharger; however, permit limit concentration data are available only for parameters that are sampled per permit requirements. Where necessary concentration data were not available, estimates based on other facilities in the watershed and waterbody data were used to develop approximated model inputs. **Table 7-5** contains model input information for the facility and the location of the facility is shown in **Figure 7-7**.

Table 7-5 Point Source Discharge Data for S. Branch La Moine River QUAL2K Model

Facility Name	Permit Number	DMF (MGD)	DAF (MGD)	Receiving Water	DO (mg/L)	CBOD (mg of O_2/L)
La Harpe STP	ILG580093	ND	0.613	S. Branch La Moine River	≥6[1]	25[2]

MGD = million gallons per day
DAF = Design Average Flow
ND = No Data
[1] Monthly minimum average as per NPDES permit limit requirement
[2] Monthly average as per NPDES permit limit requirement

This point source was added to the model at the top of the short, modeled reach.



CDM Smith

Upper La Moine River
South Branch La Moine River Q2K Point Source Discharge

FIGURE 7-7

7.2.1.5.8 QUAL2K Baseline Parameterization – South Branch La Moine River Model

The South Branch La Moine River is a small riverine system located within an agricultural watershed. There is a single point source discharge a short distance above the measured point of DO impairment. Measured data indicate DO impairment due largely to the discharge of oxidizing organic matter from this point source. The focus of the constructed baseline model was therefore on replicating the observed DO levels through oxidation of the point source discharge load and associated sediment oxygen demand.

As described above, model headwater flow and water quality were set based on observed data for the simulation day (August 22, 1988). Point source nutrient loads were set based on available permit data. The point source CBOD load, and associated oxidation rate, were adjusted iteratively in the model until a reasonable replication of observed conditions was achieved, including the observed DO concentration on the targeted sampling day. The sediment oxygen demand was set based on values derived for other sites. Benthic algae rates were maintained at default values and did not play a significant role in the model simulation. In the end, a reasonable balance between point source CBOD loads, oxidation rates, and sediment oxygen demand was simulated, through input parameter adjustment, resulting in a close replication of the observed DO profile at the modeled site.

7.2.2 Load Duration Curves

Load duration curves are used for assessment and comparison of the range of loads allowable throughout the flow regime of a stream. This approach was used to characterize the current loading of total phosphorus for Drowning Fork DGLC-01, Prairie Creek DGZN-01, and South Branch La Moine River DGZR; assessment of TSS for Drowning Fork DGLC-01 and Prairie Creek DGZN-01; assessment of chloride for Drowning Fork DGLC-01; and assessment of ammonia for the South Branch La Moine River DGZR.

7.2.2.1 Watershed Delineation and Flow Estimation

Watersheds contributing directly to the impaired stream segments at the data collection stations were delineated with GIS analyses through use of the National Elevation Dataset as discussed in Section 2.2 of this report. The watershed delineations result in the following estimates of directly contributing watershed used for each impaired segment's load duration curve development:

- Drowning Fork DGLC-01: 54.9 square miles
- La Harpe Creek DGP-01: 95.3 square miles
- Prairie Creek DGZN-01: 13.0 square miles
- South Branch La Moine River DGZR: 16.8 square miles

Figure 7-8 shows the location of the water quality stations on each segment as well as the boundary of the GIS-delineated watersheds.

In order to create a load duration curve, it is necessary to obtain flow data corresponding to each water quality sample. As discussed in Section 2.6.3 of this report, there is no active USGS stream gages in the watershed. A USGS stream gage located approximately 5 miles south of the watershed on the La Moine River was used as a surrogate gage.

USGS gauge 05584500 (La Moine River at Colmar, Illinois) was used to estimate streamflows for Drowning Fork segment DGLC-01, La Harpe Creek segment DGP-01, Baptist Creek segment DGPC-01, Prairie Creek segment DGZN-01, and South Branch La Moine River segment DGZR. Average monthly flows at the La Moine River at Colmar gage range from 161 cfs in August to 838 cfs in April. The La Moine River at Colmar gage station drains an area of 655 square miles.

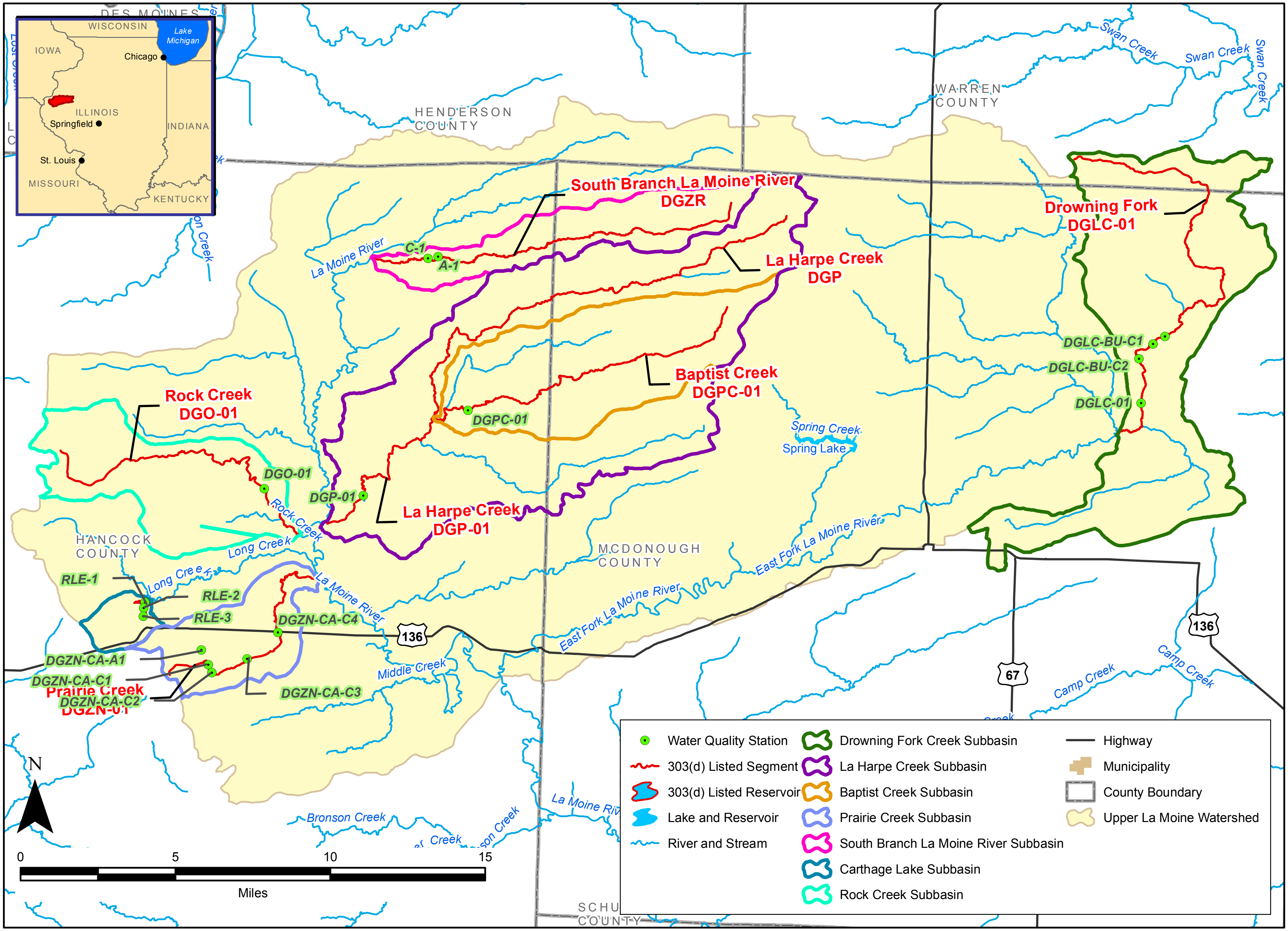
As discussed in Section 2.6.3, data from this gage was used to estimate flow values at other locations in the Upper La Moine River watershed using the drainage area ratio method represented by the following equation:

$$Q_{gauged}\left(\frac{Area_{ungauged}}{Area_{gauged}}\right) = Q_{ungauged}$$

where	Qgauged	=	Streamflow of the gauged basin
	Qungauged	=	Streamflow of the ungauged basin
	Areagauged	=	Area of the gauged basin
	Areaungauged	=	Area of the ungauged basin

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

Data downloaded through the USGS for the surrogate gauges for the available periods of record were adjusted to account for point source influences in the watershed upstream of the gauging stations. Average daily flows from all NPDES permitted facilities upstream of the surrogate USGS gauges were subtracted from the gauged flow prior to flow-per unit-area calculations. The resulting estimates account for flows associated with precipitation and overland runoff only. Average daily flows from permitted NPDES discharges upstream of the impaired segments in the Upper La Moine River watershed were then added back into the equation to more accurately reflect estimated daily streamflow conditions in a given segment. Spreadsheets used for the area ratio flow calculations are provided in **Appendix F**.



CDM Smith

Upper La Moine River Subbasin Segmentation

FIGURE 7-8

7.2.2.2 Total Phosphorus LRS: Drowning Fork DGLC-01, Prairie Creek DGZN-01, and South Branch La Moine River DGZR

A load duration curve for total phosphorus was developed for segment DGLC-01 of Drowning Fork, DGZN-01 of Prairie Creek, and DGZR of South Branch La Moine River. No numeric standard exists for total phosphorus in streams, so the watershed-specific LRS target value provided by Illinois EPA of 0.17 mg/L was used to develop the load duration curve. Total phosphorus concentration data for the impaired segments obtained during TMDL development were paired with the corresponding flows for the sampling dates and plotted against the load duration curve. **Figures 7-9**, **7-10**, and **7-11** show the load duration curve for segments DGLC-01, DGZN-01, and DGZR, respectively, as a solid line and the observed pollutant loads as points on the graphs.

The existing dataset for total phosphorus concentrations within the impaired segments were somewhat limited with a total of 13, 10, and 5 total phosphorus samples for Drowning Fork, Prairie Creek, and South Branch La Moine River, respectively. Plotting the available sample data against the load duration curve shows that exceedances of the target value for all three impaired segments occurred during dry and low flow conditions. **Appendix F** contains spreadsheets used for the calculation of these load duration curves.

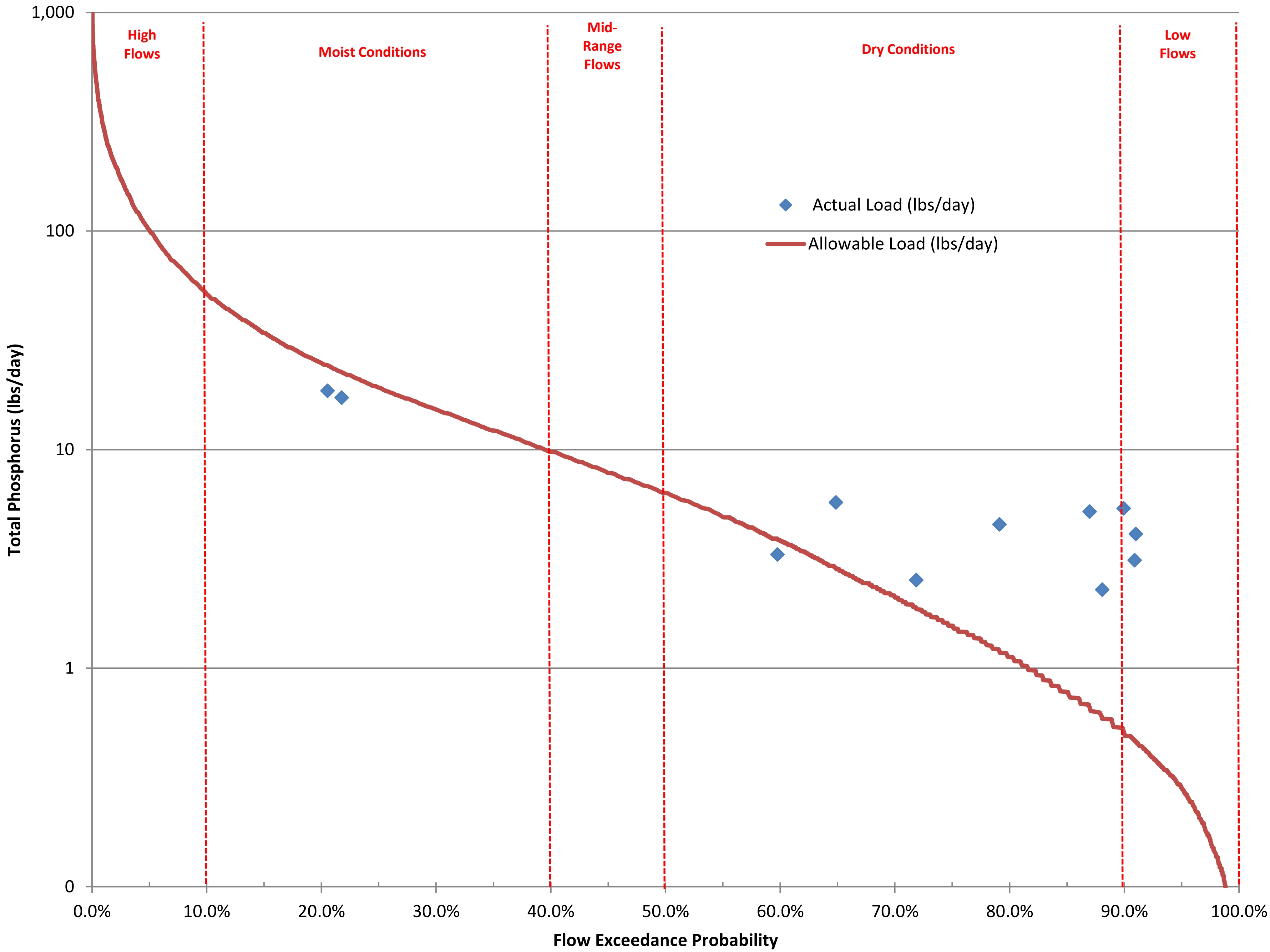


Figure 7-9
Drowning Fork (DGLC-01)
Total Phosphorus Load Duration Curve

CDM Smith

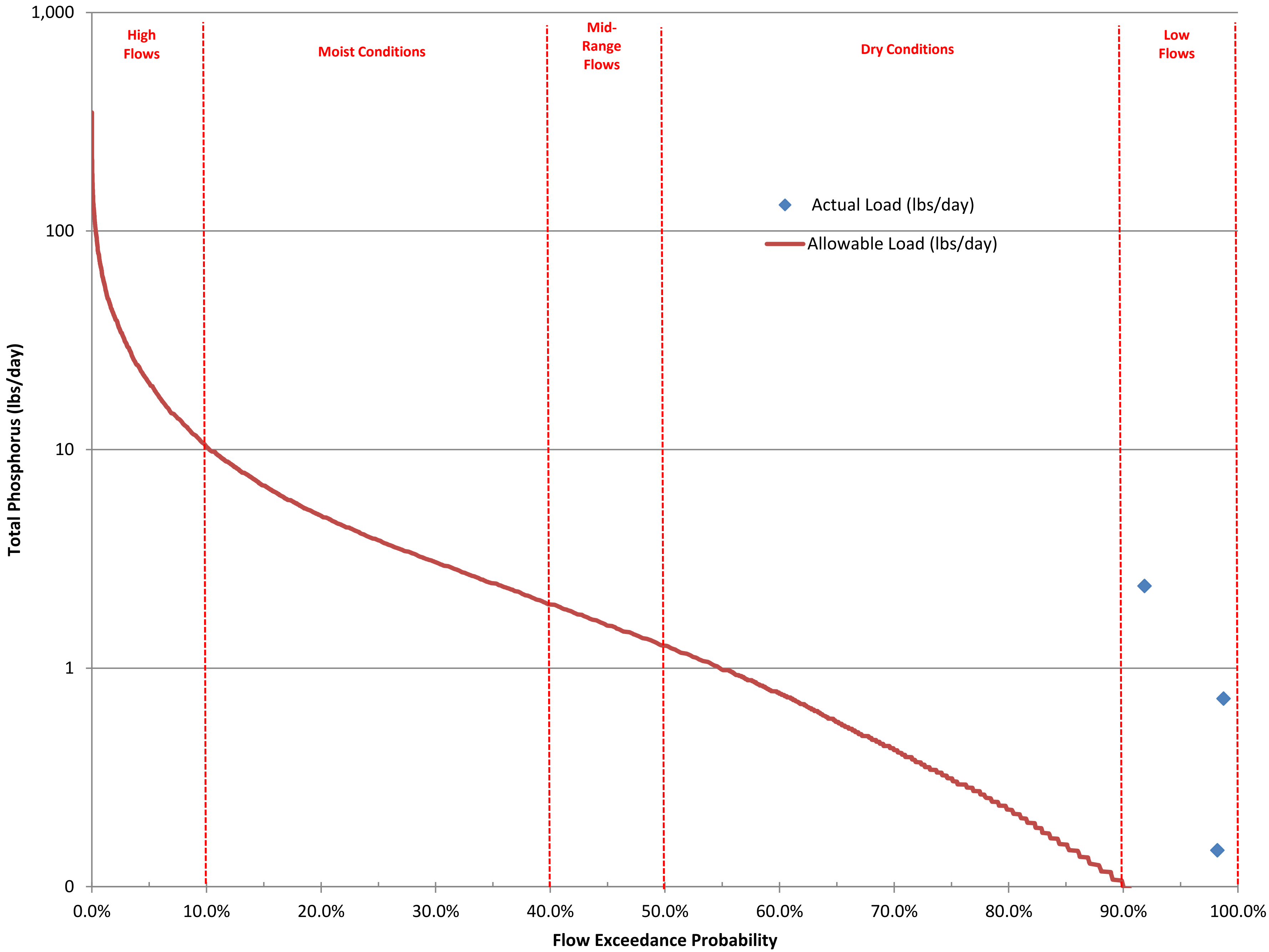


Figure 7-10
Prairie Creek (DGZN-01)
Total Phosphorus Load Duration Curve

CDM Smith

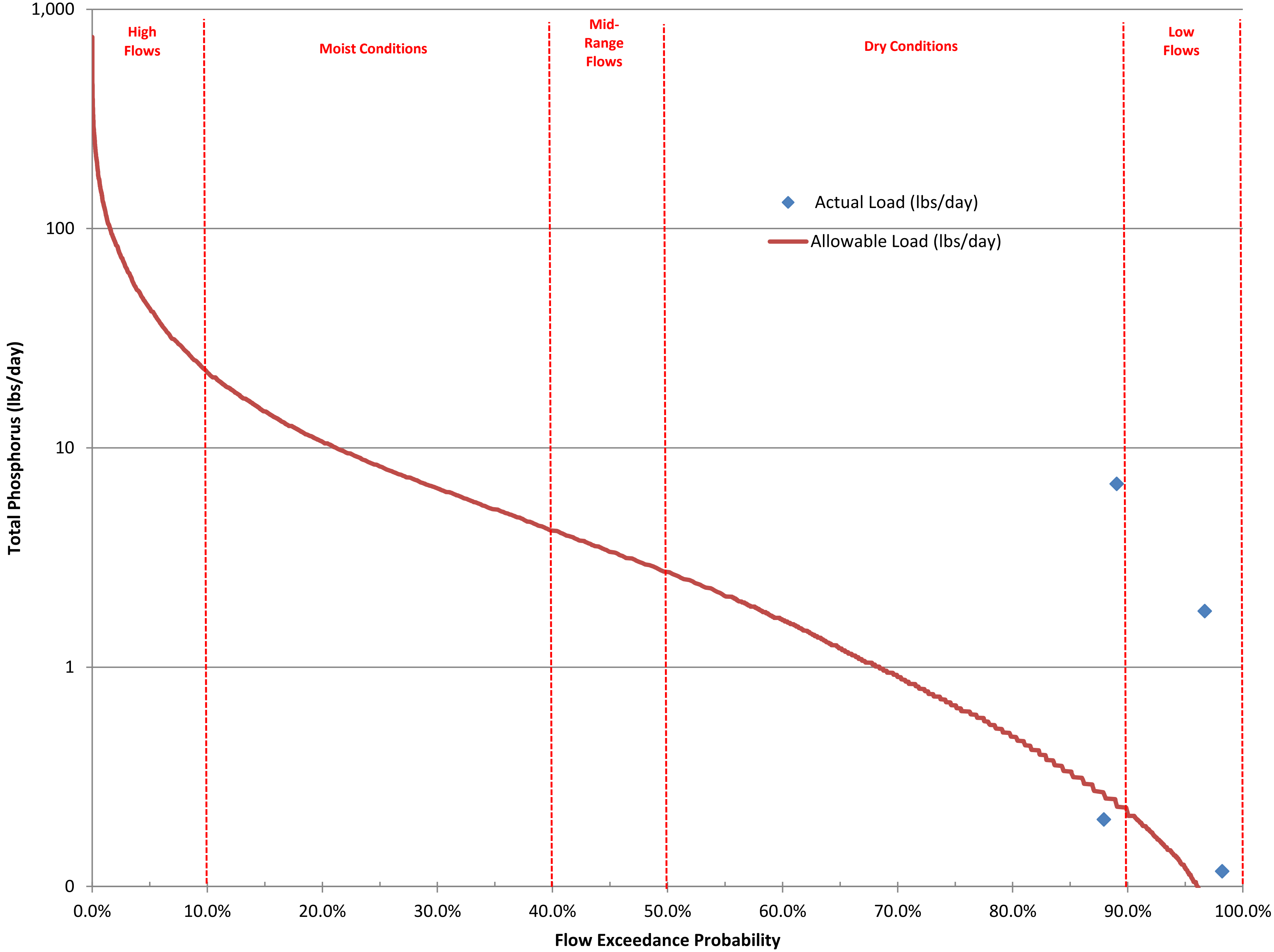


Figure 7-11
South Branch La Moine River (DGZR)
Total Phosphorus Load Duration Curve

CDM Smith

7.2.2.3 TSS and Sedimentation/Siltation LRS: Drowning Fork DGLC-01 and Prairie Creek DGZN-01

Load duration curves were developed for TSS and sedimentation/siltation impairments on Drowning Fork segment DGLC-01 and Prairie Creek segment DGZN-01. Numeric standards do not exist for TSS or sedimentation/siltation impairments in streams, so the watershed-specific LRS target value provided by Illinois EPA of 50.9 mg/L of TSS was used to develop the load duration curves for each of these impairments. TSS data for each reach obtained during Stage 1 of TMDL development were paired with the corresponding flows estimated for each reach for the sampling dates to estimate loads. The observed load estimates were then plotted against the load duration curves developed for TSS in each segment.

A total of 13 TSS samples were collected for Drowning Fork segment DGLC-01 and 10 TSS samples for Prairie Creek segment DGZN-01. Plotting the available sample data against the load duration curve shows that exceedances of the target value occurred during dry and low flow conditions for both impaired segments (**Figures 7-12, 7-13**). **Appendix F** contains spreadsheets used for the calculation of each of these load duration curves.

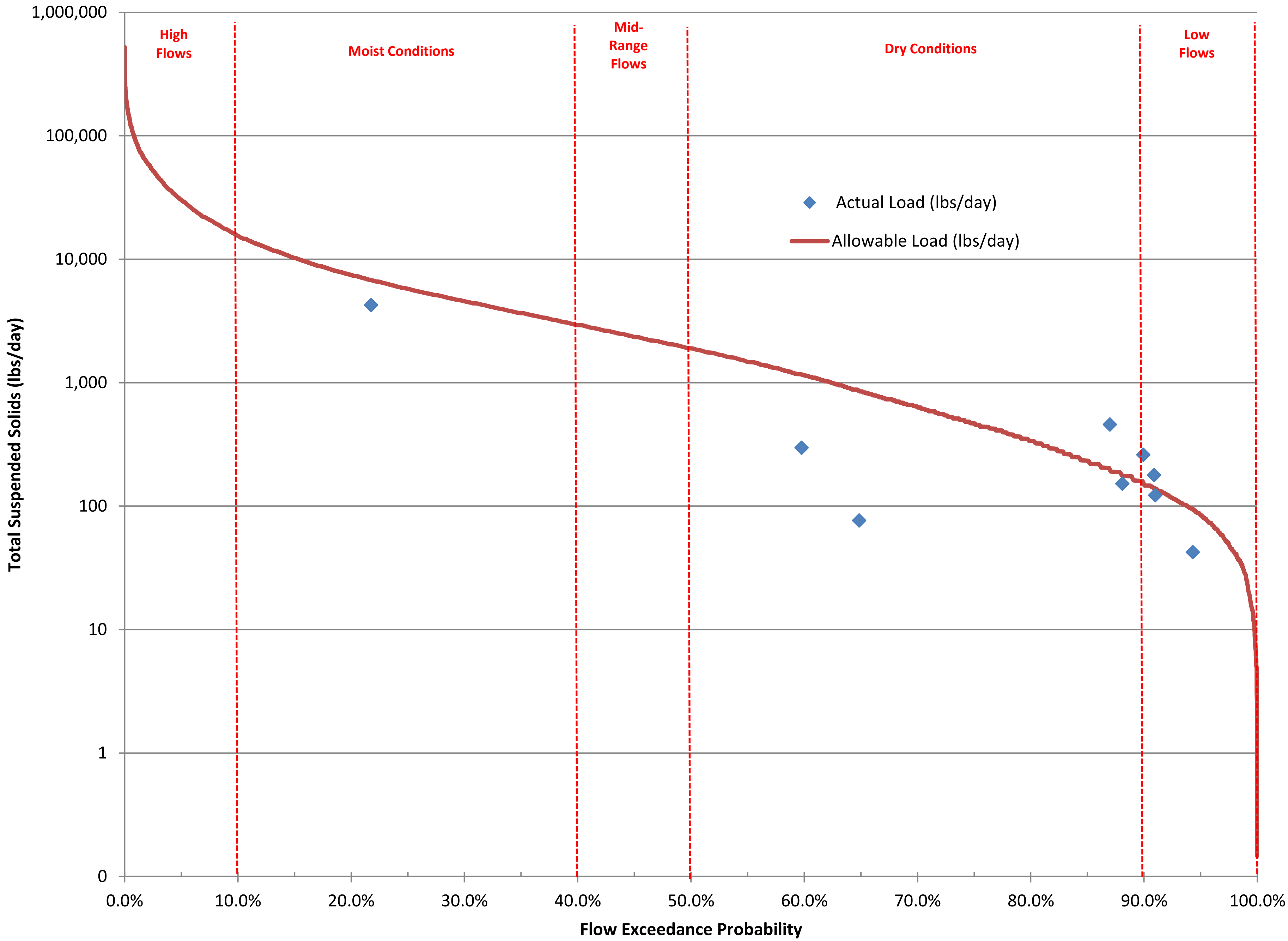


Figure 7-12
Drowning Fork (DGLC-01)
Total Suspended Solids Load Duration Curve

CDM Smith

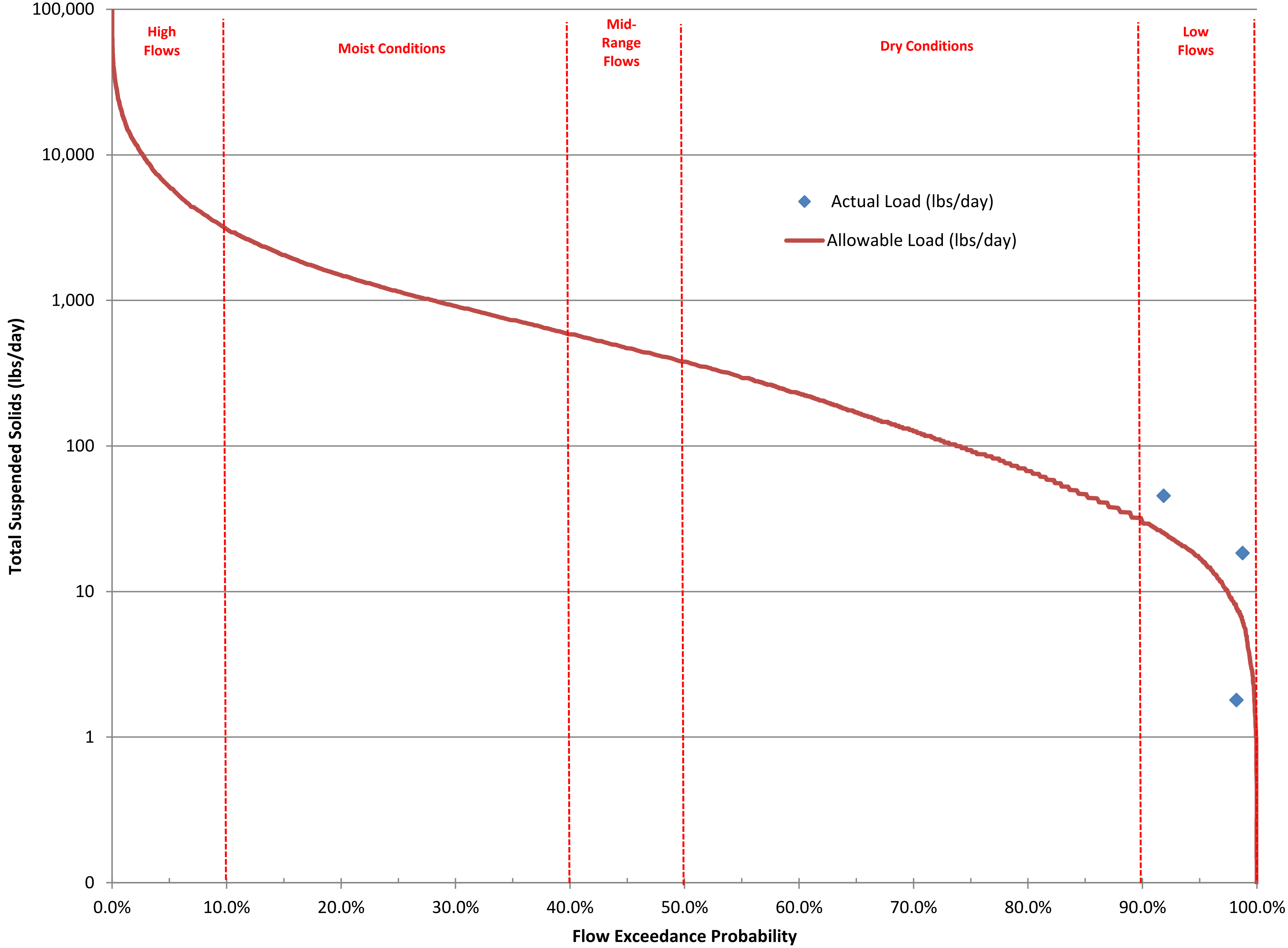


Figure 7-13
Prairie Creek (DGZN-01)
Total Suspended Solids Load Duration Curve

CDM Smith

7.2.2.4 Chloride LRS: Drowning Fork DGLC-01

A load duration curve for chloride in impaired segment DGLC-01 of Drowning Fork was generated by ranking the estimated daily flow data generated through the area ratio method, determining the percent of days these flows were exceeded, and then graphically plotting the results. The flows in the duration curve were then multiplied by the water quality standard of 500 mg/L (302.208(g)) for chloride to generate a load duration curve. Chloride data for the reach obtained during Stage 1 of TMDL development were paired with the corresponding estimated flows for the sampling dates to estimate total loading during various flow conditions. The observed load estimates were then plotted against the load duration curves developed for chloride in segment DGLC-01 of Drowning Fork.

A total of 13 chloride samples were collected for Drowning Fork segment DGLC-01. Plotting the available sample data against the load duration curve shows that exceedances of the target value occurred during dry and low flow conditions (**Figure 7-14**). **Appendix F** contains the spreadsheet used for the calculation of this load duration curve.

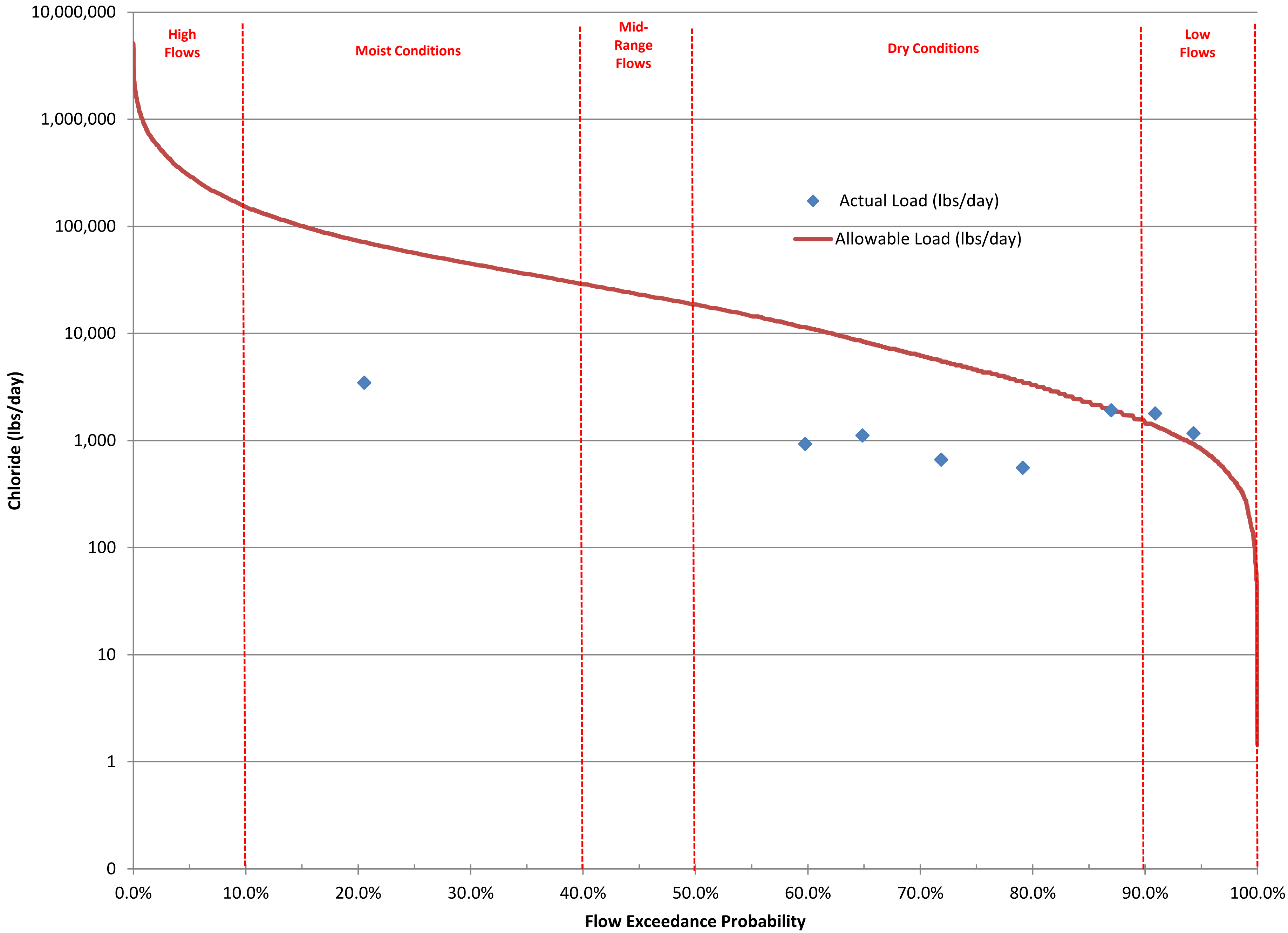


Figure 7-14
Drowning Fork (DGLC-01)
Chloride Load Duration Curve

CDM Smith

7.2.2.5 Ammonia LRS: South Branch La Moine River DGZR

Seasonal load duration curves for ammonia in impaired segment DGZR of South Branch La Moine River were generated by ranking the estimated daily flow data calculated through the area ratio method, determining the percent of days these flows were exceeded, and then graphically plotting the results. The flows in the duration curve were then multiplied by the most conservative calculated water quality standard (2.1 mg/L) for total ammonia to generate a load duration curve. The most conservative water quality standard was calculated following the formula provided in the Illinois Administrative Record, Water Quality Standards 302.212(a) using data from station DG-04. Data were grouped by season and resulting standards are shown in **Table 7-6**. Historical ammonia data for the South Branch La Moine River were paired with the corresponding flows estimated for each reach for the sampling dates to estimate loads. The observed load estimates were then plotted against the load duration curves developed for ammonia on segment DGZR of the South Branch La Moine River.

A total of 5 ammonia samples were assessed for South Branch La Moine River segment DGZR. Plotting the available sample data against the load duration curve shows that exceedances of the target value occurred during dry and low flow conditions (**Figures 7-15**). While the load duration curve presents all data along the curve generated using the most conservative water quality standard, the TMDL presented in Section 8 was developed using the applicable calculated seasonal water quality standard as presented below. **Appendix F** contains the spreadsheet used for the calculation of this load duration curve and contains the seasonal information used for TMDL development.

Table 7-6 Seasonal Ammonia Standards Calculated for TMDL Development

pH and temperature values used in calculation				Total ammonia (as N) water quality standard (mg/L)			
	pH		Temp (°C)		Chronic		Acute
	50th %ile	75th %ile	75th %ile		50th %ile	75th %ile	75th %ile
Spring/Fall	7.80	7.90	18.6	Spring/Fall	2.5	2.2	10.1
Summer	7.66	7.73	22.2	Summer	2.3	2.1	13.7
Winter	7.90	8.10	3.2	Winter	4.5	3.4	6.9

Spring/Fall consists of March - May, September - October.
Summer consists of June - August.
Winter consists of November - February.

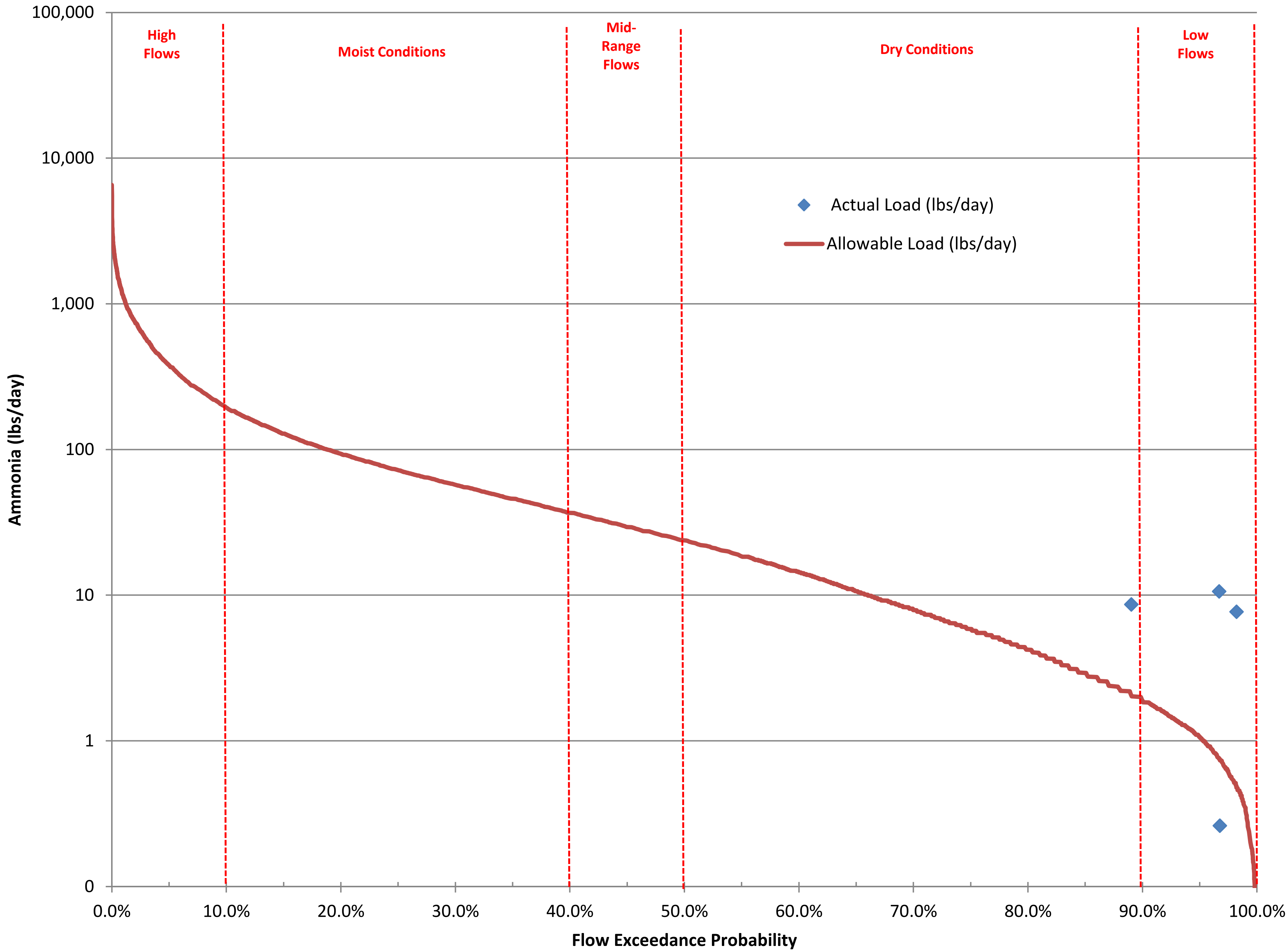


Figure 7-15
South Branch La Moine River (DGZR)
Ammonia Load Duration Curve

CDM Smith

7.2.3 SLAM Development for Lake Impairments Caused by Total Phosphorus

Historically, the U.S. Army Corps of Engineers (USACE) BATHTUB model (Walker 1996) has been the primary model used for assessment of nutrient (total phosphorus, ammonia) and nutrient-related impairments (chlorophyll a, pH, DO) in lakes. However, the BATHTUB model may not be the most efficient approach to developing this type of TMDL as it does not provide explicit modeling of the major lake and sediment interactions that are important drivers of nutrient issues in Carthage Lake. The BATHTUB model also relies on a dated platform that is less user friendly than other options and is primarily setup to model nutrient fate and transport on an annual basis. Modeling on an annual basis can lead to additional error and uncertainty when calibrating than one may typically see in models focusing on daily or even monthly time-steps.

As an alternative to BATHTUB, CDM Smith's SLAM was used to develop the TMDL for total phosphorus impairment in Carthage Lake. The SLAM relies on the following primary inputs:

- Model segmentation: number of geographically distinct segments of a reservoir to be modeled, flow direction, and an estimate of longitudinal dispersion between segments
- Lake morphology and hydraulics: surface area, average and maximum depth, volume, inflows, mixing lengths, thermal stratification
- Watershed inflows: estimated runoff and point source discharges into the reservoir's watershed, average annual phosphorus load to each segment as a function of land use using runoff coefficients and point source data
- In-lake nutrients: initial nutrient concentrations in the lake; estimates of settling velocity nutrient uptake; and burial fractions. Seasonality factors may be included to account for expected variations in settling velocity and nutrient uptake over time.
- Sediment layer dynamics: sediment characteristics used for calculating nutrient fluxes, or seasonally prescribed nutrient fluxes can be used.

The individual values input into each of the above portions of the model interface are described in the following sections along with watershed information for the impaired lake.

Up to five distinct lake segments or model zones can be defined in SLAM. Each zone is treated as a well-mixed module within the model and zones are connected via advection and/or diffusion. Concentration outputs are generated for each zone. Lake hydraulic parameter inputs are required for each zone. In addition to defining the number of lake segments, or zones, to be modeled, the model segmentation screen is used to specify the lateral or longitudinal diffusion coefficient used to provide an estimate of mixing between zones. A recommended range of longitudinal dispersion coefficients for mixing between zones is 1,000 – 1,000,000 square feet per day, based on literature values. Model segmentation, or zones, are discussed for each model in the following sections.

7.2.3.1 SLAM Development for Carthage Lake

The TMDL target for total phosphorus in Carthage Lake is 0.05 mg/L.

7.2.3.1.1 Model Segmentation

Given the available data and relatively small size of Carthage Lake, only one model zone was defined for this waterbody in SLAM. The sampling locations and watershed boundary are shown on **Figure 7-16.**

7.2.3.1.2 Lake Hydraulics

Lake hydraulics are defined in SLAM via either internal calculation or user prescription. Data needs for internal calculations of lake hydraulics are somewhat greater as the model performs dynamic water balance calculations of lake volumes at each time-step based on user-defined or calculated inflows, outflows, and evaporative losses. Corresponding lake depths, surface areas, and releases are calculated as a function of user-defined bathymetry tables. For the prescribed hydraulics option, users specify monthly-variable lake volumes, areas, and depths. Hydraulics are assumed static within a month and lake outflows are set equal to total lake inflows at each time-step. Evaporative losses are not explicitly included in the calculations but rather should be implicitly reflected in the prescribed volumes.

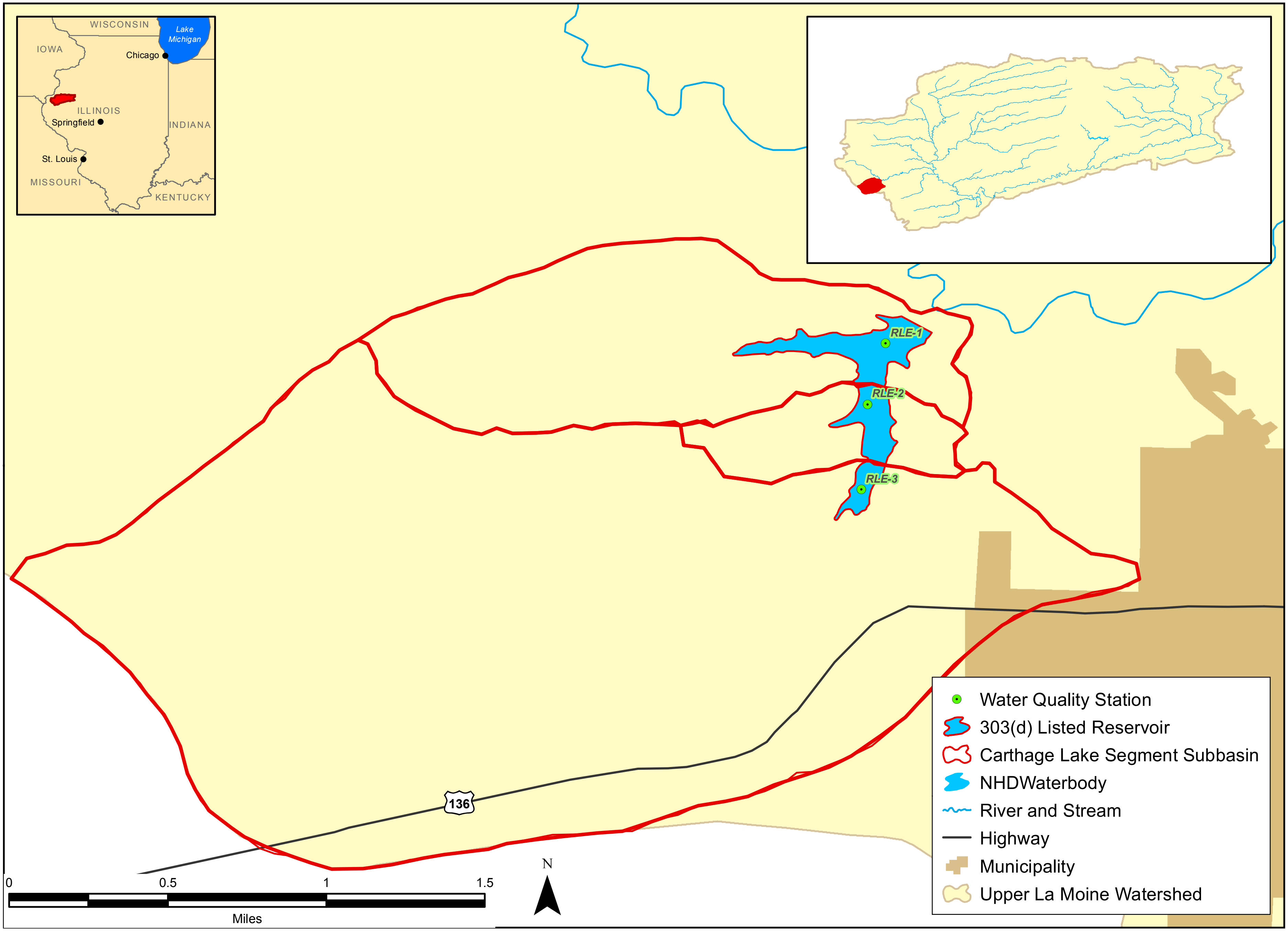
Due to data availability and the limited fluctuation of water levels Carthage Lake in a typical year, prescribed lake hydraulics were used in this model setup, and included total lake volumes by month. The surface area and volume estimates were derived using GIS and available total depth data for each sampling station. These values were input into the model as static measures without seasonal variation as there is little evidence of significant and consistent water surface elevation fluctuation over the course of a year in Carthage Lake. Surface areas were verified using GIS. A summary of these inputs is shown below in **Table 7-7**.

Table 7-7 Carthage Lake (RLE) Lake Hydraulics Data

Segment	Downstream Zone Within Model	Surface Area (acres)	Surface Area (% of total)	Volume (acre-ft)	Average Depth (ft)	Segment Mixing Length (ft)	Interface Width (ft)
RLE	1	43	100%	609	13	n/a	n/a

7.2.3.1.3 Watershed Parameters

Watershed parameters input into SLAM are associated with flows and pollutant loads entering the lake from the watershed. Watershed sources simulated in the model include storm runoff events, dry weather baseflow, and, if applicable, supplemental water. Flows and loads can either be internally calculated or prescribed by the user. Internally calculated flows and loads are calculated in the model as a combination of wet weather runoff and dry weather baseflow. Runoff is calculated as a function of user defined daily precipitation, runoff coefficients, and total drainage area. Alternatively, monthly flows and nutrient loads entering the lake from the watershed can be prescribed by the user as a daily time-series. For lake models with multiple zones, zone distribution percentages must be specified by the user. These percentages define how much of the total lake nutrient load (calculated or prescribed) enters the lake at a given zone. Estimates of the particulate fractions associated with prescribed total phosphorus concentrations are also required inputs into the model and are derived from site specific total and dissolved phosphorus data, as available.



Upper La Moine River
SLAM Model Segmentation for Carthage Lake

FIGURE 7-16

Watershed inputs to SLAM for the Carthage Lake model were developed using prescribed flows and loads. Daily flows into the reservoir were estimated using available gage data from USGS gage 05584500 La Moine River at Colmar, IL using the watershed area ratio method as described in **Section 2.6.3**.

Phosphorus loads from the contributing watershed were estimated based on land use data and the median annual export coefficients for each land use. Export coefficients for each land use category found in the Carthage Lake watershed were extracted from the USEPA's PLOAD version 3.0 user's manual. The export coefficients for each land use were multiplied by the number of acres of each land use type in the lake's subbasin to provide a median annual phosphorus load into the lake (**Appendix A**). The total phosphorus load from runoff into Carthage Lake is estimated to be approximately 1,526 lbs/year based on flow and land use characteristics. The annual total phosphorus load from overland runoff was then scaled to the daily flow estimates to estimate the daily phosphorus load into the reservoir as a function of flow. The subbasin area and estimated phosphorus load as a function of land use characteristics is provided in **Table 7-8.**

Table 7-8 Carthage Lake (RLE) Subbasin Areas and Phosphorus Loads

Lake Segment	Subbasin Area (acres)	Annual External Phosphorus Load (lbs/yr)
RLE	2,085	1,526

The inclusion of point source phosphorus loads into the SLAM model was not applicable as there are no NPDES permitted discharges located in the Carthage Lake watershed.

7.2.3.1.4 Lake Nutrient Parameters

Lake nutrient parameters support the simulation of lake water column nutrient dynamics and include nutrient uptake kinetic and settling rates and lake water quality initial conditions. Uptake kinetics are defined by first order rate constants, applied to dissolved nutrients only. These rate constants represent the transformation of dissolved nutrient into organic particulate fraction via phytoplankton uptake.

Uptake kinetics and settling rates can be specified as steady annual rates or as monthly-variable rates. Seasonality in rates might represent, for example, changes in phytoplankton uptake with growing season or differences between particulate nutrient composition in summer (phytoplankton-based organic nutrients) vs. winter (sediment-bound runoff load). Due to limited availability of site specific data, the nutrient uptake and settling rates were set to model-default values derived from literature for the SLAM developed for Carthage Lake. The initial lake water quality condition was entered into the model as the average total phosphorus concentration for all available data collected from Carthage Lake (0.16 mg/L).

7.2.3.1.5 Sediment Layer Parameters

SLAM allows for user inputs of monthly sediment nutrient fluxes, quantifying the movement of phosphorus from the shallow sediments to the water column or vice versa. Areal flux rates ($mg/m^2/day$) can be entered as positive values for fluxes from sediments to the water column and negative values for exchanges in the opposite direction. Due to lack of site-specific sediment flux data, sediment nutrient flux rates were initially set to zero during the development of the

SLAM for Carthage Lake. These rates were later adjusted during model calibration to reflect seasonal lake stratification and mixing on a monthly average basis.

7.2.3.1.6 SLAM Confirmatory Analysis

Historical water quality data for Carthage Lake were used to help calibrate the model and confirm model calculations. Although the analyses presented below do lend confidence to the modeling, additional lake and tributary water quality data, site-specific sediment characterization, and more precise land use and flow data could potentially contribute to a more thorough calibration of the model.

The Carthage Lake SLAM was initially simulated assuming default phosphorus kinetic parameters (assimilation and decay) and no internal phosphorus loading. When using these loadings, the SLAM consistently under-predicted the concentrations when compared to actual water quality data, as in-lake loads from sediment resuspension and cycling are not accounted for. To achieve a better match with actual water quality data, the internal loading rates were increased. Internal loading rates reflect nutrient recycling and resuspension from bottom sediments. Because much of the lake is relatively shallow and has relatively high concentrations of suspended sediment; wind, precipitation, and waterbody uses likely result in increased resuspension of sediment year-round. As can be seen in **Table 7-9**, a reasonably good match between observed and predicted in-lake phosphorus values was achieved, lending significant support to the predictive ability of this simple model. A printout of the SLAM files is provided in **Appendix G** of this report.

Table 7-9 Summary of Model Confirmatory Analysis – Carthage Lake Annual Total Phosphorus Concentrations (mg/L) During Model Calibration Period

Segment/Station	Observed Concentration (mg/L)	Predicted Concentration (mg/L)	Percent Difference (%)
RLE	0.095	0.096	1.6%

7.2.4 LRS Development for TSS in Carthage Lake

Spreadsheet calculations were performed for Carthage Lake to determine the reduction in TSS loading required to meet the watershed-specific LRS target value established by Illinois EPA of 50.9 mg/L. Spreadsheet inputs included the target value, watershed flow estimates based on watershed areas and surrogate gage calculations similar to those developed as part of the SLAM, the relative proportion of the lake watershed made up by each subbasin, and measured in-lake TSS concentrations to calculate the current daily load of TSS into the lake (lbs/day), the target load (lbs/day), and the percent reduction needed in order to meet the LRS target. WLAs are not calculated for impairments associated with narrative water quality standards for which this LRS was developed.

Section 8

Total Maximum Daily Loads for the Upper La Moine Watershed

8.1 TMDL Endpoints for the Upper La Moine Watershed

The TMDL endpoints and LRS target values for impairments in the Upper La Moine watershed are summarized in **Table 8-1**. For all parameters, except dissolved oxygen, the concentrations must be less than the TMDL endpoint or LRS target value. The endpoints for dissolved oxygen vary seasonally while all other endpoints are consistent throughout the year. All of these endpoints, except for total phosphorus in lakes, are based on protection of aquatic life in the impaired segments in the Upper La Moine watershed. The endpoint for total phosphorus in lakes is based on protection of the aesthetic quality designated use.

Parameters with numeric water quality standards are assessed via the TMDL process and the TMDL endpoints directly correlate to the lowest applicable water quality standard established for a given parameter. Parameters without numeric water quality standards were assigned a watershed specific LRS target value by Illinois EPA. These target values are voluntary measures and are intended to serve as planning tools for overall water quality improvement strategies in the watershed.

Table 8-1 TMDL Endpoints for Impaired Constituents in the Upper La Moine Watershed

Segment Name/ID	Potential Cause of Impairment	Designated Uses	Assessment Type	TMDL/Modeling Endpoint or LRS Target Value
Drowning Fork Creek (DGLC-01)	**Chloride**	Aquatic Life	**TMDL**	500 mg/L
	Total Phosphorus	Aquatic Life	*LRS*	0.17 mg/L
	Sedimentation/Siltation	Aquatic Life	*LRS*	39.1 mg/L of NVSS
	Total Suspended Solids (TSS)	Aquatic Life	*LRS*	50.9 mg/L
Rock Creek (DGO-01)	**Dissolved Oxygen**	Aquatic Life	**TMDL**[1]	5.0 mg/L minimum (Mar-Jul) 3.5 mg/L minimum (Aug-Feb)
La Harpe Creek (DGP)	**Dissolved Oxygen**	Aquatic Life	**TMDL**[1] - Included in DGP-01 TMDL	5.0 mg/L minimum (Mar-Jul) 3.5 mg/L minimum (Aug-Feb)
	Manganese	Aquatic Life	No TMDL developed – New Standard[2]	3,268 µg/L[3]
La Harpe Creek (DGP-01)	**Dissolved Oxygen**	Aquatic Life	**TMDL**[1] **-** includes DGP	5.0 mg/L minimum (Mar-Jul) 3.5 mg/L minimum (Aug-Feb)

Segment Name/ID	Potential Cause of Impairment	Designated Uses	Assessment Type	TMDL/Modeling Endpoint or LRS Target Value
	Manganese	Aquatic Life	No TMDL developed – delisting recommended	3,268 µg/L[3]
Baptist Creek (DGPC-01)	**Manganese**	Aquatic Life	No TMDL developed – delisting recommended	3,733 µg/L[3]
Prairie Creek (DGZN-01)	**Dissolved Oxygen**	Aquatic Life	**TMDL**[2]	5.0 mg/L minimum (Mar-Jul) 3.5 mg/L minimum (Aug-Feb)
	Total Phosphorus	Aquatic Life	*LRS*	0.17 mg/L
	Total Suspended Solids	Aquatic Life	*LRS*	50.9 mg/L
South Branch La Moine River (DGZR)	**Ammonia (Total)**	Aquatic Life	**TMDL**	2.1 mg/L[3] (Summer) 2.2 mg/L[4] (Spring) 4.5 mg/L[4] (Winter)
	Dissolved Oxygen	Aquatic Life	**TMDL**[2]	5.0 mg/L minimum (Mar-Jul) 3.5 mg/L minimum (Aug-Feb)
	Manganese	Aquatic Life	No TMDL developed – delisting recommended	
	Total Phosphorus	Aquatic Life	*LRS*	0.17 mg/L
Carthage Lake (RLE)	**Total Phosphorus**	Aesthetic Quality	**TMDL**	0.05 mg/L
	Total Suspended Solids	Aesthetic Quality	*LRS*	50.9 mg/L

[1] TMDL developed for primary contributing factors to low DO impairment as identified by QUAL2K modeling
[2] The 303(d) listing was based on previous data from the 1980's FRSS, the Manganese WQS has been changed since then, and a TMDL is not being developed
[3] Minimum chronic value
[4] Minimum seasonal chronic standards

8.2 Pollutant Sources and Linkages

Potential pollutant sources for impaired lakes and streams in the Upper La Moine watershed include both point and nonpoint sources as described in Section 5 of this report. The sources identified for each parameter of concern, based on data gathered and documented during Stage 1 and modeling completed in Stage 3, are presented in **Table 8-2**.

Table 8-2 Sources of Pollutants in the Upper La Moine Watershed

Segment ID	Segment Name	Causes of Impairment	Sources of Pollutants in the Upper La Moine Watershed
DGLC-01	Drowning Fork	Chloride	Source Unknown (see further discussion below)
		Total Phosphorus	Crop production (crop land or dry land), Municipal point source discharges
		Sedimentation/Siltation	Crop production (crop land or dry land)
		Total Suspended Solids (TSS)	Crop production (crop land or dry land), Municipal point source discharges
DGO-01	Rock Creek	Dissolved Oxygen	Crop production (crop land or dry land)
DGP	La Harpe Creek	Dissolved Oxygen	Crop production (crop land or dry land)
		Manganese	Naturally occurring
DGP-01	La Harpe Creek	Dissolved Oxygen	Crop production (crop land or dry land)
		Manganese	Naturally occurring
DGPC-01	Baptist Creek	Manganese	Naturally occurring
DGZN-01	Prairie Creek	Dissolved Oxygen	Crop production (crop land or dry land), Municipal point source discharges
		Total Phosphorus	Crop production (crop land or dry land), Municipal point source discharges
		Total Suspended Solids (TSS)	Crop production (crop land or dry land)
DGZR	South Branch La Moine River	Ammonia (Total)	Municipal point source discharges
		Dissolved Oxygen	Crop production (crop land or dry land), Municipal point source discharges
		Manganese	Naturally occurring
		Total Phosphorus	Crop production (crop land or dry land), Municipal point source discharges
RLE	Carthage Lake	Total Phosphorus	Agriculture, Internal nutrient recycling, Crop production (crop land or dry land), Golf courses, Other recreational pollution sources, Runoff from forest/grassland/parkland
		Total Suspended Solids (TSS)	Crop production (crop land or dry land), Impacts from hydrostructure flow regulation/modification, Littoral/shore area modifications (non-riverine), Other recreational pollution sources, Runoff from forest/grassland/parkland, Site clearance (land development or redevelopment)

Load duration curves were developed for the chloride and ammonia TMDLs, as well as for the total phosphorus, TSS, and sedimentation/siltation LRSs in stream segments. Load duration curves are useful in that they provide a link between historical sampling values and hydraulic condition. **Table 8-3** shows the example source area/hydrologic condition consideration developed by USEPA. Other pollutant sources and their linkages to Carthage Lake were established through the SLAM modeling as discussed in Section 7. Pollutant sources and linkages for stream segments impaired by low DO (Rock Creek, La Harpe Creek, Prairie Creek, and South Branch La Moine River) were established through the QUAL2K modeling effort.

Table 8-3 Example Source Area/Hydrologic Condition Considerations (EPA 2007)

Contributing Source Area	Duration Curve Zone				
	High Flow	**Moist**	**Mid-Range**	**Dry**	**Low Flow**
Point Source				M	H
Onsite Wastewater System			H	M	
Riparian Areas		H	H	H	
Stormwater: Impervious Areas		H	H	H	
Combined sewer overflows	H	H	H		
Stormwater: Upland	H	H	M		
Bank Erosion	H	M			

Note: potential relative importance of source area to contribute loads under given hydrologic conditions (H: High, M: Medium)

Sources of Chloride

Elevated levels of chloride were recorded during sampling in 2007. The current permit for the Bushnell West STP includes a limit for residual chlorine and the facility is not thought to be a current contributor to impairment however, future monitoring of effluent from the facility can confirm the loading associated with this source.

A nonpoint source of chloride is road, driveway, parking area, and sidewalk de-icing activities using chloride salts. These activities also result in the largely seasonal nature of chloride exceedances in the watershed. Other potential sources of chloride include naturally occurring elevated levels in area soils, fertilizer application to agricultural fields, septic systems, and dust suppressant used on rural roads.

Sources of Suspended Sediment

Point sources potentially contributing to TSS and sedimentation/siltation impairments in the watershed include STPs and other NPDES permitted facilities, most of which currently have discharge monitoring requirements for TSS. Note that both TSS and sedimentation/siltation impairments are based on narrative (i.e. non-numeric) standards and are addressed through the LRS process.

Non-point and stormwater-related inputs of sediments into the impacted waterbodies in the watershed include runoff from agricultural, undeveloped, and park lands; runoff from temporarily disturbed areas during construction processes; and stream bank erosion during high flow conditions. Pollutant sources for TSS in lakes are assumed to be similar to those identified for impaired stream segments.

8.3 TMDL Allocation

As explained in Section 1 of this report, the TMDLs for impaired segments in the Upper La Moine watershed will address the following equation:

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

where: LC = Loading capacity - the maximum amount of pollutant loading a water body can receive without violating water quality standards

WLA	=	Waste load allocation - the portion of the TMDL allocated to existing or future point sources
LA	=	Load allocation – the portion of the TMDL allocated to existing or future nonpoint sources and natural background
MOS	=	Margin of safety - an accounting of uncertainty about the relationship between pollutant loads and receiving water quality
RC	=	Reserve capacity – the portion of the load explicitly set aside for future population growth and additional development in the watershed

Each of these elements will be discussed in this section as well as consideration of seasonal variation in the TMDL calculation.

8.3.1 Chloride TMDL

Drowning Fork segment DGLC-01 in the Upper La Moine watershed is listed for impairment of the aquatic life use caused by chloride. A load duration curve was developed (see Section 7) to determine load reductions needed to meet the instream water quality standards under varying flow scenarios.

8.3.1.1 Loading Capacity

The LC is the maximum amount of chloride that Drowning Fork segment DGLC-01 can receive and still maintain compliance with the water quality standards. The allowable chloride loads that can be generated in the watershed and still maintain the standard of 500 mg/L were determined with the methodology discussed in Section 7. The chloride loading capacity according to flow is presented in **Table 8-4**.

Table 8-4 Chloride Loading Capacity in the Upper La Moine Watershed

Estimated Mean Daily Flow (cfs)	Load Capacity (lbs/day)
1	2,695
5	13,476
10	26,953
50	134,765
100	269,530
500	1,347,650
1,000	2,695,300
5,000	13,476,500
10,000	26,953,000
15,000	40,429,500

8.3.1.2 Seasonal Variation

Consideration of seasonality is inherent in the load duration analysis. The total chloride water quality standard is not seasonal, and the full range of expected flows are represented in the LC table; therefore, the LC represents conditions throughout the year.

8.3.1.3 Waste Load Allocation

There is one NPDES permitted discharger within the modeled portion of the Drowning Fork segment DGLC-01 watershed upstream of the DGLC-01 sampling location. This treatment facility does not currently have a permit limit for chloride or monitoring requirements for chloride. As a conservative measure, the instream standard of 500 mg/L for chloride was used in calculations of the facility's WLA, along with the facility's DAF or DMF (**Table 8-5**). Note that the facility has a permit limit of 0.05 mg/L for residual chlorine.

Table 8-5 WLAs for NPDES Permitted Municipal Treatment Facility in the Drowning Fork DGLC-01 Watershed

Facility	NPDES Permit Number	Design Average Flow (MGD)	WLA-DAF (lbs/Day)	Design Maximum Flow (MGD)	WLA-DMF (lbs/Day)
BUSHNELL WEST STP	IL0024384	0.25	1,043	0.625	2,606

8.3.1.4 Margin of Safety

The MOS can be implicit (incorporated into the TMDL analysis through conservative assumptions), or explicit (expressed in the TMDL as a portion of the loadings), or a combination of both. An explicit MOS for the total chloride TMDL of 10% was included to account for some of the limited site-specific data available within the watershed. Uncertainty in the calculations is associated with the estimated flows in the assessed segments, which were based on extrapolating flows from a surrogate USGS gauge.

8.3.1.5 Reserve Capacity

No RC was included in the TMDL. Large future growth is not anticipated in the area, however, because the WLA is set at the water quality standard, a future TMDL modification would be easily calculated.

8.3.1.6 Load Allocation and TMDL Summary

Table 8-6 shows a summary of the chloride TMDL for Drowning Fork segment DGLC-01. The WLA was calculated using the average design flow for the NPDES facility and the 500 mg/L water quality standard. Under low flow conditions, the calculated WLA is greater than the calculated LC, which is a product of the disproportionally high discharge flows associated with using design flows under such low flow conditions. In order to reconcile this and provide more accurate load allocation numbers, the WLA was set equal to the LC for this low flow category. Note that at times of low flow, nonpoint sources should be minimal.

Table 8-6 Chloride TMDL for Drowning Fork DGLC-01

Zone	Flow Exceedance Range (%)	LC (lbs/day)	LA (lbs/day)	WLA (lbs/day)	MOS	Actual Load[1] (lbs/day)	Percent Reduction Needed (%)
High	0 - 10	296,687	265,976	1,043	29,669	--	--
Moist	10 - 20	100,816	89,692	1,043	10,082	--	--
	20 - 30	56,457	49,769	1,043	5,646	3,457	0%
	30 - 40	36,006	31,363	1,043	3,601	--	--
Mid-Range	40 - 50	23,044	19,697	1,043	2,304	--	--
Dry	50 - 60	14,402	11,920	1,043	1,440	929	0%
	60 - 70	8,209	6,346	1,043	821	1,116	0%
	70 - 80	4,465	2,976	1,043	446	653	0%
	80 - 90	2,232	967	1,043	223	1,917	0%
Low Flow	90 - 100	835	*	752	84	1,725	52%

[1]Actual Load was calculated using the 90th percentile of observed concentrations in a given flow range (EPA 2007).
*Nonpoint source/watershed contributions during very low flows/dry conditions will be near zero

CDM Smith

8.3.2 Manganese TMDL

La Harpe Creek, Baptist Creek, and South Branch La Moine River are all listed for impairment caused by manganese. However, La Harpe Creek, South Branch La Moine River and Baptist Creek segments were assessed as impaired due to elevated manganese concentrations based on a previous water quality standard for total manganese. Prior to 2012, the applicable water quality standard for manganese to protect aquatic life uses in Illinois was 1.0 mg/L of total manganese. This standard has since been replaced by the current hardness-dependent standards developed for the dissolved fraction of manganese in water. The lack of reported exceedances for segments La Harpe Creek DGP-01, South Branch La Moine River (DGZR) and Baptist Creek DGPC-01 suggests that removal of these impairments from the Illinois 303(d) list may be warranted. No further assessments of manganese levels in segment DGP-01 or DGPC-01 were conducted due to this recommendation.

8.3.3 Ammonia TMDL

South Branch La Moine River segment DGZR in the Upper La Moine watershed is listed for impairment of the aquatic life use caused by ammonia. Seasonal load duration curves were developed to determine load reductions needed to meet the instream water quality standard under varying flow scenarios.

8.3.3.1 Loading Capacity

The LC is the maximum amount of ammonia that South Branch La Moine River segment DGZR can receive and still maintain compliance with the water quality standards. The allowable ammonia loads that can be generated in the watershed and still maintain the standard, which is based on water pH and temperature, were determined with the methodology discussed in Section 7. The seasonal ammonia loading capacity for each flow category is presented in **Table 8-7**. The minimum calculated seasonal chronic ammonia water quality standard was used in developing each seasonal load duration curve for the impaired segment.

Table 8-7 Ammonia Loading Capacity for South Branch La Moine River segment DGZR

Zone	Flow Exceedence Range (%)	Median Flow (cfs)	Target Loading Capacity (lbs/day)	Median Flow (cfs)	Target Loading Capacity (lbs/day)	Median Flow (cfs)	Target Loading Capacity (lbs/day)	Median Flow (cfs)	Target Loading Capacity (lbs/day)
		Summer		Spring/Fall		Winter		Annual*	
High	0 - 10	50	563	53	633	34	833	47	534
Moist	10 - 20	15	169	20	237	12	285	16	181
	20 - 30	8	86	11	136	7	167	9	102
	30 - 40	5	52	8	90	4	106	6	65
Mid-Range	40 - 50	3	33	5	62	3	71	4	41
Dry**	50 - 60	2	22	3	39	2	44	2	26
	60 - 70	1	14	2	22	1	27	1	15
	70 - 80	1	9	1	9	1	16	0.7	8
	80 – 90**	0.4	4.8	0.4	4.5	0.4	9	0.4	4.3
Low Flow**	90 – 100**	0.4	4.3	0.4	4.5	0.4	9	0.4	4.3

Summer consists of June – August. Spring/Fall consists of March - May, September – October. Winter consists of November – February
*Annual Loading Capacity uses the lowest chronic water quality standard of 2.1 mg/L
**Low flows are effluent-dominated and the DAF of the upstream discharger (La Harpe Sewage Treatment Plant ILG580093) was used for these flow ranges

8.3.3.2 Seasonal Variation

Consideration of seasonality is inherent in the load duration analysis. The total ammonia water quality standard varies with instream pH and temperature. The chronic water quality standard was used along with the full range of expected flows by season to provide seasonal curves. Additionally, the WLA is presented with seasonal values to account for the varying pH, temperatures, and resulting water quality standard in stream.

8.3.3.3 Waste Load Allocation

There are two NPDES permitted dischargers within the modeled portion of the South Branch La Moine River segment DGZR watershed; the La Harpe Sewage Treatment Plant (STP) and Water Treatment Plant (WTP). The WTP was not assigned a WLA as it is not expected to contribute ammonia to the receiving water. The Illinois EPA Bureau of Water's (BOW) Permit Section was consulted to determine a WLA for the La Harpe STP. La Harpe STP permit information provided by the Permit Section is available in **Appendix E**. **Table 8-8** shows the WLA based on the design average flow listed in the 2014 general permit (0.245 mgd) and the seasonal chronic instream water quality standards calculated using pH and temperature data from site DG-04 downstream of the outfall location. The general NPDES permit may be renewed in the near future, and the Permit Section may consider replacing the general permit with an individual permit due to the TMDL status of the receiving water. Note that the chronic water quality standard would be used to calculate the 30-day average permit limit while the acute water quality standard would be used to calculate the daily maximum permit limit.

Table 8-8 WLA for La Harpe STP

Facility	NPDES Permit Number	Design Average Flow (MGD)	Season	Chronic Water Quality Based Effluent Limit* Monthly Average\Daily Maximum (mg/L)	WLA DAF/DMF (lbs/day)
La Harpe STP	ILG580093	0.245	Spring/Fall	2.2	4.4
			Summer	2.1	4.3
			Winter	4.0**	8.2

*Chronic Water Quality Based Effluent Limit is used for calculation of 30-day average permit limits and was calculated using the 75th percentile values for pH and temperature
**Calculated using the median pH and 75th percentile temperature per the implementing procedures outlined in Title 35 Section 355[1]
Spring/Fall consists of March - May, September - October.
Summer consists of June - August.
Winter consists of November - February.

8.3.3.4 Margin of Safety

The MOS can be implicit (incorporated into the TMDL analysis through conservative assumptions), or explicit (expressed in the TMDL as a portion of the loadings), or a combination of both. This TMDL has an implicit margin of safety as the load duration curve was calculated using the lowest chronic instream water quality standard and the TMDL includes the chronic WLA for each season.

8.3.3.5 Reserve Capacity

No RC was included in the TMDL. Significant future population growth is not anticipated in the area.

8.3.3.6 Load Allocation and TMDL Summary

Tables 8-9 through **8-11** show a summary of the ammonia TMDL for South Branch La Moine segment DGZR. Note that the 3 exceedances that have been recorded on this segment occurred under very low flow conditions in July, August, and October. During the lowest flow conditions, nonpoint source loading to the stream will be minimal. The LC has been fully allocated to the WLA during low flows.

[1] https://pcb.illinois.gov/documents/dsweb/Get/Document-12024/

Table 8-9 Ammonia TMDL for South Branch La Moine River segment DGZR (Summer: June – August)

Zone	Flow Exceedance Range (%)	LC (lbs/day)	LA (lbs/day)	WLA[2] (lbs/day)	MOS	Actual Load[1] (lbs/day)	Percent Reduction Needed (%)
High	0 - 10	563	558	4.3	implicit	--	--
Moist	10 - 20	169	165	4.3	implicit	--	--
	20 - 30	86	82	4.3	implicit	--	--
	30 - 40	52	48	4.3	implicit	--	--
Mid-Range	40 - 50	33	29	4.3	implicit	--	--
Dry	50 - 60	22	17	4.3	implicit	--	--
	60 - 70	14	9	4.3	implicit	--	--
	70 - 80	9	5	4.3	implicit	--	--
	80 – 90	4.8	0.5	4.3	implicit	--	--
Low Flow**	90 - 100	4.3	*	4.3	implicit	10	57%

[1]Actual Load was calculated using the 90th percentile of observed concentrations in a given flow range (EPA 2007).
[2]WLA for this segment is seasonal (refer to Table 8-8).
*Nonpoint source/watershed contributions during very low flows/dry conditions will be near zero
**Low flows are effluent-dominated and the DAF of the upstream discharger (La Harpe Sewage Treatment Plant ILG580093) was used for these flow ranges

Table 8-10 Ammonia TMDL for South Branch La Moine River segment DGZR (Spring/Fall: March - May, September - October)

Zone	Flow Exceedance Range (%)	LC (lbs/day)	LA (lbs/day)	WLA[2] (lbs/day)	MOS	Actual Load[1] (lbs/day)	Percent Reduction Needed (%)
High	0 - 10	633	628	4.4	implicit	--	--
Moist	10 - 20	237	233	4.4	implicit	--	--
	20 - 30	136	132	4.4	implicit	--	--
	30 - 40	90	86	4.4	implicit	--	--
Mid-Range	40 - 50	62	57	4.4	implicit	--	--
Dry	50 - 60	39	35	4.4	implicit	--	--
	60 - 70	22	17	4.4	implicit	--	--
	70 - 80	9	5	4.4	implicit	--	--
Low Flow	80 - 100**	4.4	*	4.4	implicit	8	45%

[1]Actual Load was calculated using the 90th percentile of observed concentrations in a given flow range (EPA 2007).
[2]WLA for this segment is seasonal (refer to Table 8-8).
*Nonpoint source/watershed contributions during very low flows/dry conditions will be near zero
**Low flows are effluent-dominated and the DAF of the upstream discharger (La Harpe Sewage Treatment Plant ILG580093) was used for these flow ranges

Table 8-11 Ammonia TMDL for South Branch La Moine River segment DGZR (Winter: November - February)

Zone	Flow Exceedance Range (%)	LC (lbs/day)	LA (lbs/day)	WLA[2] (lbs/day)	MOS	Actual Load[1] (lbs/day)	Percent Reduction Needed (%)
High	0 - 10	833	825	8.2	implicit	--	--
Moist	10 - 20	285	277	8.2	implicit	--	--
	20 - 30	167	158	8.2	implicit	--	--
	30 - 40	106	97	8.2	implicit	--	--
Mid-Range	40 - 50	71	63	8.2	implicit	--	--
Dry	50 - 60	44	36	8.2	implicit	--	--
	60 - 70	27	18	8.2	implicit	--	--
	70 - 80	16	7	8.2	implicit	--	--
	80 – 90**	9	0.8	8.2	implicit	--	--
Low Flow	90 – 100**	9	0.8	8.2	implicit	--	--

[1]There are no historical data available from the winter season
[2]WLA for this segment is seasonal (refer to Table 8-8).
*Nonpoint source/watershed contributions during very low flows/dry conditions will be near zero
**Low flows are effluent-dominated and the DAF of the upstream discharger was used for this flow range

8.3.4 Dissolved Oxygen in Streams

Rock Creek, La Harpe Creek, Prairie Creek, and South Branch La Moine River are all listed for impairment caused by low DO. As discussed in Section 7 of this report, QUAL2K water quality models were developed for each impaired segment.

All QUAL2K models were developed (see Section 7) to determine load reductions of oxygen demanding materials needed to meet the relevant water quality standards. A combination of 7-day and 30-day daily minimum and mean DO concentrations were used as endpoints for each TMDL analysis. The use of extended period (7-day and 30-day) standards, rather than instantaneous minimum standards, serves as a conservative measure in the calculations (see further discussion in Section 7). Depending on the critical period modeled, either the March – July standard or the August – February standard was used.

8.3.4.1 Loading Capacity

The LC for DO impairments is the maximum amount of oxygen-demanding material that a given water body can receive and still maintain compliance with the water quality standards. The allowable loads of oxygen-demanding material that can be generated in the Upper La Moine watershed and still maintain water quality standards were analyzed using the calibrated models described in Section 7. Modeling analysis revealed that, for each of the modeled reaches in the watershed, the DO standards could be achieved with substantial reductions in nutrient load, sediment oxygen demand, and (in some cases) oxygen-demanding material loads.

The analyses indicate that, given the best available data and constructed model, low DO levels in this watershed are driven primarily by a combination of nutrient impairment, high SOD, and point loads of oxidizing materials (CBOD). SOD is the sum of all chemical and biological processes in the sediment that take up oxygen. SOD generally consists of a combination of biological respiration from benthic organisms and the biochemical decay processes in the top layer of deposited sediments, together with the release of oxygen-demanding (reduced) anaerobic chemicals such as iron, manganese, sulfide, and ammonia. Nutrient impairment, typical of agricultural watersheds like these, results in nuisance aquatic plant growth, including algae, and large diurnal swings in DO as a result of plant productivity and respiration. Minimum DO in reaches with high plant activity occurs in the morning hours after nighttime respiration. Two of the impaired reaches are impacted by sewage treatment plant discharges.

To satisfy the requirements of the TMDL analysis, incremental reductions were made in diffuse nutrient load, sediment oxygen demand, and point source CBOD load, as appropriate, until the relevant water quality standards were achieved. All other model parameters were maintained at baseline levels (see Section 7). Diffuse source nutrient loads were accompanied by reductions in model-calculated attached algae (periphyton) biomass, which reduced the diurnal variability in DO patterns (increased daily minimum). SOD was always reduced in concert with either diffuse source nutrient loads or point source CBOD loads. For the former, reduced attached algae biomass can be expected to reduce the amount of oxidizing organic matter in the bottom sediments, thereby reducing the sediment oxygen demand. For the latter, reduced point source loads will reduce the amount of organic material settling to the streambed downstream of the discharge, again reducing the SOD.

Results are summarized in **Table 8-12**. These results are intended to provide guidance for future implementation projects. Potential further monitoring and implementation measures to increase aeration or reduce SOD in the system are discussed in Section 9. Further monitoring is also recommended to confirm the preliminary conclusions outlined above. QUAL2K model parameters for each of the three models developed, including primary inputs and outputs, are provided in **Appendix F.**

Table 8-12 Loading Capacity for Dissolved Oxygen TMDLs in the Upper La Moine River Watershed

Oxygen Demanding Material	Impaired Segment			
	Rock Creek DGO-01	La Harpe Creek DGP and DGP-01	Prairie Creek DGZN-01	South Branch La Moine River DGZR
Total Nitrogen (lbs/day)	9	37	NA	NA
Total Phosphorus (lbs/day)	6	20	NA	NA
CBOD (lbs/day)	NA	NA	43	24
SOD (gO_2/m2/day)	18	28	12	15

NA = Not Applicable

8.3.4.2 Seasonal Variation

Seasonality is addressed through the targeted calculation of TMDLs using model inputs that represent the time of year when DO is at the lowest instream concentrations. This is the critical condition that represents the worst-case scenario and is therefore the most conservative way to calculate these TMDLs.

8.3.4.3 Waste Load Allocation

There are two NPDES permitted dischargers within the Upper La Moine River watershed that discharge to segments impaired by low DO. Both discharges and the relevant existing discharge concentrations were input into the existing condition QUAL2K model for calibration purposes (see discussion in Section 7). Modeling shows that the main drivers of low DO impairments in these segments are high rates of NBOD, primarily as ammonia-N, CBOD, and SOD. An ammonia TMDL was presented in Section 8.3.3 that contains an ammonia-N WLA for the LaHarpe STP (ILG580093). No instream water quality standards exist for CBOD so an explicit WLA was not developed for this parameter at the La Harpe STP. The Carthage STP (IL0021229) discharge permit contains effluent limits for CBOD that have been included in Table 8-13 for reference. **Table 8-13** contains permit and flow information for the NPDES permitted facilities that discharge to segments impaired by low DO within the watershed. Note that the Blandinsville STP (IL0072672) was included in the model for headwater conditions on La Harpe Creek, however, the STP discharges to an unnamed tributary of Bishop Creek miles more than five miles upstream of the confluence with La Harpe Creek.

Note that these permits are due for renewal. The Permit Section may consider replacing the general permit for the LaHarpe STP with an individual permit due to the TMDL status of the receiving water. All facilities may receive additional monitoring requirements.

Table 8-13 CBOD WLAs for NPDES Permitted Point Sources in the Upper La Moine River Watershed

Facility	NPDES Permit Number	Applicable Stream Segment	Design Average Flow (MGD)	CBOD Monthly Average Limit		CBOD Weekly Average Limit	
				mg/L	lbs/day	mg/L	lbs/day
Carthage STP	IL0021229	DGZN-01	0.5	25	104	40	167
La Harpe STP	ILG580093	DGZR	0.6	25	125	40	200
Blandinsville STP	IL0072672	DGP-01	0.093	25	19	40	31

* Instream numeric water quality standard does not exist, explicit WLAs were not assigned for this parameter.

8.3.4.4 Margin of Safety

The MOS can be implicit (incorporated into the TMDL analysis through conservative assumptions), or explicit (expressed in the TMDL as a portion of the loadings), or a combination of both. An explicit MOS for the DO TMDLs of 10% was included to account for the limited site-specific data available within the watershed.

8.3.4.5 Reserve Capacity

No RC was included in the TMDL. Significant future population growth is not anticipated in the area.

8.3.4.6 Load Allocation and TMDL Summary

Tables 8-14 through **8-17** show a summary of the DO TMDLs for Upper La Moine River watershed. The allowable loads of oxygen-demanding material that can be generated in the Upper La Moine watershed and still maintain water quality standards were analyzed using the calibrated models described in Section 7. Modeling analysis revealed that, for each of the modeled reaches in the watershed, the DO standards could be achieved with substantial reductions in nutrient load, sediment oxygen demand, and (in some cases) oxygen-demanding material loads.

The analyses indicate that, given the best available data and constructed model, low DO levels in this watershed are driven primarily by a combination of nutrient impairment, high SOD, and point source loads of oxidizing materials (CBOD). SOD is the sum of all chemical and biological processes in the sediment that take up oxygen. SOD generally consists of a combination of biological respiration from benthic organisms and the biochemical decay processes in the top layer of deposited sediments, together with the release of oxygen-demanding (reduced) anaerobic chemicals such as iron, manganese, sulfide, and ammonia. Nutrient impairment, typical of agricultural watersheds like these, results in nuisance aquatic plant growth, including algae, and large diurnal swings in DO as a result of plant productivity and respiration. Minimum DO in reaches with high plant activity occurs in the morning hours after nighttime respiration. Two of the impaired reaches are impacted by sewage treatment plant discharges.

To satisfy the requirements of the TMDL analysis, incremental reductions were made in diffuse nutrient load, sediment oxygen demand, and estimated point source CBOD load, as appropriate, until the relevant DO water quality standards were achieved. All other model parameters were maintained at baseline levels (see Section 7). Diffuse source nutrient loads were accompanied by reductions in model-calculated attached algae (periphyton) biomass, which reduced the diurnal variability in DO patterns (increased daily minimum). SOD was always reduced in concert with either diffuse source nutrient loads or point source CBOD loads. For the former, reduced attached algae biomass can be expected to reduce the amount of oxidizing organic matter in the bottom sediments, thereby reducing the sediment oxygen demand. For the latter, reduced point source loads will reduce the amount of organic material settling to the streambed downstream of the discharge, again reducing the SOD. Explicit WLAs were not set as both permits are due for renewal and the Permit Section staff can use the LC information to inform future permit requirements that may include revised limits and/or additional monitoring.

Table 8-14 Dissolved Oxygen (nutrients, CBOD, SOD) TMDL for Rock Creek DGO-01

Contributing Oxygen Demanding Parameter	LC	WLA	LA	MOS (10% of LC)	RC	Current Load	Reduction Needed
Total Nitrogen (lbs/d)	9	0	8	1	0	202	96%
Total Phosphorus (lbs/d)	6	0	5	1	0	133	96%
CBOD (lbs/d)	NA	NA	NA	NA	0	NA	NA
SOD (gO2/m2/d)	18	0	16	2	0	30	46%

NA = not applicable

Table 8-15 Dissolved Oxygen (nutrients, CBOD, SOD) TMDL for Prairie Creek DGZN-01

Contributing Oxygen Demanding Parameter	LC	WLA	LA	MOS (10% of LC)	RC 0	Current Load	Reduction Needed
Total Nitrogen (lbs/d)	NA	NA	NA	NA	0	NA	NA
Total Phosphorus (lbs/d)	NA	NA	NA	NA	0	NA	NA
CBOD (lbs/d)	43	*	NA	4	0	109	64%
SOD (gO2/m2/d)	12	NA	11	1	0	30	64%

*CBOD limits for the Carthage STP will be reviewed by the Illinois EPA Permits Section during permit renewal

Table 8-16 Dissolved Oxygen (nutrients, CBOD, SOD) TMDL for La Harpe Creek DGP and DGP-01

Contributing Oxygen Demanding Parameter	LC	WLA	LA	MOS (10% of LC)	RC	Current Load	Reduction Needed
Total Nitrogen (lbs/d)	37	0	33	4	0	202	84%
Total Phosphorus (lbs/d)	20	0	18	2	0	133	87%
CBOD (lbs/d)	NA	NA	NA	NA	0	NA	NA
SOD (gO_2/m2/d)	28	0	25	3	0	64	61%

Table 8-17 Dissolved Oxygen (nutrients, CBOD, SOD) TMDL for South Branch La Moine River DGZR

Contributing Oxygen Demanding Parameter	LC	WLA	LA	MOS (10% of LC)	RC	Current Load	Reduction Needed
Total Nitrogen (lbs/d)	NA	NA	NA	NA	0	NA	NA
Total Phosphorus (lbs/d)	NA	NA	NA	NA	0	NA	NA
CBOD (lbs/d)	24	*	NA	2	0	50	61%
SOD (gO_2/m2/d)	15	NA	14	1	0	30	61%

*CBOD limits for the LaHarpe STP will be reviewed by the Illinois EPA Permits Section during permit renewal. Note that the LaHarpe STP permit is currently a general permit.

8.3.5 Total Phosphorus TMDLs for Carthage Lake

8.3.5.1 Loading Capacity

The LC of Carthage Lake is the pounds of total phosphorus that can be allowed as input to the lake per day and still meet the applicable water quality standard. The water quality standard for total phosphorus is 0.05 mg/L. The allowable loads of total phosphorus that can be generated in the watershed and still maintain water quality standards were determined with the SLAM model that was developed, as discussed in Section 7. To calculate the LC, the current total phosphorus loads into the lake were first calculated in the model using average values from the historical data. The current calculated loads from internal and external sources were then iteratively reduced in the model until the water quality standards were met.

8.3.5.2 Seasonal Variation

A season is represented by changes in weather; for example, a season can be classified as warm or cold as well as wet or dry. Seasonal variation is accounted for in the total phosphorus TMDLs by developing the model and performing all calculations of load on an annual basis. Modeling on an annual basis takes into account the seasonal effects each lake will undergo during a given year. Since the pollutant source can be expected to contribute loadings in different quantities during different time periods (e.g. various agricultural processes occurring at different times of year, combined with seasonal changes in precipitation, result in different runoff characteristics at different times of year), the loadings for this TMDL are focused on average annual loadings converted to daily loads, rather than specifying different loadings by season. Carthage Lake will experience critical conditions pertaining to phosphorus concentrations every year based on the growing season. Because an average annual basis was used for TMDL development, the critical condition for each waterbody is accounted for within the analysis.

8.3.5.3 Waste Load Allocation

There are currently no NPDES permitted facilities in the Carthage Lake watershed, therefore, WLAs were not included in the TMDL calculation for this watershed.

8.3.5.4 Margin of Safety

The MOS can be implicit (incorporated into the TMDL analysis through conservative assumptions), explicit (expressed in the TMDL as a portion of the loadings), or a combination of both. The MOS for the Carthage lake TMDL is both implicit and explicit. An explicit MOS of 10% was included to account for the lack of site-specific data available within this watershed.

In addition to the explicit MOS of 10%, the analyses completed for this waterbody was conservative as a result of the default coefficients and values used in each SLAM model, which were developed to be conservative in nature in the absence of site-specific information. Default model values, such as dispersion rates, are based on scientific data accumulated from a large survey of lakes. Wherever site-specific data are not available, default model rates are used which are based on error analysis calculations. The SLAM model and the default values incorporated within the model provide a conservation range of where the predictions could fall and provide confidence in the predicted values.

As stated in the SLAM technical documentation, "if the model is re-calibrated to site-specific data and the default input values for model error coefficients are used, the procedure (Options 2 or 3) will over-estimate prediction uncertainty (CV's of predicted values)." In this case, all available data were used to perform a limited site-specific calibration, while default error coefficients were maintained in the model. Therefore, the uncertainty presented in the final results is likely an over-estimation of the actual model uncertainty, and thus conservative. In other words, the range of potential outcomes is likely smaller than the range presented. Or, put another way, the high ends of the ranges of predicted phosphorus and chlorophyll-a concentrations (worst-case concentrations) are likely higher than the actual expected outcomes.

8.3.5.5 Reserve Capacity

A portion of a TMDL's loading capacity may be set as an RC to allow for future population growth and development potentially leading to increased pollutant loads in the future. In the case of this TMDL for total phosphorus, an explicit RC was not included in the TMDL calculations due to the lack of projected population growth in the area.

8.3.5.6 Load Allocation and TMDL Summary

The total phosphorus TMDL developed for Carthage Lake is provided in **Table 8-18**. A total reduction of approximately 70 percent of total phosphorus loads will result in compliance with the applicable water quality standard of 0.05 mg/L total phosphorus in Carthage Lake. All necessary reductions are limited to reductions of internal loads and external, non-permitted non-point source loads. Both the internal and external allowable loads combine to make up the load allocation for the lake.

Table 8-18 TMDL Summary for Carthage Lake

	LC (lbs/day)	LA (lbs/day)	MOS (10% of LC)	Current Load (lbs/day)	Reduction Needed (Percent)
Internal	0.13	0.12	0.01	0.43	70%
External	1.25	1.13	0.13	4.18	70%
Total	1.38	1.25	0.14	4.61	70%

8.4 LRS Allocation

LRS impairments are based on narrative water quality standards. Watershed-specific numeric target values have been developed by Illinois EPA for LRS impairment parameters in the Upper La Moine watershed. The target values were used to develop target loading capacities for each impairment. The target loading capacities were then compared to current actual loads to develop percent reductions needed to meet the target value, as discussed in the following sections.

8.4.1 Total Phosphorus LRS in Streams

Drowning Fork segment DGLC-01, Prairie Creek segment DGZN-01, and South Branch La Moine River segment DGZR are listed for impairment of the aquatic life use caused by total phosphorus. As no numeric water quality standard exists for total phosphorus in streams in Illinois, a numeric target of 0.17 mg/L was developed by Illinois EPA for this watershed. A load duration curve was developed (see Section 7) to determine load reductions needed to meet the instream water quality target under varying flow scenarios.

8.4.1.1 Target Loading Capacity

The LC is the maximum amount of total phosphorus the impaired segments can receive and still meet the LRS target value for this watershed. The allowable phosphorus loads that may be generated in the watershed were determined using estimated flow conditions and the numeric LRS target of 0.17 mg/L for total phosphorus, as discussed in Section 7. The total phosphorus loading capacity according to flow is presented in **Table 8-19**.

Table 8-19 Total Phosphorus Target Loading Capacity in the Upper La Moine Watershed

Estimated Mean Daily Flow (cfs)	Load Capacity (lbs/day)
1	1
5	5
10	9
50	46
100	92
500	458
1,000	916
5,000	4,582
10,000	9,264
15,000	13,746

8.4.1.2 Percent Reduction and LRS Summary for Total Phosphorus

Tables 8-20 through **8-22** provide summaries of the LRS and percent reductions from current conditions needed to meet the total phosphorus targets under various flow conditions in Drowning Fork (DGLC-01), Prairie Creek (DGZN-01), and South Branch La Moine River (DGZR).

Based on the available data, instream concentrations in segment DGLC-01 exceed the LRS target value under dry and low flow conditions. Target reductions range from 0 to 93 percent with the highest reduction needed under the lowest flow conditions.

Based on the available data, instream concentrations in segment DGZN-01 exceed the LRS target value only under low flow conditions. The only target reductions necessary are in the lowest flow condition and are 97 percent.

Based on the available data, instream concentrations in segment DGZR exceed the LRS target value under dry and low flow conditions. Target reductions range from 92 to 95 percent with the highest reduction needed under dry flow conditions.

Table 8-20 LRS Targets for Total Phosphorus in Drowning Fork segment DGLC-01

Zone	Flow Exceedance Range (%)	Target Loading Capacity (lbs/day)	Actual Load[1] (lbs/day)	Percent Reduction Needed (%)
High	0 - 10	101	--	--
Moist	10 - 20	34	--	--
	20 - 30	19	18	0%
	30 - 40	12.2	--	--
Mid-Range	40 - 50	7.8	--	--
Dry	50 - 60	4.9	3	0%
	60 - 70	2.8	6	51%
	70 - 80	1.5	4	65%
	80 - 90	0.8	5	86%
Low Flow	90 - 100	0.3	4	93%

[1]Actual Load was calculated using the 90th percentile of observed concentrations in a given flow range (EPA 2007).

Table 8-21 LRS Targets for Total Phosphorus in Prairie Creek segment DGZN-01

Zone	Flow Exceedance Range (%)	Target Loading Capacity (lbs/day)	Actual Load[1] (lbs/day)	Percent Reduction Needed (%)
High	0 - 10	20	--	--
Moist	10 - 20	7	--	--
	20 - 30	4	--	--
	30 - 40	2.4	--	--
Mid-Range	40 - 50	1.6	--	--
Dry	50 - 60	1.0	--	--
	60 - 70	0.6	--	--
	70 - 80	0.3	--	--
	80 - 90	0.2	--	--
Low Flow	90 - 100	0.1	2	97%

[1]Actual Load was calculated using the 90th percentile of observed concentrations in a given flow range (EPA 2007).

Table 8-22 LRS Targets for Total Phosphorus in South Branch La Moine River segment DGZR

Zone	Flow Exceedence Range (%)	Target Loading Capacity (lbs/day)	Actual Load[1] (lbs/day)	Percent Reduction Needed (%)
High	0 - 10	43	--	--
Moist	10 - 20	15	--	--
	20 - 30	8	--	--
	30 - 40	5.2	--	--
Mid-Range	40 - 50	3.4	--	--
Dry	50 - 60	2.1	--	--
	60 - 70	1.2	--	--
	70 - 80	0.7	--	--
	80 - 90	0.3	6	95%
Low Flow	90 - 100	0.1	1	92%

[1]Actual Load was calculated using the 90th percentile of observed concentrations in a given flow range (EPA 2007).

8.4.2 TSS and Sedimentation/Siltation LRSs in Stream

Drowning Fork segment DGLC-01 and Prairie Creek segment DGZN-01 are listed for impairment of the aquatic life use caused by TSS and Drowning Fork segment DGLC-01 is also listed for impairment of the aquatic life use caused by excess sedimentation and siltation, a similar measure of sediment loads in a waterbody. As no numeric water quality standard exists for either TSS or sedimentation/siltation in streams in Illinois, a numeric target of 50.9 mg/L of TSS was developed by Illinois EPA for use in assessing TSS and a numeric target of 39.1 of NVSS was developed for use in assessing sedimentation/siltation impairments in the Upper La Moine Watershed. Load duration curves were developed (see Section 7) for each segment to determine load reductions needed to meet the instream water quality targets under a full range of flow scenarios.

8.4.2.1 Target Loading Capacity

The LC is the maximum TSS or NVSS load the impaired waters can receive and still meet the LRS target value for TSS or sedimentation/siltation, respectively, in the watershed. The allowable loads that may be generated in the watershed were determined using estimated flow conditions and the numeric LRS target of 50.9 mg/L of TSS and 39.1 mg/L of NVSS, as discussed in Section 7. The TSS and NVSS loading capacities according to flow are presented in **Table 8-23**.

Table 8-23 TSS Loading Capacity in Streams of the Upper La Moine Watershed

Estimated Mean Daily Flow (cfs)	Target Load Capacity (lbs/day of TSS)	Target Load Capacity (lbs/day of NVSS)
1	274	211
5	1,372	1,054
10	2,744	2,108
50	13,719	10,538
100	27,438	21,077
500	127,190	105,385
1,000	274,380	210,770
5,000	1,371,900	1,053,850
10,000	2,743,800	2,107,700
15,000	4,115,700	3,161,550

8.4.2.2 Percent Reduction and LRS Summary for TSS and Sedimentation/Siltation

Tables 8-24 through **8-26** provide summaries of the LRS and percent reductions from current conditions needed to meet the TSS and sedimentation/siltation targets under various flow conditions in Drowning Fork segment DGLC-01 and Prairie Creek segment DGZN-01.

Table 8-24 LRS Targets for TSS in Drowning Fork segment DGLC-01

Zone	Flow Exceedance Range (%)	Target Loading Capacity (lbs/day)	Actual Load[1] (lbs/day)	Percent Reduction Needed (%)
High	0 - 10	30,203	--	--
Moist	10 - 20	10,263	--	--
	20 - 30	5,747	4,258	0%
	30 - 40	3,665.4	--	--
Mid-Range	40 - 50	2,345.8	--	--
Dry	50 - 60	1,466.2	297	0%
	60 - 70	835.7	76	0%
	70 - 80	454.5	--	--
	80 - 90	227.3	419	46%
Low Flow	90 - 100	85.0	167	49%

[1]Actual Load was calculated using the 90th percentile of observed concentrations in a given flow range (EPA 2007).

TSS loads in DGLC-01 exceed the LRS target value during low flow conditions. Overall load reductions of 0-49 percent are needed to meet the instream target.

Table 8-25 LRS Targets for TSS in Prairie Creek segment DGZN-01

Zone	Flow Exceedance Range (%)	Target Loading Capacity (lbs/day)	Actual Load[1] (lbs/day)	Percent Reduction Needed (%)
High	0 - 10	6,041	--	--
Moist	10 - 20	2,053	--	--
	20 - 30	1,149	--	--
	30 - 40	733.1	--	--
Mid-Range	40 - 50	469.2	--	--
Dry	50 - 60	293.2	--	--
	60 - 70	167.1	--	--
	70 - 80	90.9	--	--
	80 - 90	45.5	--	--
Low Flow	90 - 100	17.0	40	58%

[1]Actual Load was calculated using the 90th percentile of observed concentrations in a given flow range (EPA 2007).

Based on the available data, exceedances of the LRS target value in segment DGZN-01 have occurred only under low-flow conditions (all data were collected during low flows), and load reductions of 58% are needed to meet the instream target.

Table 8-26 LRS Targets for Sedimentation/Siltation in Drowning Creek segment DGLC-01

Zone	Flow Exceedance Range (%)	Target Loading Capacity (lbs/day)	Actual Load[1] (lbs/day)	Percent Reduction Needed (%)
High	0 - 10	23,201	--	--
Moist	10 - 20	7,884	--	--
	20 - 30	4,415	--	--
	30 - 40	2,815.6	--	--
Mid-Range	40 - 50	1,802.0	--	--
Dry	50 - 60	1,126.3	172	0%
	60 - 70	642.0	51	0%
	70 - 80	349.1	--	--
	80 - 90	174.6	220	21%
Low Flow	90 - 100	65.3	60	0%

[1]Actual Load was calculated using the 90th percentile of observed concentrations in a given flow range (EPA 2007).

NVSS data were collected across a full range of flows and reductions to meet the LRS target value are needed during dry conditions. Reduction percentages required to meet the target loads range from 0-21 percent.

8.4.3 LRS for TSS in Lakes

Carthage Lake is listed for impairment caused by excess TSS. No numeric water quality standard exists for TSS in lakes or reservoirs in Illinois, so a watershed-specific numeric target of 50.9 mg/L of TSS was developed by Illinois EPA to aid in assessment of these impairments. Determination of the reduction in TSS load needed to meet the water quality target was performed using a simplified spreadsheet calculation approach.

Excessive TSS in lakes can negatively impact fish and macroinvertebrates within the ecosystem. Excess sediment and organic material may create turbid conditions within the water column and may increase the costs of treating surface waters used for drinking water or other industrial purposes (e.g. food processing). The potential addition of fine organic materials may lead to nuisance algal blooms that may prevent a lake from supporting aquatic life, aesthetic, and recreation uses. Algal decomposition depletes oxygen levels which may further stress benthic macroinvertebrates and fish.

The spreadsheet approach incorporates the available TSS data for each segment of each impaired lake and estimates of the average daily overland and tributary flow from each sub-watershed to produce an estimate of the current average daily TSS load into each lake segment. The current load is then compared to the maximum daily load possible without exceeding the watershed-specific TSS target concentration value, to calculate the overall percent reduction in daily TSS load into each segment of the lake necessary to meet the target value.

A summary of the percent reduction in TSS necessary to meet the target value in Carthage Lake is presented in **Table 8-27**. Based on the TSS LRS results, no additional TSS reductions are necessary to meet the target value.

Table 8-27 LRS Summary for TSS in Carthage Lake (RLE)

Segment	Target Concentration (mg/L)	Existing Concentration [1] (mg/L)	Average Overland and Tributary Flow (cfs)	Target Loading Capacity (lbs/day)	Actual Load (lbs/day)	Percent Reduction Needed (%)
RLE	50.9	44.1	433.2	118,869	102,989	0%

[1] Existing Concentration was calculated using the 90th percentile of observed TSS concentrations in a given location (USEPA 2007)

Section 9

Implementation Plan for the Upper La Moine Watershed

9.1 Implementation Overview

The goal of this watershed plan is to identify BMPs to be implemented in the Upper La Moine watershed that will provide reasonable assurance that impaired waters in the watershed will meet water quality criteria developed to ensure waterbodies are able to support their designated uses.

The USEPA has identified nine minimum elements that a watershed plan for impaired waters is expected to include. A watershed plan is expected to:

1. Identify causes and sources of pollution that will need to be controlled to achieve pollutant load reduction requirements estimated within the watershed plan.
2. Estimate pollutant load reductions expected as a result of implementation of management measures described in #3 below.
3. Describe the nonpoint source management measures that will need to be implemented to achieve load reductions estimates and identify the critical areas where measures need to be implemented.
4. Estimate the level of technical assistance, associated costs, potential funding sources and parties that will be relied upon to implement the prescribed measures.
5. Include a public information/education component designed to change social behavior.
6. Develop an implementation schedule for the plan.
7. Develop a description of interim, measurable milestones.
8. Identify indicators that can be used to determine whether pollutant loading reductions are being achieved over time.
9. Develop a monitoring component to evaluate the effectiveness of the implementation efforts over time.

9.2 Adaptive Management

An adaptive management or phased approach is recommended for the implementation of management practices designed to meet the TMDLs and LRSs developed for the Upper La Moine watershed. Adaptive management conforms to the USEPA guidelines outlined above as it is a systematic process for continually improving management policies and practices through learning from the outcomes of operational programs. Some of the defining characteristics of adaptive management include:

1. Acknowledgement of uncertainty about what policy or practice is "best" for the particular management issue
2. Thoughtful selection of the policies or practices to be applied (the assessment and design stages of the cycle)
3. Careful implementation of a plan of action designed to reveal the critical knowledge that is currently lacking
4. Monitoring of key response indicators
5. Analysis of the management outcomes in consideration of the original objectives and incorporation of the results into future decisions (British Columbia Ministry of Forests 2000)

Implementation actions, point source controls, management measures, and/or BMPs are used to control the generation or distribution of pollutants within a watershed. BMPs are either structural; such as wetlands, sediment basins, fencing, or filter strips; or managerial, such as conservation tillage practices, nutrient management plans, or crop rotation. Both structural and managerial BMPs require effective management to be successful in reducing pollutant loading to water resources (Osmond et al. 1995).

It is typically most effective to install a combination of point source controls and BMPs or a BMP system. A BMP system is a combination of two or more individual BMPs that are used to control pollutants from a single critical source. If the watershed has more than one identified pollutant, but the transport mechanism is the same, then a BMP system that establishes controls for the transport mechanism can be employed (Osmond et al. 1995).

To assist in development of an adaptive management program; implementation actions, management measures, available assistance programs, and recommended continued monitoring are all discussed throughout the remainder of this section. The point source BMPs described below are generally required and typically already being implemented although some modifications may be appropriate. The nonpoint source BMPs are entirely voluntary based on the landowner's preference.

9.3 Parameters Recommended for Delisting

As discussed in Sections 5.1.1.3 and 8.4.2, there are no manganese load reductions needed for the impaired stream segments within the Upper La Moine River watershed. The available data review for the impaired segments suggest that they were assessed and listed as impaired for elevated manganese concentrations based on a previous water quality standard for total manganese. The water quality standard was changed in 2012 and is now evaluated on hardness-dependent dissolved manganese levels. Based on the lack of reported exceedances for these segments, removal of manganese impairment from the Illinois 303(d) list is recommended. Continued monitoring of dissolved manganese and hardness through the Intensive Basin Survey program will continue to provide data that can be assessed with the current standards.

Additionally, as discussed in Section 8.4.3, there are no TSS and/or sedimentation/siltation load reductions necessary for Carthage Lake (RLE) to meet the watershed-specific LRS target value. Delisting of Carthage Lake for impairment by TSS is recommended.

9.4 BMP Recommendations for Reducing TSS and Sedimentation/Siltation in Watershed Streams

Soil erosion is the process of moving soil particles or sediment by flowing water or wind. Additionally, eroding soil transports pollutants that can potentially degrade water quality. TSS and/or sedimentation/siltation load reductions are recommended throughout the watershed and specifically within the drainage basins on segment DGLC-01 of the Drowning Fork and DGZN-01 of Prairie Creek. Percent reductions needed for the impaired segments were discussed in Section 8.4.2.

Nonpoint source runoff from agricultural areas and unstable streambanks are likely the main contributors to high sediment loads in the impaired segments. As such, nonpoint source controls designed to reduce erosion are expected to reduce TSS and sedimentation/siltation in impaired water bodies while providing the secondary benefit of reducing other contaminants such as total phosphorus that may be entering waterways via erosive processes. The BMPs discussed below are applicable to TSS and/or sedimentation/siltation impairments within the listed subbasins.

Filter Strips: Filter strips are strips or areas of permanent herbaceous vegetation situated between cropland, gazing land, or disturbed land and environmentally sensitive areas, such as waterways. Filter strips serve as controls to reduce, sediment, particulate organic matter, and sediment-absorbed contaminant and pollutant loading in runoff. The filter strips are permanently designated plantings to treat runoff and are not part of an adjacent cropland's rotation. Grass filter strips have been shown to remove as much as 65 percent of sediment and 75 percent of total phosphorus loads from runoff (USEPA 2003).

The filter strip vegetation may consist of a single species or a mixture of grasses, legumes, and/or other forbs that are appropriately adapted to the soil and climate, as well as to the farm chemicals used in the adjacent land. Approved seed listings are provided in the Illinois NRCS Conservation Practice Standard (CPS) 393 (June 2003). Applicable maintenance shall be performed as needed to ensure the strips continue to function properly, including removal of state-listed noxious weeds, gully repair, removal of excess sediment, and re-seeding. Overland flow entering the filter strip should be primarily sheet flow; areas of concentrated flow should be dispersed as part of the maintenance activities so as not to circumvent the filter strip. Harvesting of the filter strip vegetation, where appropriate, will help to encourage dense growth, maintain an upright growth habit, and remove contaminants and unwanted nutrients contained in the plant tissue. Prescribed burning may be used to manage and maintain the filter strip when an approved burn plan has been developed.

The installation of filter strips adjacent to the impaired stream segments, as well as any contributing tributaries, can result in considerable reduction of overland contributions of sediments and suspended solids to an impaired waterbody. Filter strips implemented along stream segments slow and filter runoff and provide bank stabilization thereby decreasing erosion and re-sedimentation; however, they should not be installed on unstable channel banks already eroding due to undercutting of the bank toe. In some cases, riparian vegetation also provides bank stability that further reduces sediment loading to the stream. When used in support of a riparian forest buffer, filter strips can also restore or maintain sheet flow.

The Illinois NRCS CPS 393 (June 2003) describes filter strip requirements based on land slope; the requirements are designed to achieve a minimum flow through time of 15 to 30 minutes at a one-half inch depth. **Table 9-1** provides a summary of the guidance for filter strip width, or flow length, as a function of slope (NRCS 2003).

Table 9-1 Filter Strip Flow Lengths Based on Land Slope

Percent Slope	0.5%	1.0%	2.0%	3.0%	4.0%	5.0% or greater
Minimum (feet)	36	54	72	90	108	117
Maximum (feet)	72	108	144	180	216	234

GIS land use and topographic data, described in Section 2 of this report, were used in conjunction with soil slope data to provide an estimate of acreage where filter strips could be installed. As discussed in Section 2.4.1 of this report, a total of 123 soil types exist within the watershed. The two most common soil types (Ipava silt loam and Sable silty clay loam) show 0-2 percent slopes and together account for approximately 28 percent of the watershed. Soils containing “clay” in some part of the classification name cover roughly 10 percent of the watershed area while all other soil types each represent less than 6 percent of the total watershed area. Many soil types are found in the watershed.

In conjunction with the available land use, topography, and soil information discussed in Section 2, mapping software was used to buffer impaired stream segments and their major tributaries to an appropriate and reasonable width to determine the total area found in each subbasin. Due to the wide range of soil types and slopes found throughout the watershed, the appropriate buffer widths estimated in GIS were based on the average slope of land within the maximum buffer areas of each impaired segment’s major tributaries. These average slopes were then used to calculate approximate buffer distances based on the NRCS guidance using a best-fit equation to interpolate between the slope percentages to buffer width relationships provided in the NRCS guidance.

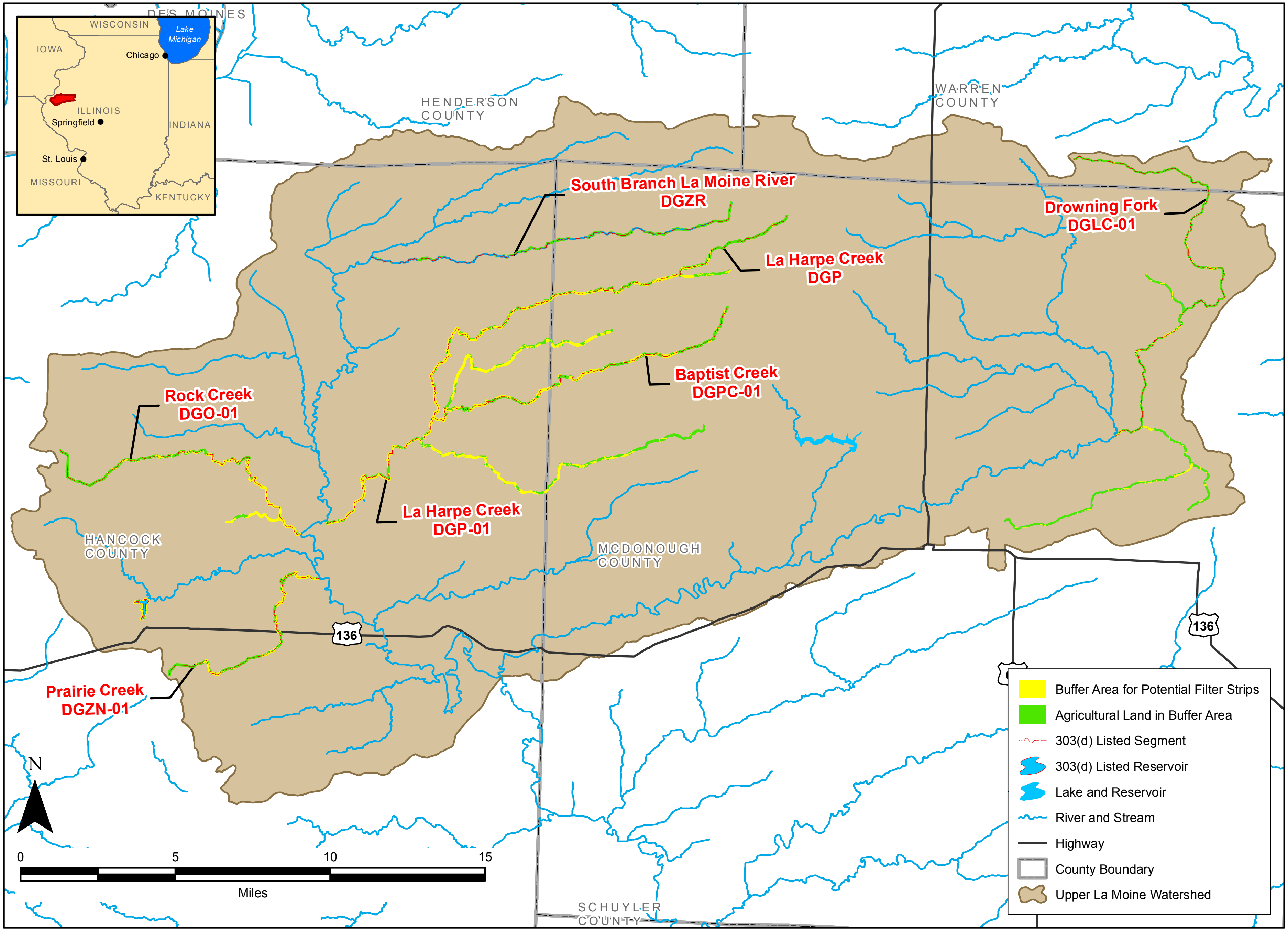
Not all land use types within the buffer areas are candidates for conversion to buffer strips. Existing forests and undisturbed grasslands already function as filter strips and conversion of developed residential or commercial lands is often infeasible. In general, agricultural lands are the land use type most conducive to conversion to buffer strips and will likely provide the greatest benefit to water quality once converted. Therefore, GIS software was used to extract the approximate acreage of agricultural lands within the appropriate buffer area for each impaired stream segment and its tributaries. The calculated overall buffer areas and acreage of agricultural land within the buffer distances for each impaired stream segment and its tributaries are provided in **Table 9-2**. These data represent an approximation of the maximum acreage of land potentially available for conversion to filter strips. More detailed assessment of a given property is necessary to determine the exact size and extent of convertible lands likely to provide the greatest benefit to instream water quality following conversion to filter strips.

While not impaired specifically for TSS or sedimentation/siltation, additional areas within the Upper La Moine River watershed are shown in the table for use in later discussions within Section 9. There are approximately 9,039 total acres within the various buffer distances of the impaired stream segments and their tributaries, an estimated 4,231 acres of which are agricultural land where filter strips could potentially be installed or improved. Landowners should be encouraged to evaluate their land adjacent to impaired streams and their tributaries to determine the practicality of installing or extending filter strips to achieve effective flow lengths as described in the NRCS guidance provided in **Table 9-1**. Figures depicting the buffered areas and agricultural lands suitable for conversion to filter strips in each subbasin are provided in **Figure 9-1**.

Table 9-2 Average Slopes, Filter Strip Flow Length, Total Buffer Area, and Area of Agricultural Land Within Buffers Potentially Suitable for Conversion to Filter Strips, by Stream Segment

Stream Name	Segment ID	Average Slope Adjacent to Streams (%)	Filter Strip Flow Length (feet)	Total Area in Buffer (Acres)	Agricultural Land in Buffer (Acres)
Drowning Fork	DGLC-01	3.71	180	1,390	1,171
Rock Creek	DGO-01	6.42	234	815	363
La Harpe Creek	DGP	8.67	234	1,053	417
La Harpe Creek	DGP-01	9.88	234	3,335	1,251
Baptist Creek	DGPC-01	10.97	234	1,171	447
Prairie Creek	DGZN-01	8.25	234	494	262
South Branch La Moine River	DGZR	10.87	234	781	320

If filter strip installation is selected for use by a landowner, a separate plan shall be prepared for each area which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 393, including site preparation; seed, seeding rates, and mixtures; lime and fertilizer; seedbed preparation and seeding; and operation and maintenance.



CDM Smith

Upper La Moine River

Buffer Areas and Agricultural Lands Potentially Suitable for Conversion to Filter Strips

FIGURE 9-1

Field Borders: A field border is a strip of permanent vegetation established at the edge or around the perimeter of a field to reduce erosion from wind and water and protect soil and water quality. This practice applies to cropland and grazing lands which are often farmed to the extent possible, sometimes even into adjacent road ditches and to creek banks. Leaving a field border will reduce erosion and transportation of sediment, including contaminant-impacted materials, to nearby environmentally sensitive areas.

As a minimum, field borders should be located along the edge(s) of fields where runoff enters or leaves the field. The minimum width shall be 30 feet; wider if needed to meet the resource needs. When determining the border width, consideration should be given to factors such as equipment turning, parking, loading/unloading, grain harvest operations, and other related activities. For example, field borders planned to be used for turn strips shall be at least twice as wide as the widest equipment to be used. Border widths should also comply with all applicable state and local manure and chemical application setbacks. The field border shall not be used as a hay yard or machinery parking lot for any extended period of time, especially if doing so will damage or impair the function of the field border. When crossing the border, sprayers should be shut off and tillage equipment raised to avoid damage to the borders.

The field border shall be established using permanent stiff-stemmed, upright grasses; grass/legumes; forbs; and/or shrubs to trap wind- or water-borne soil particles. These plants should be appropriately adapted to the soil and climate, have the physical characteristics necessary to control wind and water erosion to tolerable levels in the field border area, be tolerant to sediment deposition and the chemicals planned for application in the cropfield, be tolerant to equipment traffic, and shall not include any state-listed noxious plant. For water quality purposes (adsorbed, dissolved and suspended contaminants), the field border should have a vegetation stem density/retardance of moderate to high (e.g., equivalent to a good stand of wheat). Field border establishment shall be timed so that the soil will be adequately protected during the critical erosion period(s). Seedbed preparation, seeding rates, dates, depths, fertility requirements, and planting methods will be consistent with approved local criteria and site conditions.

Applicable maintenance shall be performed as needed to ensure the borders continue to function properly, including removal of state-listed noxious weeds and excess accumulated sediment. Overland flow entering the border should be primarily sheet flow; areas of concentrated flow should be dispersed as part of the maintenance activities so as not to circumvent the border. Any area damaged by animals, chemicals, tillage, or equipment traffic should be repaired as soon as possible. Use of contour buffer, no-till, or other conservation practices on adjacent upland areas will help to reduce surface runoff and excessive sedimentation of field borders.

If this BMP is selected for use by a landowner, a separate plan shall be prepared for each area which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 386.

Conservation Tillage Practices: Conservation tillage practices could help reduce nutrient and sediment loads into the impaired stream segments by reducing erosion of soils. **Table 9-3** shows the areas (acres) in each watershed that are under cultivation, along with the percent of the corresponding watershed area which is cultivated. Crop residuals or living vegetation cover on the soil surface protects against soil detachment from water and wind erosion.

Table 9-3 Cultivated Areas for impaired stream segment subbasins

Waterbody Name	Segment ID	Land Cover Area (Acres)	Cultivated Area (Acres)	Percent Cultivated
Drowning Fork	DGLC-01	35,043	32,374	92.4%
Rock Creek	DGO-01	15,661	13,616	86.9%
La Harpe Creek	DGP	17,251	14,541	84.3%
La Harpe Creek	DGP-01	61,026	47,662	78.1%
Baptist Creek	DGPC-01	20,459	15,330	74.9%
Prairie Creek	DGZN-01	8,456	6,415	75.9%
South Branch La Moine River	DGZR	10,743	8,108	75.5%

Conservation tillage practices are no-till and reduced-till. No-till is the practice of limiting soil disturbance in order to manage the amount, orientation, and distribution of crop and plant residue on the soil surface year around (Illinois NRCS CPS 329). Reduced-till is managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year-round while limiting the soil-disturbing activities used to grow and harvest crops in systems where the field surface is tilled prior to planting (Illinois NRCS CPS 345).

The no-till practice consists only of an in-row soil tillage operation during the planting activities and a seed row/furrow closing device. No full-width tillage is performed from the time of harvest or termination of one cash crop to the time of harvest/termination of the next cash crop in the rotation regardless of the depth of the tillage operation. Limited tillage is allowed to close or level ruts from harvesting equipment; however, no more than 25 percent of the field may be tilled for this purpose.

As noted above, the reduced-till practice consists of managing plant residue on the soil surface while limiting soil-disturbing activities. The practice includes tillage methods commonly referred to as mulch tillage or conservation tillage where the entire soil surface is disturbed by tillage operations such as chisel plowing, field cultivating, tandem disking, or vertical tillage. It also includes tillage/planting systems with few tillage operations (e.g., ridge till) but which do not meet the criteria for the no-till practice as described above and in Illinois NRCS CPS 329.

In both the no-till and reduced-till practices, removal of residue from the row area prior to or as part of the planting operation is acceptable. In the no-till practice, however, the disturbed portion of the row width should not exceed one third of the crop row width. In either practice, none of the residue should be burned. To reduce erosion to the targeted level, the current approved water and/or wind erosion prediction technology should be used to determine the amount of randomly distributed surface residue needed, the period of the year the residue needs to be present in the field, and the amount of surface soil disturbance allowed. All residues shall be uniformly distributed over the entire field. Residue should not be shredded after harvest because shredding makes it susceptible to movement by wind or water, and areas where the shredded residue accumulates may interfere with planting of the next crop.

If the no-till BMP is selected for use by a landowner, a separate plan shall be prepared for each area which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 329. If the reduced-till BMP is selected for use by a landowner, a separate plan shall be prepared for each area which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 345.

Conservation tillage practices can remove up to 45 percent of the phosphorus from runoff and approximately 75 percent of the sediment. Additionally, studies have found around 93 percent less erosion occurred from no-till acreage compared to acreage subject to moldboard plowing (USEPA 2003). The 2013 Illinois Department of Agriculture's Soil Transect Survey estimates indicate that conventional till currently accounts for the vast majority of tillage practices in the four counties containing some portion of the Upper La Moine watershed. Tillage practices throughout the watershed should be assessed for implementation of conservation tillage practices to reduce sediment loads.

Contour Farming – Contour farming is the practice of aligning ridges, furrows, and roughness formed by tillage, planting, and other operations to alter the velocity and/or direction of water flow to or around the hillslope. Use of this practice results in reduced erosion; reduced transport of sediment, other solids, and the contaminants attached to them; and reduced transport of contaminants found in solution runoff (e.g., excess nutrients and pesticides) by increasing water infiltration. Contour farming applies on sloping land where crops are grown.

Criteria which apply to this practice are minimum and maximum row grades, minimum ridge heights, and stable outlets to receive surface flow. The practice standard (Illinois NRCS CPS 330) provides more information; however, in general, crop rows shall have sufficient grade to ensure that runoff water does not pond and cause unacceptable crop damage. The maximum row grade shall typically not exceed one-half of the up-and-down hill slope percent used for conservation planning or 2 percent; see the standard for exceptions. During the period of the rotation that soil is most vulnerable to erosion, the minimum ridge height is 2 inches when row spacing is greater than 10 inches and 1 inch for close-grown crops such as small grains (row spacing less than 10 inches). Additionally, for close-grown crops, the spacing between plants within the row shall not be greater than 2 inches. The minimum ridge height criteria are not required when the no-till practice (Illinois NRCS CPS 329) is employed and at least 50 percent surface residue cover is present between the rows after planting.

Farming operations should begin on the contour baselines/markers and proceed both up and down the slope in a pattern parallel to any contour baselines/markers or terraces, diversions, or contour buffer strip boundaries where these practices are also present, until the patterns meet, and provided the applicable row grade criteria are met. Where field operations begin to converge between two non-parallel contour baselines, a correction area should be established that is permanently in sod or established to an annual close-grown crop. Sod turn strips should also be established where contour row curvature becomes too sharp to keep machinery aligned with rows during field operations, on sharp ridge points, or other odd areas as needed. Where terraces, diversions, or contour buffer strips are not present, contour markers shall be retained on grades that, when followed during establishment of each crop, will maintain crop rows at designed grades. Contour markers may be field boundaries, a crop row left untilled near or on an original contour baseline or other readily identifiable, continuous, lasting marker. If a marker is lost, a contour baseline shall be re-established within the applicable criteria set forth in Illinois NRCS CPS 330 prior to seedbed preparation for the next crop.

When using contour farming, a separate plan shall be prepared for each field which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 330.

Conservation Crop Rotation – Conservation crop rotation is a planned sequence of at least two different crops grown on the same ground over a period of time (i.e., the rotation cycle), and applies to all cropland where at least one annually-planted crop is included in the crop rotation. This practice can reduce sheet, rill, and wind erosion as well as reduce water quality degradation due to excess nutrients. For the purposes of the practice, a cover crop is considered a different crop. Where applicable, suitable crop substitutions may be planted when the planned crop cannot be planted due to weather, soil conditions, or other local situations. Acceptable substitutes are crops having similar properties that will accomplish the purpose of the original crop.

For reducing sheet, rill, and wind erosion, the crops, a tillage system, and cropping sequences should be selected that will produce sufficient and timely quantities of biomass or crop residue which will reduce erosion to the planned soil loss objective, as calculated using current approved erosion prediction technology. Selection of high-residue producing crops and varieties, use of cover crops, and adjustment of plant density and row spacing can enhance production of the kind, amount, and distribution of residue needed, especially when used in combination with Illinois NRCS CPSs for Residue and Tillage Management (Codes 329 and 345, discussed above under "Conservation Tillage"). Crop damage by wind erosion can be reduced by selecting crops tolerant to abrasion from windblown soil or high wind velocity. Alternatively, if crops sensitive to wind erosion damage are grown, the potential for plant damage can be reduced by crop residue management, field windbreaks, herbaceous wind barriers, intercropping, or other methods of wind erosion control.

To recover excess nutrients from the soil profile in order to reduce water quality degradation, crops with the following qualities should be used: quick germination and root system formation, a rooting depth sufficient to reach the nutrients not removed by the previous crop, and nutrient requirements that readily utilize the excess nutrients. In addition, including perennial or annual legume crops in the rotation can help provide nitrogen for the non-legume crops, especially in fields where manure applications are restricted by high or excessive soil phosphorus or potassium levels.

When using conservation crop rotation, a separate plan shall be prepared for each field or treatment unit which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 328.

Stripcropping: Stripcropping is the practice of growing planned rotations of erosion-resistant and erosion-susceptible crops or fallow in a systematic arrangement of approximately equal strips (two or more) across a field. This practice reduces sheet, rill, and wind erosion as well as the transport of sediment and other water- and wind-borne contaminants. Stripcropping can be applicable on steeper slopes but is less effective on slopes exceeding 12 percent. The practice has the greatest impact where cropped or fallow strips having less than 10 percent cover are alternated with close grown and/or grass/legume strips or crop strips with 75 percent or greater surface cover. Stripcropping is not well suited to rolling topography and does not apply to situations where the widths of alternating strips cannot be made generally equal.

Vegetation in a stripcropping arrangement consists of crops and/or forages grown in a planned rotation. No two adjacent strips should be in an erosion-susceptible condition at the same time during the year although two adjacent strips may be in erosion-resistant cover at the same time. Erosion-resistant strips should be crops or crop residues that provide the needed protective cover during those periods when erosion is expected to occur. Acceptable protective cover is tolerant of the anticipated depth of sediment deposition and includes a growing crop, including grasses, legumes, or grass-legume mixtures, standing stubble, residue with enough surface cover to provide protection, or surface roughness sufficient to provide protection. When the erosion-resistant strip is in permanent vegetation, the species established shall either be tolerant to herbicides used on the cropped strips or protected from damage by herbicides used on the cropped strips.

All tillage and planting operations will follow an established strip line. Strip boundaries shall run parallel to each other and follow as close to the contour as practical. Strips widths shall be determined using currently approved erosion prediction technologies but shall not exceed 50 percent of the slope length used for erosion prediction or 150 feet, whichever is less. Strips susceptible to erosion shall be alternated down the slope with strips of erosion-resistant cover.

When using stripcropping, a separate plan shall be prepared for each field which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 585, including arrangement and vegetative condition of strips, minimum and maximum row grades, minimum ridge height, critical slope length, headlands and end rows, and establishment of stable outlets to control runoff. Sediment accumulations along strip edges should be smoothed or removed and re-distributed over the field as necessary to maintain practice effectiveness. When headlands are in permanent cover, they should be renovated as needed to keep ground cover above 65 percent. No-till renovation of headlands is recommended, but in any case, should only include the immediate seedbed preparation and reseeding to a sod-forming crop with or without a nurse crop. Full headland width should be maintained to allow turning of farm implements at the end of a tilled strip to double back on the same strip.

Conservation Cover: Conservation cover is the practice of establishing and maintaining permanent vegetative cover in order to: reduce sheet, rill, and wind erosion and sedimentation; and reduce ground and surface water quality degradation by nutrients and surface water quality degradation by sediment. This practice applies on all lands needing permanent herbaceous vegetative cover and can be applied on only a portion of a field; however, it does not apply to plantings for forage production or to critical area plantings.

When using conservation cover, the amount of plant biomass and cover needed to reduce wind and water erosion to the planned soil loss objective should be calculated using the current approved wind and/or water erosion prediction technology. The selected plant species should be suitable for the planned purpose as well as adapted to the soil, ecological, and climatic conditions of the area. Planting dates, planting methods, and care in handling and planting of the seed or planting stock shall ensure that planted materials have an acceptable rate of survival. No-till seeding methods are preferred where erosion concerns are present. Periodic removal of some products such as high value trees, medicinal herbs, nuts, and fruits is permitted provided the conservation purpose is not compromised by the loss of vegetation or harvesting disturbance.

When using conservation cover, a separate plan shall be prepared for each field which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 327, including seeding periods; seed quality; seedbed preparation and seeding; use of temporary and/or nurse crops (if necessary); native species; seed mixtures; soil testing; fertilizer, lime, and pesticide requirements; weed and companion crop control; and maintenance of the vegetative cover. Mowing after the establishment period (except for noxious weed control) shall be done prior to April 15 or after August 1 to protect nesting wildlife. Exceptions can be made to allow mowing, burning, and/or chemical treatments when necessary to maintain the health and diversity of the plant community.

Cover Crop: A cover crop consists of grasses, legumes, and forbs planted for seasonal vegetative cover. This practice can help reduce wind and water erosion as well as reduce water quality degradation by utilizing excessive soil nutrients. Cover crops may either be established between successive production crops, or companion-planted or relay-planted into production crops. Species and planting dates should be selected that will not compete with the production crop yield or harvest. Cover crops should not be harvested for seed, nor should the residue be burned.

As discussed in Illinois NRCS CPS 340, plant species, seeding rates, seeding dates, and seeding depths should be determined using the Illinois Cover Crop Selection Tool (http://mccc.msu.edu/selector-tool/). Cover crops should be selected based on having the physical characteristics necessary to provide adequate erosion protection, their ability to effectively utilize the nutrients of concern, and their ability to produce higher volumes of organic material and root mass in order to maintain or increase soil organic matter. Use of deep-rooted species will help maximize nutrient recovery. The cover crop should be established as soon as practical prior to or after harvest of the production crop, and terminated as late as practical to maximize plant biomass production and nutrient uptake, while allowing time to prepare the field for the next production crop.

When using a cover crop, a separate plan shall be prepared for each field which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 340. The cover crop should be evaluated periodically to determine if the cover crop is meeting the planned purpose. If not, changes to the crop species, management, or technology should be implemented.

Critical area planting: Critical area planting is the establishment of permanent vegetation on sites that have or are expected to have high erosion rates, and/or on sites that have physical, chemical, or biological conditions that prevent the establishment of vegetation using normal practices. This practice can be used to stabilize a variety of areas, including: areas with existing or expected high rates of soil erosion by wind or water; riparian areas; sand dunes; stream and channel banks; and pond, lake, and other shorelines. In addition, critical area planting applies to highly disturbed areas such as active or abandoned mined lands; urban restoration sites; construction areas; conservation practice construction sites; areas needing stabilization before or after natural disasters such as floods, hurricanes, tornados and wildfires; and other areas degraded by human activities or natural events. Use of the area should be managed as long as necessary to stabilize the site and achieve the intended purpose.

To use this practice, a site investigation should be conducted to identify any physical, chemical, or biological conditions that could affect the successful establishment of vegetation. Plant species should then be selected based on any identified factors and should have the capacity to achieve adequate density and vigor within an appropriate period to stabilize the site sufficiently to permit suited uses with ordinary management activities. The amount of plant biomass and cover needed to reduce wind and water erosion to the planned soil loss objective shall be determined using the current approved wind and/or water erosion prediction technology. Seeding or planting shall be done at a time and in a manner that best ensures establishment and growth of the selected species. See Illinois NRCS CPS 342 for additional guidance on this and other considerations.

When using a critical area planting, a separate plan shall be prepared for each treatment unit which will use this practice. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 342, including species selection, seeding, restoring degraded areas such as gullies and deep rills, amending the soil if needed to ameliorate or eliminate physical or chemical conditions that inhibit plant establishment and growth, and shaping stream/channel banks and pond/lake shorelines so they are stable and allow for the establishment and maintenance of desired vegetation. Planted areas should be protected from damage by farm equipment, vehicular traffic, and livestock. Inspections should be performed on a regular basis, and reseeding or replanting, fertilization, pest control, and repair of damaged or scoured areas performed as needed to ensure that this practice continues to function as intended throughout its expected life.

Grassed Waterways: A grassed waterway is a shaped or graded channel, established with suitable vegetation, used to convey surface water at a non-erosive velocity by way of a broad and shallow cross-section to a stable outlet. The vegetative cover within the waterway reduces peak discharge and protects the channel surface from rill and gully erosion. Waterways are often constructed in naturally-occurring depressions where the water collects and flows to an outlet but can be constructed in any area where added water conveyance capacity and vegetative protection are needed to prevent erosion resulting from concentrated surface flow. In addition to reducing erosion, grassed waterways can positively affect water quality through uptake of other pollutants attached to soils such as nutrients. Criteria for constructing grassed waterways are discussed in Illinois NRCS CPS 412, including capacity, stability, width, depth, side slopes, drainage and outlets, and establishment of vegetation.

When using a grassed waterway, a separate plan shall be prepared for each treatment unit which will use this practice and which describes how the practice requirements will be applied to that particular area. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 342, The NRCS recommends these maintenance measures for grassed waterways:

1. Plant a good quality NRCS-approved seed mixture. Fertilization of the vegetation should not be necessary unless the waterway is proven to lack proper nutrients. Avoid spraying herbicides in or adjacent to the waterway. Mowing or periodic grazing of the vegetation may be appropriate to maintain waterway capacity and reduce sediment deposition. Noxious weeds should be controlled.

2. Inspect the area frequently for eroding areas, places needing reseeding, and damaged caused by machinery, herbicides, or livestock. Repair all areas as needed; e.g., minor rills or gullies may be repaired by reshaping and reseeding. Outlets should also be maintained to prevent gullies from forming. This may include reshaping and reseeding the outlet, or repairing components of structural outlets.

3. Maintain the width of the grass area when tilling and planting adjacent fields. If possible, bring row crop patterns up to (but not into) the waterway nearly on the contour. Do not plant end rows along the side of the waterway. Do not use the waterway as a turn area because this can result in damage to the vegetation.

4. Avoid driving up and down, or crossing, grassed waterways, especially during wet conditions. This can damage the vegetation and the ruts caused by tire tracks can lead to gullies.

5. When crossing grassed waterways, lift tillage equipment off of the waterway and turn off chemical application equipment.

Diversion: A diversion is a channel generally constructed across a slope with a supporting ridge on the lower side. This practice applies to all land uses where surface runoff water control and/or management are needed, where soils and topography are such that the diversion can be constructed, and where a suitable outlet is available or can be provided. Diversions can be used to support a variety of purposes, including the following:

1. Break up concentrations of water on long slopes, on undulating land surfaces, and on land that is generally considered too flat or irregular for terracing.

2. Protect terrace systems by diverting water from the top terrace where topography, land use, or land ownership prevents terracing the land above.

3. Intercept surface and shallow subsurface flow.

4. Reduce runoff damages from upland runoff.

5. Reduce erosion and runoff on urban or developing areas and at construction or mining sites.

6. Divert water away from active gullies or critically eroding areas.

7. Supplement water management on conservation cropping or stripcropping systems.

A diversion in a cultivated field should be aligned and spaced from other structures or practices to permit use of modern farming equipment. The side slope lengths should be sized to fit equipment widths when cropped. For vegetated diversions, areas of unsuitable subsurface, subsoil, or substratum material that limits plant growth should be avoided. Limiters include salts, acidity, root restrictions, etc., which may be exposed during implementation of the practice. Where these areas cannot be avoided, a soil scientist can provide recommendations for ameliorating the condition or, if that is not feasible, stock piling the topsoil, over-cutting the diversion, and replacing the topsoil over the cut area may be used to facilitate vegetative establishment. Wetland functions and values can be maximized with the diversion design while minimizing adverse effects. For example, diversion of upland water to prevent entry into a wetland may convert a wetland by changing the hydrology.

When using a diversion, a separate plan shall be prepared for each unit. Additional guidance and minimum plan elements are discussed in Illinois NRCS CPS 362, including capacity, cross-section, stability, protection against sedimentation, outlets for diverted water, and establishment of vegetation, where appropriate. As with other practices, regular maintenance should be performed to ensure the diversion is operating as intended. Maintenance activities include the following.

1. Perform periodic inspections, especially immediately following significant storms. Promptly repair or replace damaged components of the diversion as necessary.
2. Maintain diversion capacity, ridge height, and outlet elevations especially if high sediment yielding areas are in the drainage area above the diversion. Establish necessary clean-out requirements. Redistribute sediment as necessary to maintain the capacity of the diversion.
3. Keep each inlet for underground outlets clean and redistribute sediment buildup so that the inlet is at the lowest point. Inlets damaged by farm machinery must be replaced or repaired immediately.
4. Maintain vegetation and trees and control brush by hand, chemical, and/or mechanical means. Maintenance of vegetation will be scheduled outside of the primary nesting season for grassland birds.
5. Control pests that will interfere with the timely establishment of vegetation.

Water and Sediment Control Basins (WASCOBs): WASCOBs are earth embankments or combination ridge and channel systems constructed across the slopes of minor watercourses to reduce watercourse and gully erosion. These basins act as water detention basins and trap sediments (and the pollutants bound to the sediment) prior to them reaching a receiving water. The WASCOB reduces gully erosion by controlling flow within the drainage area, and the basins may be installed singly or in series as part of a system. The practice applies to sites where the topography is generally irregular, runoff and sediment damage land and improvements, and watercourse or gully erosion is a problem, Adequate and stable outlets from the basin are required to convey runoff water to a point where it will not cause damage. Additionally, sheet and rill erosion should be controlled by other conservation practices; i.e., the WASCOB would be part of another conservation system that adequately addresses resource concerns both above and below the basin. However, if land ownership or physical conditions preclude treatment of the upper portion of a slope, a WASCOB may be used to separate the upper area from and permit treatment of the lower slope.

WASCOBS should, at a minimum, be designed to be large enough to control runoff from at least a 10-year, 24-hour storm using a combination of flood storage and discharge through the outlet.

Additionally, the WASCOB must be designed to have the capacity to store at least the anticipated 10-year sediment accumulation. Otherwise, periodic sediment removal is required as part of the maintenance activities in order to maintain the required capacity. Locations are determined based on slopes, erosion areas, crop management, and soil survey data.

When using a WASCOB, a separate plan shall be prepared for each treatment unit which will use this practice. Local NRCS personnel can often provide information and advice for design and installation. Illinois NRCS CPS 638 also provides additional information on the design and maintenance requirements for WASCOBs, as well as information on cropping activity recommendations and requirements around the basin. Maintenance includes reseeding or planting the basins in order to maintain vegetation, where specified, and periodically checking them, especially after large storms, to determine the need for embankment repairs or mechanical removal of excess sediment. Inlets and outlets should be cleaned regularly. Damaged components should be replaced promptly.

Sediment Control Basins: A sediment control basin is a basin formed by an embankment or excavation, or combination of these, and constructed with an engineered outlet. These basins are used to capture and detain sediment-laden runoff, or other debris, for a sufficient length of time to allow it to settle out in the basin. They differ from WASCOBs in that the sediment control basins are the last line of defense for capturing sediment when erosion has already occurred and these basins act more like ponds; sediment control basins also differ in where they can be used.

The sediment control basin practice applies to urban land, construction sites, agricultural land, and other disturbed lands where a sediment basin offers the most practical solution. This includes areas where physical conditions or land ownership preclude treatment of a sediment source by the installation of erosion-control measures, and where failure of the basin will not result in loss of life, damage to homes, commercial or industrial buildings, main highways or railroads; or in the use of public utilities. A sediment basin should be located so that it intercepts as much of the runoff as possible from the disturbed area while minimizing the number of entry points for runoff into the basin. These basins should also be located to minimize interference with construction or farming activities but should not be located in perennial streams.

The sediment basin must have sediment storage capacity, detention storage, and temporary flood storage capacities. Flood storage capacity is based on the design storms for the principal and auxiliary spillways. Sediment storage should be for a minimum of 900 ft^3/acre of disturbed area, and the detention storage for a minimum of 3,600 ft^3/acre of drainage area. For maximum sediment retention, the basin should be designed so that the detention storage remains full of water between storm events. However, if site conditions, safety concerns, or local laws preclude a permanent pool of water, all or a portion of the detention and sediment storages may be designed to be dewatered between storm events.

A large sediment basin may have an effect on the peak discharge rate from a watershed and this should be taken into account during and placement of the basin. In these cases, steps should be taken to mitigate any potential negative effects on riparian habitat downstream of the structure. In many cases, the use of a sediment basin alone may not provide sufficient protection against offsite sedimentation. To work most effectively, the sediment basin should be the last practice in a series of erosion control and sediment capturing practices installed in the disturbed area. This incremental approach will reduce the load on the basin and improve the effectiveness of the overall effort to prevent offsite sedimentation problems. Additionally, because the sediment basin must be designed to handle all of the contributing drainage whether it is from disturbed areas or not, diverting runoff from undisturbed areas away from the basin will improve the function of the basin.

When using a sediment control basin, a separate plan shall be prepared for each treatment unit which will use this practice. Local NRCS personnel can often provide information and advice for design and installation. Illinois NRCS CPS 350 also provides additional information on the design and maintenance requirements for sediment control basins. Maintenance includes periodic inspections and maintenance of the embankment, principal and auxiliary spillways, and dewatering device especially following significant runoff events. Damaged components should be replaced promptly and accumulated sediment should be removed when it reaches the pre-determined storage elevation for the basin. Where applicable, planting, reseeding, and mowing of the basin should be performed in order to maintain vegetation and to control trees, brush, and invasive species.

Streambank and Shoreline Protection: Treatments used to stabilize and protect banks of streams or constructed channels, and shorelines of lakes, reservoirs, or estuaries, are discussed in Illinois NRCS CPS 580. This practice can be used to help maintain the flow capacity of streams or channels, and to reduce the offsite or downstream effects of sediment resulting from bank erosion.

Prior to implementation of the practice, an assessment of the unstable streambank or shoreline sites should be conducted in sufficient detail to identify the causes contributing to the instability (e.g., livestock access, watershed alterations resulting in significant modifications of discharge or sediment production, and in channel modifications such as water level fluctuations and boat-generated waves). Protective treatments need to be compatible with the bank or shoreline materials, water chemistry, channel or lake hydraulics, and slope characteristics above and below the water line.

Treatment area designs should provide for protection of installed treatments from overbank flows resulting from upslope runoff and flood return flows, and from bank seepage. The designs should also account for any anticipated ice action, wave action, and fluctuating water levels. End sections of treatment areas shall be adequately anchored to existing treatments, terminate in stable areas, or be otherwise stabilized to prevent flanking of the treatment. Livestock traffic along treated streambanks and shorelines shall be limited to stable access points. All disturbed areas around protective treatments shall be protected from erosion through cultivation or selected vegetation suitable for the site conditions and intended purposes.

Streambanks should be assessed to determine if the causes of instability are local (e.g., poor soils, high water table in banks, alignment, obstructions deflecting flows into the bank, etc.) or systemic (e.g., aggradation due to increased sediment from the watershed, increased runoff due to urban development in the watershed, degradation due to channel modifications, etc.). Bank protection treatment should not be installed in channel systems undergoing rapid and extensive changes in bottom grade and/or alignment unless the treatment is designed to control or accommodate the changes. Bank treatment shall be constructed to a depth at or below the anticipated lowest depth of streambed scour. When appropriate, a buffer strip and/or diversion may be established at the top of the bank or shoreline protection zone to help maintain and protect installed treatments; improve their function; and filter out sediments, nutrients, and pollutants from runoff.

Some available approaches to potentially decrease nonpoint TSS, sedimentation/siltation, and/or pollutant source loads, as well as helping to stabilize eroding banks include the following:

1. Stone Toe Protection: Non-erodible materials are used to protect the eroding banks of a stream. Meandering bends found in the watershed could potentially be stabilized by placing the hard armor only on the toe of the bank. Stone toe protection is most commonly implemented "using stone quarry stone that is sized to resist movement and is placed on the lower one third of the bank in a windrow fashion" (STREAMS 2005).
2. Rock Riffle Grade Control: Naturally stable stream systems typically have an alternating riffle-pool sequence that helps to dissipate stream energy. Riffle rock grade control places loose rock grade control structures at locations where natural riffles would occur to create and enhance the riffle-pool flow sequence of stable streams. By installing riffle rock in an incised channel, the riffles will raise the water surface elevation resulting in lower effective bank heights, which increases the bank stability by reducing the tractive force on the banks (STREAMS 2005).
3. Floodplain Excavation: Rather than raising the water level, Floodplain Excavation lowers the floodplain to create a more stable stream. Floodplain Excavation uses mechanical means to restore the floodplain by excavating and utilizing the soil that would eventually be eroded away and deposited in the stream (STREAMS 2005).
4. Rock chutes: Rock chutes are riprap lined water conveyance structures used to move water down a slope in a non-erosive manner. The main purpose of a rock chute is to reduce channel flow velocity by dissipating energy and to provide a stable grade at the outlet to prevent erosion.

The extent of streambank erosion within and upstream of the Drowning Fork (DGLC-01) and Prairie Creek (DGZN-01) impaired segments is unknown. Further investigation is recommended to determine the extent that erosion control measures could help manage TSS and/or sedimentation/siltation loads in the reaches.

Grade Stabilization Structure: A grade stabilization structure is a structure used to control the grade in either natural or constructed channels to reduce erosion and improve water quality. This practice does not apply to structures designed to control the rate of flow or to regulate the water level in channels, or to structures designed to stabilize the bed or bottom of a continuous flow (non-intermittent) stream channel. Grade stabilization structures may be open flow or closed flow. Open flow structures, such as toe walls or chutes, are used where there is downstream stability. Closed structures are required where the downstream is unstable but can also be used where it is stable. In this case, topography, cost, or landowner preference can sometimes dictate what type of structure is used.

Regardless of the type of structure used, sufficient discharge should be provided to minimize crop damaging water detention. Fences may be needed to protect structures, earth embankments, and vegetated spillways from livestock, or, near urban areas, to control access and exclude traffic. When designing, and implementing each structure, consideration should be given to the effect of the structure on fluvial geomorphic conditions (especially in natural channels), aquatic habitat, and landscape resources and forms; i.e., select sites to reduce adverse impacts or create desirable focal points.

The following general considerations apply to either open or closed flow structures. The crest of the inlet should be set at an elevation that will stabilize the channel and prevent upstream head cutting. Runoff should be able to safely pass through a principal spillway or a combination of principal and auxiliary spillways. Soil material proposed for use as fill and for foundation must be verified as suitable for the purpose, using soil borings, review of existing data, or other suitable means. A foundation cutoff may be needed if the structure will impound permanent water and the total embankment height is greater than 4 feet. See Illinois NRCS CPS 410 for more information. Seepage control is needed for all embankments over 25 feet high. For embankments less than 25 feet high, seepage control is to be included if pervious layers are not intercepted by the cutoff, seepage could create swamping downstream, or such control is needed to ensure a stable embankment. Seepage may be controlled by foundation, abutment, or embankment drains and/or reservoir blanketing.

The grade stabilization structure must include an embankment or berm to direct flow to the entrance of the principal spillway. See Illinois NRCS CPS 410 for more information on sizing of the embankment depending on concurrent use; e.g., public road. The upstream and downstream side slopes of the settled embankment must each be no steeper than two horizontal to one vertical. For all embankments with effective height greater than 4 feet, the sum of the upstream and downstream side slope of the settled embankment must be at least 5 horizontal to one vertical. All slopes must be designed to be stable, even if flatter side slopes are required. Downstream or upstream berms can be used to help achieve stable embankment sections. An auxiliary spillway must be provided for each grade stabilization structure unless the principal spillway is large enough to pass the peak discharge from the design event, and associated trash, while still meeting the freeboard requirements. See Illinois NRCS CPS 410 for more information on settlement allowance requirements, freeboard requirements, and auxiliary spillways. The exposed surfaces of earthen embankments, earth spillways, non-cropped borrow areas, and other disturbed areas should be seeded or sodded following construction or covered by an inorganic cover such as gravel.

When using a grade stabilization structure, a separate plan shall be prepared for each structure. Additional information on the types of structures and their design requirements may be found in Illinois NRCS CPS 410. As with other practices, regular maintenance should be performed to ensure the structure is operating as intended. Maintenance activities include the following: periodic inspection of the structure and prompt repair of any identified concerns; prompt removal of sediment once the accumulation reaches the pre-determined storage elevation; periodic removal of trees, brush, and invasive species; and maintenance of vegetative cover and immediate seeding of bare areas as needed.

Stream Crossing: A stream crossing is a stabilized area or structure constructed across a stream to provide a travel way for people, livestock, equipment, or vehicles. Use of established stream crossings can reduce streambank and streambed erosion, as well as improve water quality by reducing sediment, nutrient, organic, and inorganic loading to the stream. This practice applies to all land uses where an intermittent or perennial watercourse exists and a ford, bridge, or culvert type crossing is needed.

Stream crossings should be located in areas where the streambed is stable or can be stabilized, and preferably where the crossing can be installed perpendicular to the direction of stream flow. Each proposed crossing site should be evaluated for variations in stage and discharge, hydraulics, aquatic organism life stages, fluvial geomorphic impacts, sediment transport and flow continuity, groundwater conditions, and movement of woody and organic material. The crossing should then be designed to account for the know range of factors. Crossings should not be placed where the channel grade or alignment changes abruptly, excessive seepage or instability is evident, overfalls exist (evidence of incision and bed instability), where large tributaries enter the stream, within 300 feet of know spawning areas for listed species, or in wetland areas. The width of the crossing will depend upon its intended purpose. Side slope cuts and fills will depend on the channel materials involved; e.g., soil vs. rock. Surface runoff should be diverted around the approaches to prevent erosion. All areas around the crossing to be vegetated should be planted as soon as practical after construction to minimize erosion.

When using a stream crossing, a plan shall be prepared for each crossing as discussed in Illinois NRCS CPS 578. The CPS also provides additional guidance for each type of crossing. Maintenance activities should continue throughout the life of the practice, and at a minimum, include regular inspections and repairs of the crossing's components. Accumulated organic material, woody material, and excess sediment should be removed periodically.

Urban Soil/Erosion BMPs: Section 2.3 of this report indicates that only about 5 percent of the watershed is developed or urban. Because the developed/urban percentage of the watershed is small compared to the agricultural and natural percentages, this implementation plan does not focus on urban BMPs.

In the developed/urban areas, runoff from urban areas, decreased infiltration associated with the prevalence of impervious surfaces, and increased overland flow can contribute to high sediment loads in the impaired stream segment. Most modern developments route runoff from impervious surfaces directly into storm sewers or paved channels which effectively convey the pollutants, including sediments and suspended solids, into receiving water bodies with little to no opportunity for infiltration or filtering. The storm sewers and lined channels then convey the runoff water downstream at a much faster rate than would normally occur in a natural, non-urbanized, setting. The increased flow rate leads to several issues including stream channel erosion and/or downcutting of the channel, both of which contribute to sedimentation/siltation and suspended solid loads. Alterations to natural storage and conveyance functions (e.g., stream channel modification) can also result in increased flow velocities and volumes subsequently causing stream channel erosion and increased flooding.

In addition to flow and conveyance concerns, building and road construction activity in and adjacent to water bodies and wetlands create both short-term and long-term effects on water quality. Although erosion on construction sites often affects only a relatively small acreage of land in a watershed, it is a major source of sediment because the potential for erosion on highly disturbed land is commonly 100 times greater than on agricultural land (Brady and Weil 1999). The primary short-term effect is erosion in the denuded areas, those lacking vegetation, with potential deposition of sediment in nearby waterbodies. The long-term effects of urban development upon waterbodies and wetlands primarily results in the elimination of vegetation and other natural materials. The typical consequences of these alterations include reduced shading and a resultant increase in water temperature, reduced capacity for pollutant filtering, and increased stream instability and erosion.

The Association of Illinois Soil and Water Conservation Districts maintains and updates the Illinois Urban Manual (http://www.aiswcd.org/illinois-urban-manual/) which is "intended for use as a technical reference by developers, planners, engineers, government officials and others involved in land use planning, building site development, and natural resource conservation in rural and urban communities and developing areas." According to McDonough County SWCD staff, there are no known urban stormwater BMPs in use within the watershed.

9.5 BMP Recommendations for Increasing DO in Streams

As discussed in Section 5.1.1.2, the following streams are listed for impairment of aquatic life use due to low DO concentrations:

1. Rock Creek (DGO-01)
2. La Harpe Creek (DGP)
3. La Harpe Creek (DGP-01)
4. Prairie Creek (DGZN-01)
5. South Branch La Moine River (DGZR)

Pollutant sources and linkages for stream segments impaired by low DO were analyzed through the QUAL2K modeling effort. Modeling indicated that low DO levels in this watershed are driven primarily by a combination of nutrient enrichment and accompanying plant growth and respiration, and high SOD. Potential causes of high SOD and low reaeration are watershed and streambank erosion which increase sedimentation and widen streambeds.

Certain point sources, as well as runoff from nonpoint sources likely contribute loading of sediment and oxygen-demanding materials into the impaired segments. Another potential contributing factor to low DO concentrations in the streams is increased water temperature often caused by loss of riparian vegetation or high temperature effluent discharges. DO impairments are often most effectively addressed by focusing on reducing organic loads which consume oxygen through decomposition as well as reducing nutrient loads that can cause excess algal growth, which can also lead to depletion of DO. Management measures for these segments will focus on reducing nonpoint source loading through sediment and surface runoff controls, reducing point source loading through potential changes to NPDES permits, reducing stream and effluent temperatures, and reducing stagnant conditions by increasing reaeration.

9.5.1 Municipal/Industrial Point Sources of Oxygen-Demanding Materials

Table 5-11 listed a total of 19 permitted facilities (11 individual permits and 8 general permits) within the Upper La Moine River watershed. In total, three permitted facilities have the potential to discharge oxygen-demanding materials into the DO impaired stream segments. **Table 9-4** contains permit information on each of the facilities as well as model inputs for available parameters used in the QUAL2K modeling discussed in Section 8 of this report.

Illinois EPA will evaluate the need for point source controls through the NPDES permitting program as each facility's permit is due for renewal. The existing permit limits are currently believed to be adequately protective of aquatic life uses within the impaired segments. The NPDES permitted facilities' DMRs should continue to be monitored and ongoing violations of the effluent limits at any of the permitted facilities may prompt further regulatory action.

Table 9-4 Point Source Discharges and QUAL2K Inputs for Impaired Stream Segments

NPDES Permitted STP	NPDES Permit Number	Receiving Waterbody	303(d) Listed Stream Segment	Avg. Daily Flow (MGD)	*DO (mg/L)*	*Fast CBOD (mg O_2/L)*
Blandinsville STP	IL0072672	Unnamed tributary to Baptist Creek	DPG-01	0.093	≥5.5[1]	25[2]
Carthage STP	IL0021229	Prairie Creek	DGZN-01	0.5	≥5.5[1]	25[2]
La Harpe STP	ILG580093	South Branch of La Moine River	DGZR	0.245	≥6.0[1]	25[2]

[1] Aug-Feb monthly average as per NPDES permit limit requirement
[2] Monthly average as per NPDES permit limit requirement

9.5.2 Nonpoint Sources of Oxygen-Demanding Materials

Potential nonpoint sources for oxygen-demanding materials include nutrient loss (associated with both agricultural and urban land uses), streambank erosion, low stream flow, and high water temperatures. BMPs evaluated for treatment of these nonpoint sources include:

1. Nutrient management
2. Reaeration/Streambank Stabilization
3. Filter strips and Riparian Buffers
4. Farming/soil retention methods as discussed in Section 9.4, including field borders, conservation tillage, contour farming, conservation crop rotation, stripcropping, conservation cover, cover cropping, terracing, and critical area planting.

Soil retention methods, and streambank stabilization and erosion control, can limit the oxygen-demanding material entering the stream. Organic material and nutrient loads originating from cropland can be treated with a combination of riparian buffers or grass filter strips. A reduction in nutrient loads will decrease the biological productivity and, along with the decreased inputs of oxygen-demanding materials, will lead to a reduction in the levels of SOD present in the stream. Instream management measures for DO focus on reaeration techniques. The Q2K models used to develop the TMDLs utilize reaeration coefficients. Increasing reaeration within the stream by physical means will increase DO in the impaired segments.

Filter Strips: As mentioned in Section 9.4, filter strips can be used as a control to reduce both pollutant loads from runoff and sedimentation to impaired waterbodies. Excess nutrients in streams can cause excessive algal growth, which can deplete DO in streams. Organic debris in topsoil contributes to the BOD in water bodies. Therefore, increasing the length of stream segments bordered by grass and riparian buffer strips will decrease the amount of BOD and nutrient loads associated with sediment loads entering the stream segments.

Filter strips were discussed in Section 9.4 as an option for management of TSS and other pollutant loading within the watershed. Filter strips will have a similar impact in reducing loads of nutrients from overland runoff by slowing and filtering nutrients out of runoff, helping to reduce stream water temperatures thereby increasing the waterbody DO saturation level, and providing bank stabilization thereby decreasing erosion and re-sedimentation. While it is known that filter strips help control BOD by removing organic loads associated with sediment from runoff, no studies were identified as providing an estimate of removal efficiency. Grass filter strips can remove as much as 65 percent of sediment and 75 percent of total phosphorus from runoff, so it is assumed that the removal of BOD contributors falls within this range (USEPA 2003).

Filter strip areas for nutrient control are calculated as described in Section 9.4. Based on those calculations, and as noted in **Table 9-2**, there are approximately 1,171 acres of agricultural land within a 180-foot buffer developed for DGLC-01 and its tributaries. Similarly, there are approximately (**Figure 9-1**):

1. 363 acres of agricultural land within the 234-foot buffer developed for DGO-01 and its tributaries,
2. 417 acres of agricultural land within the 234-foot buffer for DGP and its tributaries,
3. 1,251 acres of agricultural land within the 234-foot buffer for DGP-01 and its tributaries,
4. 447 acres of agricultural land within the 234-foot buffer for DGPC-01 and its tributaries,
5. 262 acres of agricultural land within the 234-foot buffer for DGZN-01 and its tributaries, and
6. 320 acres of agricultural land within the 234-foot buffer for DGZR and its tributaries.

Riparian Buffers: Riparian corridors, including both the stream channel and adjacent land areas, are important components of watershed ecology. Riparian vegetation, specifically the shade-producing variety, plays a significant role in controlling stream temperature change. The shade provided will reduce both solar radiation loading to the stream and peak temperatures during the growing season which can in turn increase the water body DO saturation level. Furthermore, preserving natural vegetation along stream corridors can effectively reduce water quality degradation associated with development. The root structure of the vegetation in a buffer enhances infiltration of runoff and subsequent trapping of nonpoint source pollutants, such as phosphorus. The buffers are only effective in this manner, however, when the runoff enters the buffer as a slow moving, shallow sheet. Concentrated flow in a ditch or gully will quickly pass through the buffer offering minimal opportunity for retention and uptake of pollutants.

Even more important than the filtering capacity of the buffers is the protection the herbaceous varieties provide to streambanks. The rooting systems of the vegetation serve as reinforcements in streambank soils, which help to hold streambank material in place and minimize erosion. Due to the increase in stormwater runoff volume and peak rates of runoff associated with agriculture and other land development, stream channels are subject to greater erosional forces during stormflow events. Thus, preserving natural vegetation along stream channels minimizes the potential for water quality and habitat degradation due to streambank erosion as well as that additional pollutant or sediment load entering the stream.

Converting land adjacent to streams for the creation of riparian buffers will provide stream bank stabilization, stream shading, and nutrient uptake and trapping from adjacent areas. Minimum buffer widths of 25 feet are required for water quality benefits. Higher removal rates are provided with greater buffer widths. The USEPA (2003) reports phosphorus removal rates of approximately 25 to 30 percent for 30 foot wide buffers and 70 to 80 percent for 60 to 90 foot wide buffers. Riparian corridors can typically treat a maximum of 300 feet of adjacent land before runoff forms small channels that short circuit treatment. In addition to the treated area, the land converted from agricultural land to buffer strip will generate up to a 90 percent lower nutrient load based on data presented in Haith et al. (1992).

Land use data for the Upper La Moine River watersheds were clipped to 25-foot buffer zones created around the impaired stream segments and their tributaries. Grassland, forest, and agricultural areas within the 25-foot buffer zones are shown in **Table 9-5** by segment.

There are approximately:

1. 215 acres within 25 feet of Drowning Fork (DGLC-01); approximately 34 of these acres are existing grassland or forest, while 168 acres are currently classified as agricultural;
2. 95 acres within 25 feet of Rock Creek (DGO-01); approximately 54 of these acres are existing grassland or forest, while 36 acres are currently classified as agricultural;
3. 117 acres within 25 feet of La Harpe Creek (DGP); approximately 85 of these acres are existing grassland or forest, while 27 acres are currently classified as agricultural;
4. 363 acres within 25 feet of La Harpe Creek (DGP-01); approximately 228 of these acres are existing grassland or forest, while 100 acres are currently classified as agricultural;
5. 128 acres within 25 feet of Baptist Creek (DGPC-01); approximately 79 of these are acres are existing grassland or forest, while 40 acres are currently classified as agricultural;
6. 58 acres within 25 feet of Prairie Creek (DGZN-01); approximately 32 of these acres are existing grassland or forest, while 26 acres are currently classified as agricultural; and

7. 77 acres within 25 feet of South Branch La Moine River (DGZR); approximately 49 of these acres are existing grassland or forest, while 26 acres are currently classified as agricultural.

Landowners should assess parcels adjacent to the stream channels and maintain or improve existing riparian areas or potentially convert cultivated lands.

Table 9-5 Total Area and Area of Grassland, Forest, and Agricultural Land Within 25-Foot Buffer, by Stream Segment

Stream Name	**Segment ID**	**Area in 25 ft Buffer** (Acres)	**Grassland in 25 ft Buffer** (Acres)	**Forest in 25 ft Buffer** (Acres)	**Agricultural Land in 25 ft Buffer** (Acres)
Drowning Fork	DGLC-01	215	0	34	168
Rock Creek	DGO-01	95	0	54	36
La Harpe Creek	DGP	117	0	85	27
La Harpe Creek	DGP-01	363	0.3	228	100
Baptist Creek	DGPC-01	128	0.3	79	40
Prairie Creek	DGZN-01	58	0	32	26
South Branch La Moine River	DGZR	77	0	49	26

If this BMP is selected for use by a landowner, a separate plan shall be prepared for each area which will use this practice. Minimum plan elements are discussed in Illinois NRCS CPS 390 for herbaceous riparian covers and Illinois NRCS CPS 391 for forest riparian covers, along with additional guidance such as plant selection and required maintenance activities.

Nutrient Management: Nutrient management programs could result in reduced nutrient loads to the impaired stream segments in the Upper La Moine watershed. Crop management of nitrogen and phosphorus originating in the agricultural portions of the watershed can be accomplished through Nutrient Management Plans (NMPs) that focus on increasing the efficiency with which applied nutrients are used by crops, thereby reducing the amount available to be transported to both surface water and groundwater. **Table 9-3** listed the number of acres in each watershed that are currently under cultivation; these areas may benefit from NMPs.

The overall goal of nutrient reduction from agriculture should be to increase the efficiency of nutrient use by balancing nutrient inputs in feed and fertilizer with outputs in crops and animal produce as well as to manage the concentration of nutrients in the soil. The four "Rs" of nutrient management are applying the right fertilizer source at the right rate at the right time and in the right place. It is not unusual for crops in fields or portions of fields to show nutrient deficiencies during periods of the growing season, even where an adequate NMP is followed. The fact that nutrients are applied does not necessarily mean they are available. Plants obtain most of their nutrients and water from the soil through their root system. Any factor that restricts root growth and activity has the potential to restrict nutrient availability and result in increased nutrient runoff.

Reducing nutrient loss in agricultural runoff may be brought about by source and transport control measures, such as filter strips or grassed waterways. The NMPs account for all inputs and outputs of nutrients to determine reductions. NMPs typically include the following measures:

1. A review of aerial photography and soil maps
2. Recommendation for regular soil testing – Traditionally, soil testing has been used to decide how much lime and fertilizer to apply to a field. With increased emphasis on precision agriculture, economics, and the environment, soil tests have become a logical tool to determine areas where adequate or excessive fertilization has taken place. Additionally, they can be used to monitor nutrient buildup in soils due to past fertility practices and aid in determining maintenance fertilization requirements. Appropriate soil sampling and analysis techniques are described in the Illinois Agronomy Handbook (http://extension.cropsciences.illinois.edu/handbook/).
3. A review of current and/or planned crop rotation practices
4. Establishment of yield goals and associated nutrient application rates – Matching nutrient applications to crop needs will minimize the potential for excessive buildup of phosphorus soil tests and reallocate phosphorus sources to fields or areas where they can produce agronomic benefits.
5. Development of nutrient budgets with planned application rates (which may be variable), application methods, and timing and form of nutrient application
6. Identification of sensitive areas and restrictions on application when land is snow covered, frozen or saturated

Phosphorus is listed as a potential cause of impairment in some areas of the Upper La Moine watershed. Regional differences in phosphorus-supplying power are shown in Figure 8-4 of the Illinois Agronomy Handbook (http://extension.cropsciences.illinois.edu/handbook/). The differences were broadly defined primarily based on variability in parent material, degree of weathering, native vegetation, and natural drainages. For example, soils developed under forest cover appear to have more available subsoil phosphorus than those developed under grass. Soil test values are used to determine when buildup and maintenance of soil phosphorus is needed to supplement soils with low phosphorus-supplying power often found in the Upper La Moine watershed. Specific application amounts should be determined by periodic soil testing. Subsoil levels of phosphorus in the southern Illinois region may be rather high by soil test in some soils, but this is partially offset by conditions that restrict rooting (http://extension.cropsciences.illinois.edu/handbook/).

It should be noted, however, that excessively high-phosphorus soil test levels should not be maintained. While soil test procedures were designed to predict where phosphorus was needed, not to predict environmental problems, the likelihood of phosphorus loss increases with high-phosphorus test levels. Environmental decisions regarding phosphorus applications should include such factors as distance from a significant lake or stream, infiltration rate, slope, and residue cover. One possible problem with using soil test values to predict environmental problems is in sample depth. Normally samples are collected to a 7-inch depth for predicting nutritional needs. For environmental purposes, it would often be better to collect the samples from a 1- or 2-inch depth, which is the depth that will influence phosphorus runoff. Another potential problem is variability in soil test levels within fields in relation to the dominant runoff and sediment-producing zones. Several fertilizer placement recommendations are described in the Illinois Agronomy Handbook (http://extension.cropsciences.illinois.edu/handbook/). However, given the propensity of phosphorus to bind tightly to soil particles and subsequently enter streams through erosion, the deep fertilizer placement technique may be most appropriate in phosphorus impaired areas such as the Big Muddy River watershed. Under the deep placement technique, the fertilizer is placed 4 to 8 inches deep into the soil rather than being spread near the surface.

Reaeration/Bank Stabilization: The purpose of reaeration is to directly increase DO concentrations in streams. Physical measures that will assist in increasing reaeration of a stream include bank stabilization, channel modification, and the addition of pool and riffle sequences. Bank stabilization reduces erosion by planting vegetation along the bank or modifying the channel to decrease the slope of the bank. Non-eroding materials, such as stone-toe protection (as describe in Section 9.4), may also be used for bank stabilization. The addition or enhancement of pool and riffle sequences would increase reaeration by increasing turbulence. The increased turbulence intensifies interaction between air and water, which draws air into the river thereby increasing aeration. Rock riffle grade controls are further described in Section 9.4. Expanding DO monitoring to several locations along the impaired segments, and a longitudinal survey of the topography of impaired reaches, could help identify reaches that would benefit the most from an increase of turbulence.

9.6 BMP Recommendations for Additional Nutrient Reduction

The Drowning Fork segment DGLC-01 is impaired by elevated phosphorus levels while the Prairie Creek segment DGZN-01 and South Branch La Moine River segment DGZR are listed for impairment due to elevated total phosphorus and low DO. South Branch La Moine River segment DGZR is also listed for impairment by ammonia. Note that many of the data associated with these impairments are from 1988. A WLA for the La Harpe STP was set for ammonia using the facility's DAF and calculated seasonal standards for total ammonia. The facility is currently under a general permit. The current nutrient conditions in the streams are unknown. Additional monitoring is recommended to confirm that impairment still exists. The Illinois EPA Permit Section will evaluate the need for an individual permit for the facility when it comes up for renewal.

The nutrient reductions needed for these segments are discussed in Section 8.3.3 and 8.4.1. The analyses completed for dissolved oxygen indicate that, given the best available data and constructed models, low DO levels are driven primarily by a combination of nutrient impairment, high SOD, and point loads of oxidizing materials (CBOD). Runoff from nonpoint sources likely contributes loading of oxygen-demanding materials into the impaired segments as well. Another potential contributing factor to low DO concentrations in the stream is increased water temperature which may be caused by loss of riparian vegetation or higher temperature effluent discharges.

To achieve a reduction of nutrients for segments DGLC-01, DGZN-01 and DGZR, management measures must address loading through point-source discharge and, in particular, nonpoint source sediment and surface runoff controls. DO impairments are often most effectively addressed by focusing on reducing organic loads which consume oxygen through decomposition as well as reducing nutrient loads that can cause excess algal growth, which in turn can also lead to depletion of DO. Management measures for the DO impairment in segments DGZN-01 and DGAR focus on reducing nonpoint source loading through sediment and surface runoff controls, reducing stream temperatures, and reducing stagnant conditions by increasing reaeration.

9.6.1 Nonpoint Sources of Nutrients and Oxygen-Demanding Materials

Nonpoint sources of nutrients include septic systems and both urban and rural land runoff. Potential nonpoint sources for oxygen-demanding materials include nutrient loss (associated with both agricultural and urban land uses), streambank erosion, low stream flow, and high water temperatures. BMPs that could be used for treatment of these nonpoint sources include:

1. Nutrient management
2. Filter strips and riparian buffers
3. Any farming/soil retention methods such as those discussed in Section 9.3, including field borders, conservation tillage, contour farming, conservation crop rotation, stripcropping, conservation cover, cover cropping, terracing, critical area planting, WASCOBs, and sediment basins
4. Wetlands
5. Phosphorus-based lawn fertilizer restrictions

For oxygen-demanding materials, BMPs may also include:

6. Reaeration/bank stabilization

Soil retention practices could help reduce nutrient and sediment loads into the impaired stream segment by reducing erosion of soils. As indicated in **Table 2-1**, approximately 241,682 acres in the Upper La Moine River watershed are under cultivation, which accounts for 65 percent of the watershed area. Farming practices in each subbasin should be assessed to determine methods being used, where they can be improved upon, and what additional practices might be appropriate to help reduce sediment loads.

Filter Strips: As discussed in Sections 9.4 and 9.6, filter strips can be used as a control to reduce both pollutant loads from runoff, such as phosphorus, and sedimentation to impaired waterbodies, as well as help to increase DO. Filter strip areas for nutrient control are calculated as described in Section 9.3. Based on those calculations, and as noted in **Table 9-2**, there are approximately 3,784 acres of agricultural land within the respective buffers for DGLC-01, DGO-01, DGP, DGP-01, DGZN-01 and DGZR and their tributaries (see **Figure 9-1**).

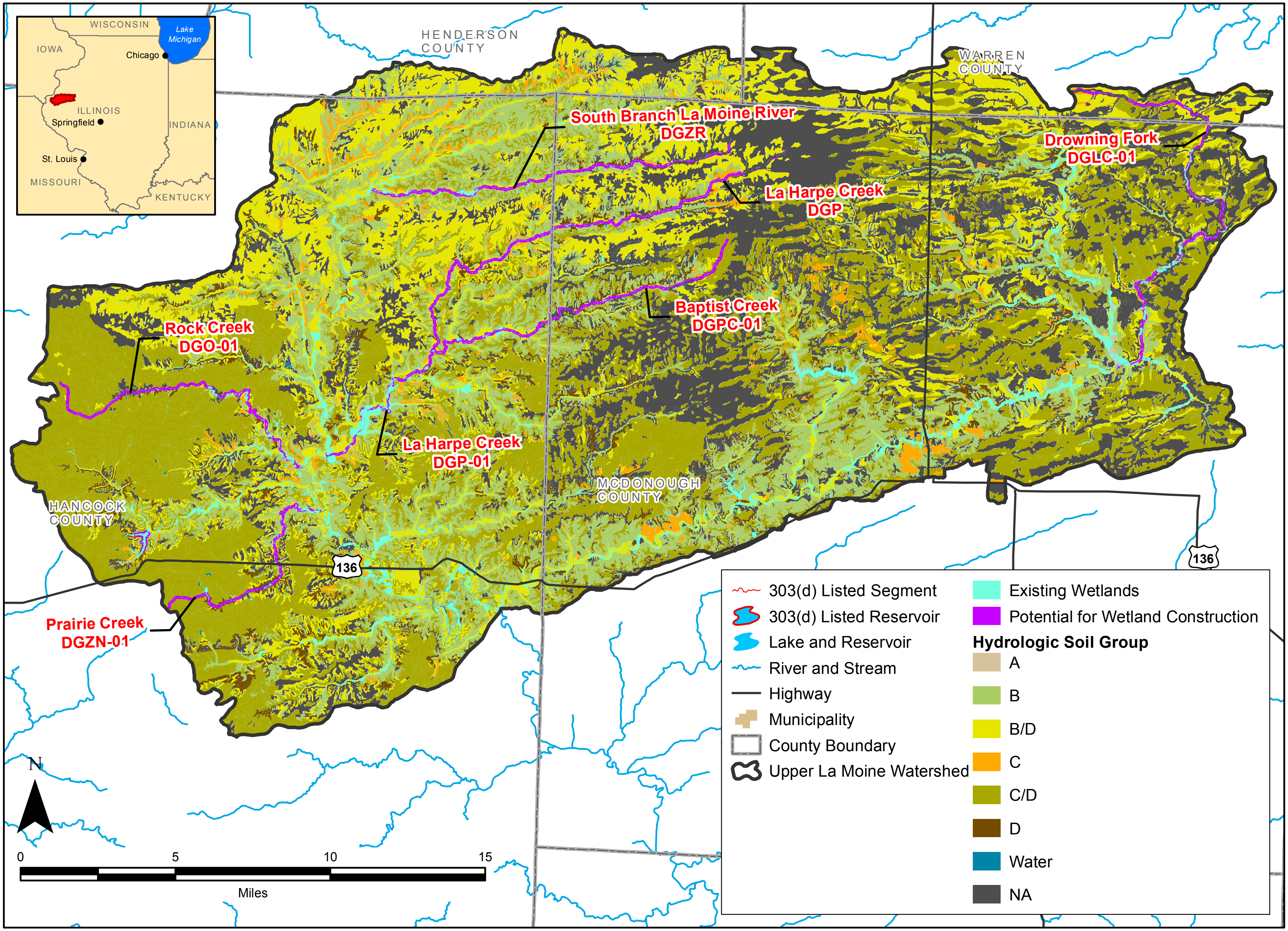
Riparian Buffers: Riparian vegetation in a buffer enhances infiltration of runoff and subsequent trapping of nonpoint source pollutants such as phosphorus. The vegetation also serves to reinforce streambank soils, which helps minimize erosion. These buffers are described in more detail in Section 9.7. Grassland, forest, and agricultural areas within the 25-foot buffer zone for the Drowning Fork (DGLC-01), Rock Creek (DGO-01), La Harpe Creek (DGP), La Harpe Creek (DGP-01), Prairie Creek (DGZN-01), and South Branch La Moine River (DGZR) watersheds are shown in **Table 9-4**. There are 925 acres within 25 feet of the segment. Approximately 483 of these acres are existing grassland or forest, while 383 acres are currently classified as agricultural. Landowners should assess parcels adjacent to the stream channels and maintain or improve existing riparian areas or potentially convert cultivated lands.

Nutrient Management: As described in Section 9.6, nutrient management programs could result in reduced nutrient loads to the impaired stream segments. As indicated in **Table 9-3**, approximately 46,897 acres in the Drowning Fork, Prairie Creek, and South Branch La Moine River watersheds are under cultivation, 92.4%, 75.9%, and 75.5% of the total watersheds, respectively, and these areas may benefit from NMPs.

Wetlands: The use of wetlands as a structural control is applicable to nutrient reduction. To treat loads from agricultural runoff, such as phosphorus, wetlands could potentially be constructed at select locations where more focused runoff from fields occurs; e.g., downstream of a tile drainage system. Wetlands are effective BMPs for phosphorus and sediment control because they:

1. Prevent floods by temporarily storing water, allowing the water to evaporate or percolate into the ground
2. Improve water quality through natural pollution control such as plant nutrient uptake
3. Filter sediment
4. Slow overland flow of water thereby reducing soil erosion

A properly designed and functioning wetland can provide very efficient treatment of pollutants, such as phosphorus. Design of wetland systems is critical to the sustainable functionality of the system and should consider soils in the proposed location, hydraulic retention time, and space requirements. In general, soils classified as hydric are most suitable for wetland construction. The current extent of soils classified as hydric by the NRCS, as well the current extent of existing USFWS classified wetlands in the impaired segments, are shown in **Figure 9-2**. Areas near waterways that are not currently classified as wetlands but have hydric soils present are typically strong candidates for potential wetland construction. Existing wetland areas may also be candidates for reconstruction or enhancement to improve their nutrient uptake capacity. These data layers are developed on a large-scale and onsite soil investigation and wetland delineation is typically necessary for verification of the suitability of a given area for wetland construction.



CDM Smith

Upper La Moine River
Hydric Soils, Existing Wetlands, and Potential for Wetland Construction

FIGURE 9-2

Constructed wetlands, which comprise the second or third stage of a nonpoint source treatment system, can be very effective at improving water quality. Studies have shown that artificial wetlands designed and constructed specifically to remove pollutants from surface water runoff have removal rates of greater than 90 percent for suspended solids, up to 90 percent for total phosphorus, 20 to 80 percent of orthophosphate, and 10 to 75 percent for nitrogen species (Johnson, Evans, and Bass 1996; Moore 2006; USEPA 2003; Kovosic et al. 2000). Although the removal rate for phosphorus is low in long-term studies, the rate can be improved if sheet flow is maintained to the wetland and vegetation and substrate are monitored to ensure the wetland is operating optimally. Sediment or vegetation removal may be necessary if the wetland removal efficiency is lessened over time (USEPA 2003). Guidelines for wetland design suggest a wetland to watershed ratio of 0.6 percent for nutrient and sediment removal from agricultural runoff.

Phosphorus-Based Lawn Fertilizer Restrictions: Runoff from urban areas may include phosphorus-based fertilizers applied to residential lawns, golf courses, and other surfaces. If used too close to a receiving waterbody, phosphorus present in stormwater runoff will enter the waterbody. Illinois has a statute in place which governs the use of phosphorus-based fertilizers in urban areas: Lawn Care Products Application and Notice Act (415 ILCS 65). This act includes the following prohibitions for phosphorus-based fertilizers (see act for limited exceptions):

1. They shall not be applied to lawns unless it can be demonstrated by soil test that the lawn is lacking in phosphorus when compared against the standard established by the University of Illinois; see the act for exceptions
2. They shall not be applied to impervious surfaces
3. They shall not be applied within 3 feet of any waterbody if a spray, drop, or rotary spreader is used. If other equipment is used, the fertilizer may not be applied within 15 feet of a water body.
4. They shall not be applied when the ground is frozen or saturated
5. Appropriate lawn markers for the application event and notifications to potentially affected adjacent properties are required

Reaeration/Bank Stabilization: As described in Section 9.7, the purpose of reaeration is to directly increase DO concentrations in streams. Expanding DO monitoring to in the impaired stream segments, along with a longitudinal survey of the topography of impaired reaches, could help identify areas that would benefit most from an increase of turbulence.

9.7 BMP Recommendations for Total Phosphorus in the Carthage Lake Watershed

Carthage Lake is listed for impairment by total phosphorus. Phosphorus loads in Carthage Lake originate from internal and external sources. As presented in Section 5, possible external sources of total phosphorus include septic systems and agricultural activity. To achieve a reduction of total phosphorus for the lake, management measures must address loading through sediment and surface runoff controls as well as internal cycling. BMPs evaluated that could be utilized to treat these nonpoint sources are described below.

Conservation Tillage Practices: Conservation tillage was described in Section 9.4. As indicated in **Table 2-1**, the entire Upper La Moine watershed consists of approximately 241,682 acres under cultivation, which represents 65 percent of the watershed area.

The 2017 Illinois Department of Agriculture's Soil Transect Survey estimated that conventional till currently accounts for 28 percent of corn and 6 percent of soybean tillage practices in Hancock County, which includes Carthage Lake (RLE). To achieve TMDL load reductions, tillage practices already in place should be continued, and practices should be assessed and improved upon for all agricultural areas in the impaired watersheds. Additional soil retention practices should also be assessed, such as field borders, contour farming, conservation crop rotation, stripcropping, conservation cover, cover cropping, terracing, and critical area planting.

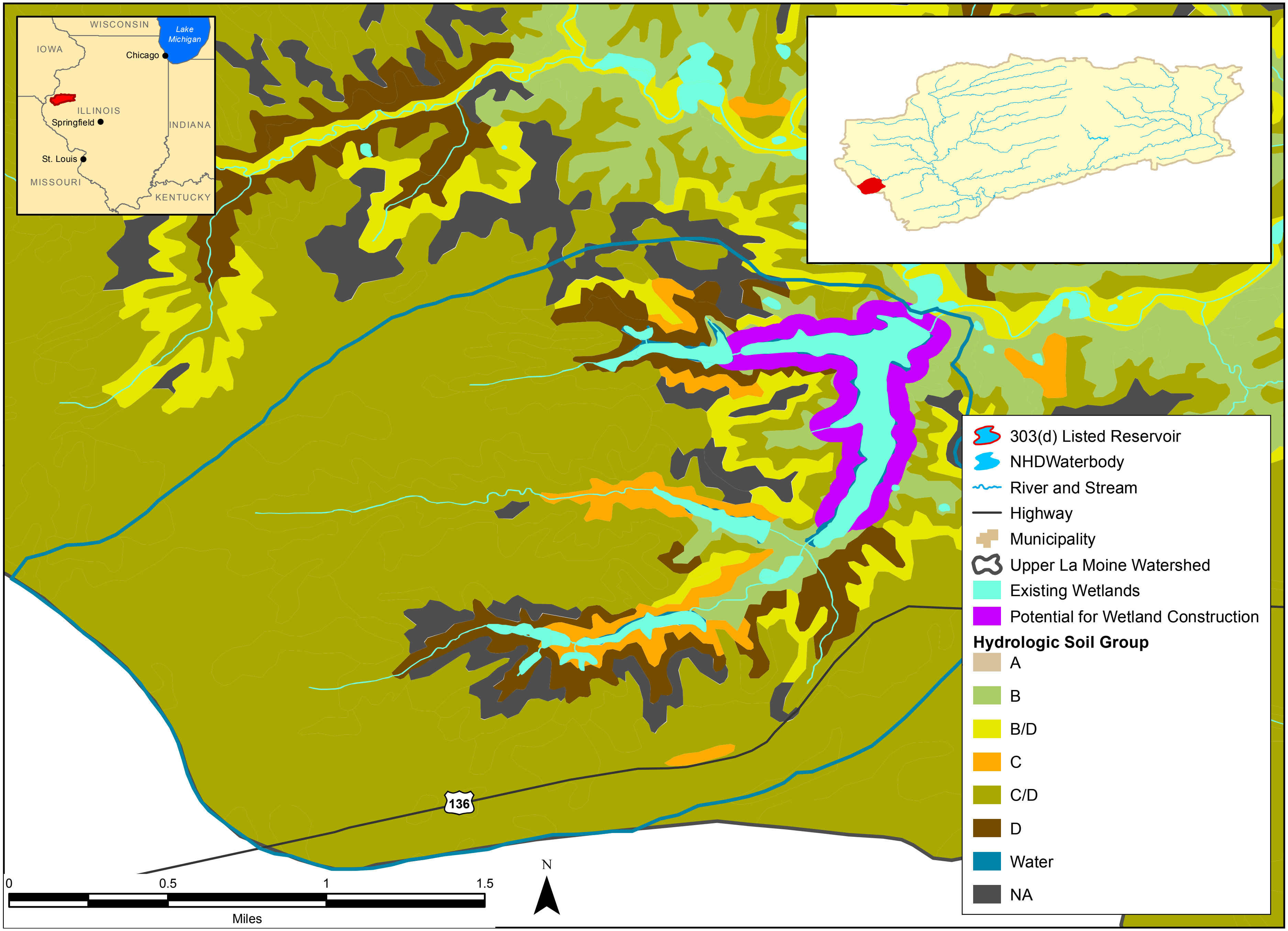
Filter Strips and Riparian Buffers: Filter strips are first discussed in Section 9.4, while riparian buffers were discussed in Section 9.6. The same techniques for evaluating available land were applied to the Carthage Lake watershed. Areas in this watershed, which could potentially be converted into filter strips include 112 acres of land within the 234-foot buffer established for Carthage Lake and its tributaries, of which 9 acres are categorized as agricultural.

Nutrient Management: As described in Section 9.6, nutrient management programs could result in reduced nutrient loads to the impaired Lake. Areas that may benefit from NMPs are shown in the "Cultivated Area" column in **Table 9-6** for the lake.

Table 9-6 Cultivated Areas for Impaired Lakes in the Upper La Moine Watershed

Waterbody Name	Segment ID	Land Cover Area (Acres)	Cultivated Area (Acres)	Percent Cultivated
Carthage Lake	RLE	2,081	1,532	73.6

Wetlands: To treat loads from agricultural runoff, a wetland could potentially be constructed on the upstream end of the lake. The use of wetlands as structural controls was discussed in Section 9.6. Hydric soils with potential for wetland construction are shown along with existing wetlands to indicate potential areas where wetlands may be installed for the Carthage Lake subbasin in **Figure 9-3.** Areas near waterways that are not currently classified as wetlands but have hydric soils present are typically strong candidates for potential wetland construction. Existing wetland areas may also be candidates for reconstruction or enhancement to improve their nutrient uptake capacity. These data layers are developed on a large-scale and onsite soil investigation and wetland delineation is typically necessary for verification of the suitability of a given area for wetland construction.



Upper La Moine River

Hydric Soils, Existing Wetlands, and Potential for Wetland Construction for Carthage Lake

FIGURE 9-3

Phosphorus-Based Lawn Fertilizer Restrictions: Section 9.6 discussed how runoff from urban areas may include phosphorus-based fertilizers which may enter nearby waterbodies if present in stormwater runoff. These fertilizers may also impact the reservoirs, either by phosphorus-enriched runoff flowing directly into the water bodies or from phosphorus-impaired streams entering the reservoirs.

In-Lake Phosphorus Loading: Modeling described in Section 8 determined that internal loading of phosphorus is likely a significant contributor to overall watershed loads. A reduction of phosphorus from in-lake cycling through in-lake management strategies is necessary for attainment of the TMDL load allocations. Internal phosphorus loading can occur when the water above the sediments becomes anoxic causing the release of phosphorus from the sediment in a form which is available for plant uptake. The addition of bioavailable phosphorus in the water column stimulates more plant growth and die-off, which may perpetuate or create anoxic conditions and enhance the subsequent release of phosphorus into the water. Internal phosphorus loading can also occur in shallow lakes through release from sediments by the physical mixing and reintroduction of sediments into the water column as a result of wave action, winds, boating activity, and other means.

For lakes experiencing high rates of phosphorus input from bottom sediments, several management measures are available to control internal loading. Three BMP options for the control of internal loading include the installation of an aerator, the addition of aluminum, and dredging.

1. **Hypolimnetic (bottom water) aeration** involves an aerator air-release that can be positioned at a selected depth or at multiple depths to increase oxygen transfer efficiencies in the water column and reduce internal loading by establishing aerobic conditions at the sediment-water interface.

2. **Phosphorus inactivation by aluminum addition** (specifically aluminum sulfate or alum) to lakes is the most widely-used technique to control internal phosphorus loading. Alum forms a polymer that binds phosphorus and organic matter. The aluminum hydroxide-phosphate complex (commonly called alum floc) is insoluble and settles to the bottom, carrying suspended and colloidal particles with it. Once on the sediment surface, alum floc inhibits phosphate diffusion from the sediment to the water (Cooke et al.1993).

3. Phosphorus release from the sediment is greatest from recently deposited layers. **Dredging** approximately one meter of recently deposited phosphorus–rich sediment can remove approximately 80 to 90 percent of the internally loaded phosphorus without the addition of potentially toxic compounds to the reservoir. Dredging may also contribute to reductions in internal phosphorus loading by increasing the depth of large portions of the waterbody, reducing the degree of reintroduction of sediments into the water column through physical mixing. However, dredging is typically more costly than other management options.

9.8 BMP Recommendations for Chloride in Drowning Fork

Drowning Fork DGLC-01 is listed as impaired for elevated chloride concentrations. The causes of impairment may potentially include municipal point sources, septic systems, or other nonpoint sources. The use of chlorinated disinfection methods to treat wastewaters at permitted facilities or on site septic systems have the potential of introducing chloride into area waterways. Additionally, runoff containing de-icing compounds or artificial fertilizers may pose a chloride contamination risk as well. To achieve a reduction of chloride levels in Drowning Fork DGLC-01, management measures must address loading through point-source discharge along with sediment and surface runoff controls.

9.8.1 Point Sources of Chloride in Drowning Fork

The Bushnell West STP (IL0024384) discharges directly into Drowning Fork. The WLA for the facility was calculated using each facility's DAF and the water quality standard for chloride. Note that the current permit includes a limit of 0.05 mg/L for residual chlorine. The overall contribution of chloride to Drowning Fork from this point source is relatively low. The Illinois EPA will continue to evaluate the DMR data and decide whether changes to treatment methods or permit limits will be necessary in future permit cycles.

9.8.2 Nonpoint Sources of Chloride in Drowning Fork

Nonpoint sources of chloride could include runoff from deiced roads, lands treated with phosphorus-based fertilizer, and septic effluents containing water softening agents. BMPs evaluated that could be utilized to treat these nonpoint sources are the same as discussed in Section 9.6.

Conservation Tillage Practices: Conservation tillage was described in Section 9.4. To achieve TMDL load reductions, tillage practices already in place should be continued, and practices should be assessed and improved upon for all agricultural areas in the impaired watersheds. Additional soil retention practices should also be assessed, such as field borders, contour farming, conservation crop rotation, stripcropping, conservation cover, cover cropping, terracing, and critical area planting.

Filter Strips and Riparian Buffers: Filter strips are first discussed in Section 9.3, while riparian buffers were discussed in Section 9.6. The same techniques for evaluating available land were applied to the Drowning Fork watershed. Areas in these watersheds which could potentially be converted into filter strips include 1,396 acres of land within the established buffer area, of which 1,171 acres are categorized as agricultural.

Wetlands: To treat runoff loads from fertilizer and road deicers, a wetland could potentially be constructed on the upstream end of Drowning Fork. The use of wetlands as structural controls was discussed in Section 9.7. Hydric soils with potential for wetland construction are shown along with existing wetlands to indicate potential areas where wetlands may be installed for the Drowning Fork subbasin in **Figure 9-2.** Areas near waterways that are not currently classified as wetlands but have hydric soils present are typically strong candidates for potential wetland construction. Existing wetland areas may also be candidates for reconstruction or enhancement. These data layers are developed on a large-scale and onsite soil investigation and wetland delineation is typically necessary for verification of the suitability of a given area for wetland construction.

Phosphorus-Based Lawn Fertilizer Restrictions: Section 9.7 discusses how runoff from urban areas may include phosphorus-based fertilizers which may enter nearby waterbodies if present in stormwater runoff. These fertilizers also contain high concentrations of chlorine and may in part be responsible for the elevation of chloride levels in Drowning Fork. Restrictions or limitations on the application of phosphorus-based fertilizers may help to reduce such contamination. Additional education and outreach in urban and rural areas covering the proper use and application of phosphorus-based fertilizers is also recommended.

Septic Effluent: Effluent discharge from private septic systems may contain high concentrations of chloride, especially in systems that utilize water softening agents. Samples collected from septic systems in Illinois have contained chloride concentrations of up to 618 mg/L (Panno et al. 2002). These waters pass into the drain field and may eventually reach surface waters through runoff or interaction with adjacent groundwater resources. Development of a watershed-wide database to map septic system densities may help in identifying waterways at greater risk of septic effluent contamination.

9.9 Cost Estimates of BMPs

Cost estimates for a number of suggested BMPs are available through the SWCD (**Table 9-7**). Cost information for additional BMPs not included in the table are discussed below.

Table 9-7 Fiscal Year 2018 SWCD BMP Cost Data

Component	Unit	Average Cost
No-till	acre	$350.00
Strip-till	acre	$260.00
Cover Crops	acre	$53.75
Diversions	foot	$2.70
Block Lined Chute (Includes earthwork)	block	$7.00
Rock Lined Chute (Includes earthwork)	ton	$40
Grassed Waterway Earthwork	acre	$3,154.50
Pasture+Hayland Planting (Applys to land not in pasture or hayland within the past 5 years)	acre	$286.67
Nutrient Management Plan	acre	$4
Nutrient Management Plan Implementation	acre	$12
Water & Sediment Control Basin, < 3 feet (Earthwork for narrow base)	foot	$3.30
Water & Sediment Control Basin, > 3 feet (Earthwork for narrow base)	foot	$3.80

9.9.1 Filter Strips and Riparian Buffers

Several types of filter strip practices are available, including areas for native herbaceous vegetation with or without fertility measures required and areas of introduced species, also with or without fertility measures required. Filter strip implementation that includes seedbed preparation and native seed application ranges from $520/acre to $639/acre depending on the type used, with an average cost of approximately $594/acre.

Riparian buffers consisting of bare-root shrubs cost approximately $1.10 to $1.65 each while direct seeding of trees and/or shrubs costs approximately $741/acre. The direct seeding scenario includes a planting rate of approximately 3,000 to 4,800 seeds per acre as well as the foregone income for the land taken out of crop production. Land preparation, including removing undesirable vegetation and improving site conditions, is estimated at $38/acre. For cases where an herbaceous cover is preferable, such a native grass or certain species of forbs and/or shrubs, costs average $642/acre.

9.9.2 Wetlands

The price to establish a wetland is very site specific and depends on factors such as size and type of vegetation used. Examples of costs associated with constructed wetlands include excavation costs, vegetation removal, and revegetation costs. Costs for wetlands created on a flat mineral uplands where surface runoff may be intercepted and ponded by excavation range from $3,186 (no embankment) to $3,680 (with embankment). Some areas may favor a wetlands setting which just needs to be enhanced or restored. In an area of natural depression fed by surface runoff, enhancement/restoration is approximately $2,557/acre. Enhancing or restoring a wetland on a floodplain site that has existing levees and/or ditches may consist of regrading or shaping the land, potentially including levee removal, for $1,167/acre. Constructed wetlands to reduce the pollution potential of runoff and wastewater average $7,725/acre where natural regeneration of wetland plants will be a major contributor to the working vegetation and $10,286/acre where wetland vegetation in the pool area is planted at a denser grid (3-foot by 3-foot or closer). As needed, embankments, water control and grade stabilization structures, and filter strips should be added.

9.9.3 Septic System Maintenance

Septic tanks are designed to accumulate sludge in the bottom portion of the tank while allowing water to pass into the drain field. If the tank is not pumped out regularly, the sludge can accumulate and eventually become deep enough to allow for flow into the drain field. Pumping the tank every three to five years prolongs the life of the system by protecting the drain field from solid material that may cause clogs and system back-ups. In addition, septic systems should not be connected to field tile lines.

The cost to pump a typical septic tank ranges from $250 to $350 depending on how many gallons are pumped out and the disposal fee for the area. If a system is pumped once every three to five years, this expense averages out to less than $100 per year.

The cost of developing and maintaining a watershed-wide database of the onsite wastewater treatment systems in the Upper La Moine watershed depends on the number of systems that need to be inspected and the means by which the systems are inventoried. Education of home and business owners that use onsite wastewater treatment systems should occur periodically. Public meetings; mass mailings; and radio, newspaper, and TV announcements can all be used to remind and inform owners of their responsibility to maintain their systems. The costs associated with education and inspection programs will vary depending on the level of effort required to communicate the importance of proper maintenance and the number of systems in the area.

It is unknown at this time how many septic systems are present within the watershed. However, as discussed in Section 5.4.3, the town of Carthage is served by sewer, but most county residents within the watershed rely on private septic systems. Additionally, health department officials in McDonough County reported that residents within Macomb city limits are served by sewer and most residents in the county rely on private systems or wildcat sewer/collection systems that discharge untreated or partially treated wastewater to the surface of the ground, such as ditches or yards.

Section 2.5 indicates that approximately 25,700 people reside in the Upper La Moine watershed. The largest urban development in the watershed is the city of Macomb, which lies partially within the watershed and has an estimated population of approximately 11,949 people within the watershed. Assuming that the majority of the remaining watershed population reside in rural areas, up to 13,000 people may be served by private septic systems. If a typical household is assumed to consist of four people, there may be around 3,300 households which have septic systems in the watershed.

9.10 Site-Specific BMPs

Information regarding site-specific BMPs or projects slated for cost-sharing and future implementation were requested through the public stakeholder group. Any information received during the Stage 3 meeting has been included throughout this implementation plan.

9.11 Information and Education

As discussed in Section 3, public education and participation is a key factor for TMDL and watershed plan implementation. Increased public awareness can increase implementation of BMPs. Small incremental improvements and individual adoption of BMPs can be achieved at a much lower cost compared to the large-scale BMPs identified above. Outreach and education efforts should focus on activities that support the watershed plan goals, including:

1. Continued regular meeting of local stakeholder group with intent of broadening audience/attendance

2. Field visit days with demonstrations of agricultural conservation practices

3. Continued outreach and messaging to landowners to encourage implementation of edge of field BMPs, nutrient management, conservation tillage, cover crops, and livestock/pasture management.

4. Soil testing

5. Reducing the use of lawn chemicals (pesticides and phosphorus fertilizers)

6. Education/outreach for rural residence on proper septic system maintenance
7. Periodic updates on watershed health/monitoring results

Illinois EPA staff have met with the local stakeholder group, including county SWCD staff, to discuss BMPs used throughout the watershed and continued future collaboration. An additional public meeting will be held within the watershed in late 2018 or early 2019 to present the final TMDL results and this implementation plan. Feedback received from the county SWCD staff will be incorporated throughout this plan to include local information and discuss BMPs that are thought to be most effective and implementable in this watershed. Additional recommended activities to support public outreach and education include:

1. Websites and social media to publicize meetings, upcoming events and links to resources
2. E-mail updates
3. Brochures with information on household pollutant reduction, fertilizer use, and septic tanks
4. Educational signs to educate viewers on water quality issues, purpose of BMPs, and environmental stewardship
5. Public service announcements
6. Informational meetings on State and Federal cost share programs

9.12 Project Funding

Cost-share and incentive programs at the state and federal level are available to landowners, homeowners, and farmers in the watershed to help offset costs of implementing many of the BMPs recommended in this report. Some of these programs are discussed below. When reviewing the programs, it should be noted that some of the programs are only meant to provide incentives to encourage operators or landowners to try the practice. These incentive programs are not intended to cover the entire cost associated with implementing a practice. Additionally, some practices have many variables to consider that will affect both the cost of the program and the incentive or cost-share amount to be received; e.g., NMPs.

9.12.1 Available State-Level Programs for Nonpoint Sources

State-level programs to encourage landowners to implement resource-conserving practices for water quality and erosion control purposes are discussed in the following paragraphs.

9.12.1.1 Illinois Department of Agriculture and Illinois EPA Nutrient Management Plan Project

The IDA and Illinois EPA co-sponsor a cropland Nutrient Management Plan project in watersheds that have developed or are developing TMDLs. This voluntary project supplies incentive payments to producers to have NMPs developed and implemented. Additionally, watersheds that have sediment or phosphorus identified as a cause for impairment (as is the case in this watershed), are eligible for cost-share assistance in implementing traditional erosion control practices through the Nutrient Management Plan project.

9.12.1.2 Partners for Conservation Program

The Partners for Conservation Program (PFC) provides cost sharing on a variety of practices such as no-till systems, WASCOBs, pasture/hayland establishment, critical area planting, cover crops, temporary cover (if added to another practice in order to extend the construction season), filter strips, rain gardens, terrace systems, diversions, well decommissioning, NMPs, and grade stabilization structures. The PFC is funded through the IDA and administered by the local SWCDs. Life/maintenance contracts can be 1 to 10 years depending on the practice and costs per acre vary significantly from project to project.

9.12.1.3 Streambank Stabilization and Restoration Program

The SSRP was established to address problems associated with streambank erosion, such as loss or damage to valuable farmland, wildlife habitat, and roads; stream capacity reduction through sediment deposition; and degraded water quality, fish, and wildlife habitat. The primary goals of the SSRP are to develop and demonstrate vegetative, stone structure, and other low cost bio-engineering techniques for stabilizing streambanks and to encourage the adoption of low-cost streambank stabilization practices by making available financial incentives, technical assistance, and educational information to landowners with critically eroding streambanks. A cost share of 75 percent is available for approved project components such as willow post installation, bendway weirs, rock riffles, stream barbs/rock, vanes, lunker structures, gabion baskets, and stone toe protection techniques. There is no limit on the total program payment for cost-share projects that a landowner can receive in a fiscal year. However, maximum cost per foot of bank treated is used to cap the payment assistance on a per foot basis and maintain the program's objectives of funding low-cost techniques (IDA 2000). All project proposals must be sponsored and submitted by the local SWCD.

9.12.2 Available Federal-Level Programs for Nonpoint Sources

There are several voluntary conservation programs established by various federal agencies that encourage landowners to implement resource-conserving practices for water quality and erosion control purposes. These programs apply to crop fields as well as rural grasslands that are presently used for livestock grazing. Federal-level programs are discussed in the following paragraphs. The USEPA manages the Clean Water Act Section 319 Grants. The Farm Service Agency (FSA) oversees the Conservation Reserve Program (CRP) and the Grasslands Reserve Program (GRP). Voluntary conservation programs established through the 2014 U.S. Farm Bill, and managed by the NRCS, include the Agricultural Conservation Easement Program (ACEP), the Conservation Stewardship Program (CSP), and the Environmental Quality Incentives Program (EQIP).

9.12.2.1 Clean Water Act Section 319 Grants

Section 319 was added to the CWA to establish a national program to address nonpoint sources of water pollution. Through this program, each state is allocated Section 319 funds on an annual basis according to a national allocation formula based on the total annual appropriation for the section 319 grant program. The total award consists of two categories of funding: incremental funds and base funds. A state is eligible to receive USEPA 319(b) grants upon the USEPA's approval of the state's Nonpoint Source Assessment Report and Nonpoint Source Management Program. States may reallocate funds through sub-awards (e.g., contracts, sub-grants) to both public and private entities, including local governments, tribal authorities, cities, counties, regional development centers, local school systems, colleges and universities, local nonprofit organizations, state agencies, federal agencies, watershed groups, for-profit groups, and individuals.

USEPA designates incremental funds, a $163-million award in 2016, for the restoration of impaired water through the development and implementation of watershed-based plans and TMDLs for impaired waters. Base funds, funds other than incremental funds, are used to provide staffing and support to manage and implement the state Nonpoint Source Management Program. Section 319 funding can be used to implement activities which improve water quality, such as filter strips, streambank stabilization, etc. (USEPA 2003).

Illinois EPA receives federal funds through Section 319(h) of the CWA to help implement Illinois' Nonpoint Source Pollution Management Program. The purpose of the program is to work cooperatively with local units of government and other organizations toward the mutual goal of protecting the quality of water in Illinois by controlling nonpoint source pollution. The program emphasizes funding for implementing cost-effective corrective and preventative BMPs on a watershed scale; funding is also available for BMPs on a non-watershed scale and the development of information/education nonpoint source pollution control programs.

The maximum Federal funding available is 60 percent of the total cost, with the remaining 40 percent coming from local match. The program period is two years unless otherwise approved. This is a reimbursement program.

Section 319(h) funds are awarded for the purpose of implementing approved nonpoint source management projects. The funding will be directed toward activities that result in the implementation of appropriate BMPs for the control of nonpoint source pollution or to enhance the public's awareness of nonpoint source pollution. Applications are accepted June 1 through August 1.

9.12.2.2 Conservation Reserve Program

The CRP is a voluntary program, administered through the FSA, which encourages landowners to agree to remove environmentally sensitive land from agricultural production and plant long-term resource-conserving cover to improve water quality, prevent soil erosion, and reduce loss of wildlife habitat. The program was initially established in the Food & Security Act of 1985 and is the largest private-lands conservation program in the United States.

Participants can enroll in CRP in two ways and the duration of the contracts under CRP range from 10 to 15 years. The first enrollment method is through a competitive process known as the CRP General Sign-up. These are announced on a periodic basis by the Secretary of Agriculture but do not occur on any fixed schedule. The second enrollment method is through CRP Continuous Sign-up, which is offered on a continuous basis. Continuous sign-up provides management flexibility to farmers and ranchers to implement certain high-priority conservation practices on eligible land. All enrollment offers are processed through the local FSA office.

Certain conditions must be met in order for land to be eligible for CRP enrollment. These conditions include the following:

1. The farmer applying for enrollment must have owned or operated the land for at least 12 months prior to the previous CRP sign-up period (except in cases of a change in ownership due to the previous owner's death, foreclosure, or land purchase by the new owner without the sole intention of placing it in the CRP).
2. Cropland that is planted or considered planted to an agricultural commodity for four of the six most recent crop years (including field margins) and must be physically and legally capable of being planted in a normal manner to an agricultural commodity.
3. Certain marginal pastureland suitable for use as any of the following conservation practices: buffer for wildlife habitat, wetlands buffer or restoration, filter strips, riparian buffer, grass waterway, shelter belt, living snow fence, contour grass strip, salt tolerant vegetation, or shallow water area for wildlife.

In addition to the eligible land requirements, cropland must meet one of the following criteria:

1. Have a weighted average erosion index of 8 or higher
2. Be expiring CRP acreage
3. Be located in a national or state CRP conservation priority area.

The FSA bases rental rates on the relative productivity of soils within each county and the average dryland cash rent or cash-rent equivalent. The maximum rental rate for each offer is calculated in advance of enrollment. Producers may offer land at the maximum rate or at a lower rental rate to increase likelihood of offer acceptance. In addition, the FSA provides cost-share assistance for up to 50 percent of the participant's costs in establishing approved conservation practices (USDA 2020: https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/index). CRP annual rental payments may include an additional amount up to $2 per acre per year as an incentive to perform certain maintenance obligations (up to $7 for certain continuous sign-up practice).

Finally, the FSA offers additional financial incentives for certain continuous sign-up practices. Signing Incentive Payment is a one-time incentive payment of $10/acre for each acre enrolled for each full year of the contract. Eligible practices include field windbreaks; grassed waterways; shelter belts; living snow fences; filter strips; riparian buffers; marginal pastureland wildlife and wetland buffers; bottom timber establishment; field borders; longleaf pine establishment; duck nesting habitat; SAFE buffers, wetlands, trees, longleaf pine, and grass; pollinator habitat; and several wetlands practices. The Performance Incentive Payment is a one-time incentive payment made to participants who enroll land in CRP to be devoted to all continuous sign up practices except establishment of permanent vegetative cover on terraces, wetland restoration (including non-floodplain), bottomland timber establishment, and duck nesting habitat.

The maximum annual non-cost share payment that an eligible "person" can receive under the CRP is $50,000 per fiscal year. This is a separate payment limitation applying only to CRP non-cost share payment.

The current extent of land enrolled in CRP within the Upper La Moine watershed is unknown.

9.12.2.3 Grassland Reserve Program

The purpose of the GRP, administered by the FSA, is to prevent grazing and pasture land from being converted into cropland, used for urban development, or developed for other non-grazing uses. Participants in the program voluntarily limit future development of the land while still being able to use the land for livestock grazing and activities related to forage and seed production. Some restrictions on activities may apply during the nesting season of certain bird species that are in decline or protected under federal or state law.

The GRP has several enrollment options, including a rental contract for 10, 15, or 20 years, or enrollment of the land in a conservation easement for an indefinite period of time. Applications are accepted any time and are processed through the local FSA office.

To be eligible for a rental agreement, the applicant must own or have control of the land for the length of the contract. To enroll in a conservation easement, the applicant must own and be willing to restrict use of the land either in perpetuity or under the maximum length of time under state law. Persons enrolled in GRP receive an annual rental payment for their enrolled acres. Rental payments were not available on the USDA website as of June 2016 (https://www.fsa.usda.gov/programs-and-services/conservation-programs/grassland-reserve/index); however, further information about the program, including payment amounts, eligibility and maintenance criteria, and land requirements may be obtained from the local FSA office.

9.12.2.4 Agricultural Conservation Easement Program

ACEP provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the Agricultural Land Easements component, NRCS helps American Indian tribes, state and local governments, and non-governmental organizations protect working agricultural lands and limit non-agricultural uses of the land. Land protected by agricultural land easements provides additional public benefits, including environmental quality, historic preservation, wildlife habitat, and protection of open space. Under the Wetlands Reserve Easements component, NRCS helps to restore, protect, and enhance enrolled wetlands. Wetland Reserve Easements provide habitat for fish and wildlife, including threatened and endangered species, improve water quality by filtering sediments and chemicals, reduce flooding, recharge groundwater, protect biological diversity and provide opportunities for educational, scientific and limited recreational activities.

Agricultural Land Easements: NRCS provides financial assistance to eligible partners purchase Agricultural Land Easements that protect the agricultural use and conservation values of eligible land. In the case of working farms, the program helps farmers and ranchers keep their land in agriculture. The program also protects grazing uses and related conservation values by conserving grassland, including rangeland, pastureland and shrubland. Land eligible for agricultural easements includes cropland, rangeland, grassland, pastureland and non-industrial private forest land. NRCS will prioritize applications that protect agricultural uses and related conservation values of the land and those that maximize the protection of contiguous acres devoted to agricultural use.

To enroll land through agricultural land easements, NRCS enters into cooperative agreements with eligible partners. Each easement is required to have an agricultural land easement plan that promotes the long-term viability of the land. Under the Agricultural Land component, NRCS may contribute up to 50 percent of the fair market value of the agricultural land easement. Where NRCS determines that grasslands of special environmental significance will be protected, NRCS may contribute up to 75 percent of the fair market value of the agricultural land easement.

Wetland Reserve Easements: NRCS also provides technical and financial assistance to restore, protect, and enhance wetlands through the purchase of a wetland reserve easement. These agreements include the right for NRCS to develop and implement a wetland reserve restoration easement plan to restore, protect, and enhance the wetland's functions and values. Land eligible for wetland reserve easements includes farmed or converted wetland that can be successfully and cost-effectively restored. NRCS will prioritize applications based the easement's potential for protecting and enhancing habitat for migratory birds and other wildlife. For acreage owned by an Indian tribe, there is an additional enrollment option of a 30-year contract. Through the wetland reserve enrollment options, NRCS may enroll eligible land through one of the following:

1. Permanent Easements – These are conservation easements in perpetuity. NRCS pays 100 percent of the easement value for the purchase of the easement. Additionally, NRCS pays between 75 to 100 percent of the restoration costs.
2. 30-year Easements – These expire after 30 years. Under 30-year easements, NRCS pays 50 to 75 percent of the easement value for the purchase of the easement. Additionally, NRCS pays between 50 to 75 percent of the restoration costs.
3. Term Easements – Term easements are easements made for the maximum duration allowed under applicable State laws. NRCS pays 50 to 75 percent of the easement value for the purchase of the term easement. Additionally, NRCS pays between 50 to 75 percent of the restoration costs.
4. 30-year Contracts – 30-year contracts are only available to enroll acreage owned by Indian tribes, and program payment rates are commensurate with 30-year easements.

For wetland reserve easements, NRCS pays all costs associated with recording the easement in the local land records office, including recording fees, charges for abstracts, survey and appraisal fees, and title insurance.

Wetland Reserve Enhancement Partnership – The 2014 Farm Bill replaced the Wetland Reserve Enhancement Program with the Wetland Reserve Enhancement Partnership (WREP) as an enrollment option under ACEP. WREP continues to be a voluntary program through which NRCS signs agreements with eligible partners to leverage resources to carry out high priority wetland protection, restoration, and enhancement and to improve wildlife habitat.

- Partner benefits through WREP agreements include:

- Wetland restoration and protection in critical areas
- Ability to cost-share restoration or enhancement beyond NRCS requirements through leveraging
- Able to participate in the management or monitoring of selected project locations
- Ability to use innovative restoration methods and practices

In 2016, NRCS made $15 million in financial and technical assistance available to help eligible conservation partners leverage local resources to voluntarily protect, restore, and enhance critical wetlands on private and tribal agricultural land nationwide. The funding is provided through the WREP, a special enrollment option under the Agricultural Conservation Easement Program. Proposals were due to the local NRCS offices by May 16, 2016; however, landowners should check with the NRCS to see about applying in future years. To enroll land eligible partners may submit proposals to the local NRCS office.

9.12.2.5 Conservation Stewardship Program

The CSP helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resources concerns. Participants earn CSP payments for conservation performance—the higher the performance, the higher the payment.

Through CSP, participants take additional steps to improve resource conditions including soil quality, water quality and quantity, air quality, habitat quality, and energy. CSP provides two types of payments through 5-year contracts: annual payments for installing new conservation activities and maintaining existing practices; and supplemental payments for adopting a resource-conserving crop rotation. Producers may be able to renew a contract if they have successfully fulfilled the initial contract and agree to achieve additional conservation objectives. Payments are made soon as practical after October 1 of each fiscal year for contract activities installed and maintained in the previous year. In fiscal year 2016, NRCS made $150 million available for producers through the CSP.

Eligible lands include private and Tribal agricultural lands, cropland, grassland, pastureland, rangeland and non-industrial private forest land. CSP is available to all producers, regardless of operation size or type of crops produced, in all 50 states, the District of Columbia, and the Caribbean and Pacific Island areas. Applicants may include individuals, legal entities, joint operations, or Indian tribes that meet the stewardship threshold for at least two priority resource concerns when they apply. They must also agree to meet or exceed the stewardship threshold for at least one additional priority resource concern by the end of the contract. Producers must have effective control of the land for the term of the proposed contract, which include all eligible land in the agricultural operation. Some additional restrictions and program requirements may apply and interested applicants should contact the local NRCS office for more information.

9.12.2.6 Environmental Quality Incentive Program

EQIP is a voluntary program that provides financial and technical assistance to agricultural producers to plan and implement conservation practices that improve soil, water, plant, animal, sir, and related natural resources on agricultural land and non-industrial private forestland. Through EQIP, the NRCS develops contracts with agricultural producers to implement conservation practices to address environmental natural resource problems. Persons engaged in livestock or agricultural production and owners of non-industrial private forestland are eligible for the program. Eligible land includes cropland, rangeland, pastureland, private non-industrial forestland, and other farm or ranch lands. Eligible applicants must, at a minimum, meet the following criteria; additional program requirements may apply:

1. Be agricultural producer (person, legal entity, or joint operation who has an interest in the agricultural operation, or who is engaged in agricultural production or forestry management).
2. Control or own eligible land.
3. Comply with adjusted gross income for less than $900,000. Note: Federally recognized Native American Indian Tribes or Alaska Native corporations are exempt from the adjusted gross income payment limitations.
4. Be in compliance with the highly erodible land and wetland conservation requirements.
5. Develop an NRCS EQIP plan of operations that addresses at least one natural resource concern

Persons interested in entering into a cost-share agreement with the NRCS for EQIP assistance may file an application at any time; however, each state may establish deadlines for one or more application periods in which to consider eligible applications for funding. Applications submitted after the deadlines will be evaluated and considered for funding during later funding opportunities.

As part of the program, a Conservation Activity Plan (can be developed for producers to address a specific natural resource concern on their agricultural operation. Each plan is developed by a certified Technical Service Provider, who is selected by the EQIP participant. Technical assistance payments for Technical Service Providers do not count against the financial assistance aggregate payment limitation or the contract financial assistance payment limitation. The plan becomes the basis of the EQIP contract between NRCS and the participant, and the contracts can be up to 10 years in duration. Financial assistance payments are made to eligible producers once conservation practices are completed according to NRCS requirements. Payment rates are set for each fiscal year and are attached to the EQIP contract when it is approved.

Historically underserved producers (limited resource farmers/ranchers, beginning farmers/ranchers, socially disadvantaged producers, Indian Tribes, and veteran farmer or ranchers) who self-certify on Form NRCS-CPA-1200, Conservation Program Application are eligible for a higher practice payment rate to support implementation of contracted conservation practices and activities. Historically underserved producers may also be issued advance payments up to 50 percent of the established payment rate to go toward purchasing materials or contracting services to begin installation of approved conservation practices. Self-certified socially disadvantaged farmer/rancher, beginning farmer/rancher, and veteran farmer/rancher producers may elect to be evaluated in special EQIP funding pools. More information can be obtained from the local NRCS office.

EQIP provides payments up to 75 percent of the incurred costs and 100 percent estimated income foregone of certain conservation practices and activities. Payments received by producers through EQIP contracts after February 7, 2014 may not exceed $450,000 for all EQIP contracts entered into during the period from 2014 to 2018. Payment limitations for organic production may not exceed an aggregate $20,000 per fiscal year or $80,000 during any 6-year period for installing conservation practices.

Conservation practices eligible for EQIP funding which are recommended BMPs for this watershed TMDL include filter strips, conservation tillage, grade stabilization structures, grass waterways, riparian buffers, streambank/shoreline protection, terraces, and wetland restoration. More information regarding state and local EQIP implementation can be found at https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/.

9.12.3 Local Program Contact Information

The FSA administers the CRP and GRP. NRCS administers the ACEP, CSP, and EQIP. Local contact information for counties containing some portion of the Upper La Moine watershed are listed in the **Table 9-8** below.

Table 9-8 Local SWCD, NRCS, and FSA Contact Information

County	Address	Phone
McDonough County	1607 West Jackson Street Macomb, IL 61455	(309) 833-1711
Hancock County	110 Buchanan Street Carthage, IL 62321	(217) 357-2180
Warren County	701 North Main Street Monmouth, IL 61462	(309) 734-9308
Henderson County	323 East Main Street Stronghurst, IL 61480	(309) 924-1167

9.13 Planning Level Cost Estimates for Implementation Measures

Cost estimates for different implementation measures are presented in **Table 9-9**. The column labeled "Program" or "Sponsor" lists the financial assistance program or sponsor available for various BMPs (as discussed in Section 9.13). Illinois EPA 319 Grants are applicable to all of the practices.

Table 9-9 Cost Estimates of Various BMP Measures

BMP	Units	Installation Cost	Program	Sponsor(s)
Filter strip (seeded)	per ac	$520 - $639, avg $594	CRP	NRCS, IDA
Riparian buffer – bare-root shrubs	each	$1.10 - $1.65	CRP	NRCS, IDA
– forested	per ac	$741		
– herbaceous cover	per ac	$642		
– land preparation	per ac	$38		
Nutrient management – development and implementation	per ac	$16	EQIP	NRCS, IDA, Illinois EPA
Water and sediment control basin, <3 ft	per ft	$3.30	CPP	IDA
– >3ft	per ft	$3.80		
Bank stabilization	per ac	$27 - $52/ft	SSRP	IDA
– weirs/rock riffles	each	$2,448 - $6,305		
– stream barb/bendway weir with longitudinal peaked stone toe	per ft	$27.27 - $52.50		
– bank armor	per CY	$37.55		
Grade stabilization			CPP, SSRP	IDA
– concrete block chutes	per block	$7.00		
– rip rap-lined (rock) chute	per ton	$40.00		
– metal toe wall	per SF	$140		
– modular block structure	perblock	$85		
Grassed waterway	per ac	$2,900	CPP CRP	IDA NRCS
Conservation tillage			EQIP	NRCS, IDA
– no-till/strip-till	per ac	$133.33		
Contour farming	per ac	$6.06	EQIP	NRCS
Cover Crops	per ac	$66.67	EQIP	NRCS
Wetland – enhancement/restoration	per ac	$1,167 - $3,680	ACEP	NRCS
– constructed	per ac	$7,725 - $10,286		
Mulch as needed for various BMPs, such as alternate water access ramp and WASCOBs	per ac	$440 for mulch	See corresponding program and sponsor listed above	
Septic system maintenance	per event	$250 - $350	Private system owner	

ac = acre
ft = foot
CY = cubic yard
SF = square foot

9.14 Milestones and Monitoring

Successful plan implementation relies on establishing and tracking milestones to measure progress. **Table 9-10** below identifies an implementation schedule for meeting milestones listed in **Table 9-11**. Stakeholders should evaluate schedule/milestone progress on an annual basis and implement adaptive management to modify management measures, milestones, and schedule as necessary.

9.14.1 Implementation Schedule

Implementation of the management actions outlined in this section should occur in phases, often over the course of several years, with effectiveness assessments made as improvements are completed. The process of obtaining funding, and developing and implementing projects designed to improve water quality, can take months or years to complete and once in place, improvements in water quality, as a result of BMPs, may not be detectable for several years. Continued monitoring and reevaluation of the implementation measures during this time will allow for more expedient adjustment to BMP implementation measures that may result in earlier attainment of water quality targets.

Table 9-10 Implementation Schedule

Schedule Category	Detailed Description	Recommended Schedule
Funding	Develop grant applications	Short term: 2-5 years
Implement Short-term Projects	Identify and implement short-term pilot projects that can be completed (i.e. willing landowners and available funding)	Mid-term: 2-5 years
Monitoring	Implement monitoring plan	Continuous: 1-20 years
Annual Stakeholder meetings	Stakeholders will convene at once a year to gauge progress and discuss evolving needs and planned activities	Annually
Implement Larger Projects	Identify and implement larger projects. These projects are more likely to have multiple funding sources and stakeholders.	Mid- Term: 5-10 years
Education and outreach	Prepare and implement and education and outreach plan. Conduct at least two public meetings annually.	Immediate: 1-2 years
Schedule Category – Critical Areas	**Detailed Description**	**Recommended Schedule**
Implement Identified Projects	Work with local SWCD to use TMDL priority to secure funding and implement "ready-to-go" projects	Begin process in 2020
Erosion Control Measures	Identify willing landowners in upstream areas of Drowning Fork DGLC-01, Prairie Creek DGZN-01, and Carthage Lake RLE to participate in pilot studies to implement edge of field BMPs and/or in-field cover BMPs	Begin process in 2020
	Monitor results of pilot studies to measure success and adapt/adjust wider-scale implementation	Throughout 2021 under varying flow scenarios
	Identify key farmland and work with landowners to implement erosion control BMPs along impaired segments and tributaries (refer to Figure 9-1 for identified filter strip conversion areas).	Begin by 2022
	Work with local stakeholders to identify key areas of shoreline erosion in Upper La Moine watershed.	Throughout 2020
	Implement shoreline stabilization measures in identified key areas.	By the end of 2027
Reduce Septic System Loading	Perform community outreach with septic system management educational information to non-sewered areas in rural areas of the Upper La Moine watershed	2021-2022
Reduce In-Lake Phosphorus	Perform cost-benefit study to understand options of dredging, alum addition, and/or reaeration in Carthage Lake	By the end of 2027
	Implement in-lake management measures to reduce TP (if above study shows cost-effectiveness)	By 2030

9.14.2 Monitoring Plan

The purpose of the monitoring plan for the Upper La Moine watershed is to assess the overall implementation of management actions outlined above. This can be accomplished by conducting the monitoring programs designed to:

1. Track implementation of BMPs in the watershed
2. Estimate effectiveness of BMPs
3. Further monitor point source discharges in the watershed
4. Continued monitoring of impaired stream segments and tributaries (particularly the segments that have not been sampled in the last two decades)
5. Monitor storm-based high flow events
6. Low flow monitoring of total phosphorus, chloride, DO, and TSS in impaired streams

Tracking the implementation of management measures can be used to:

1. Determine the extent to which management measures and practices have been implemented compared to action needed to meet the TMDL endpoints
2. Establish a baseline from which decisions can be made regarding the need for additional incentives for implementation efforts
3. Measure the extent of voluntary implementation efforts
4. Support work-load and costing analysis for assistance or regulatory programs
5. Determine the extent to which management measures are properly maintained and operated

Estimating the effectiveness of the BMPs implemented in the watershed could be completed by monitoring before and after the BMP is incorporated into the watershed. Additional monitoring could be conducted on specific structural systems such as a sediment control basin. Inflow and outflow measurements could be conducted to determine site-specific removal efficiency.

Illinois EPA conducts Intensive Basin Surveys every 5 years. Additionally, select ambient sites are monitored nine times a year. Continuation of this state monitoring program will assess lake and stream water quality as improvements in the watershed are completed. This data will also be used to assess whether water quality standards in the impaired segments are being attained.

9.14.3 Success Criteria

Measuring the plan's success depends largely on tracking milestones. Implementing BMPs should equate to improved water quality and attainment of designated uses and water quality standards. Monitoring pollutant-load reductions will be the primary success criteria. General components include:

1. Securing funding for priority projects within 5 years
2. Meeting the identified milestones
3. Meeting 25-50% of target reductions within 10 years
4. Meeting 100% of target reductions within 20 years
5. Utilizing adaptive management to ensure best practices
6. Delisting of the impaired waterbodies

Table 9-11 Implementation Milestones

Milestone	Detailed Description	Milestone Date
Stakeholder Engagement	Continue work that has been completed to date through Upper La Moine watershed stakeholder group and continue attempts to engage additional landowners, municipalities, environmental groups, and others.	Minimum of annual stakeholder meeting
TSS Reduction (and associated reductions in nutrients)	10% of target reductions through implementation of "ready-to-go" projects	End of 2022
	25% of target reductions through beginning implementation of filter strips and other key farmland erosion control in upper Drowning Fork and Prairie Creek subbasins	End of 2025
	50% of target reductions through continued implementation of erosion control BMPs and adaptive management	End of 2029
	100% or target reductions achieved through implementation of most successful BMPs continuously identified through regular monitoring and adaptive management	2032
Nutrient Reduction	10% of target reductions through implementation of "ready-to-go" projects	End of 2022
	25% of target reductions through implementation of erosion control measures, septic system maintenance outreach, and expanded nutrient management planning	End of 2025
	50% of target reductions through continued implementation of erosion control BMPs and adaptive management	End of 2029
	100% or target reductions achieved through implementation of most successful BMPs continuously identified through regular monitoring and adaptive management and cost-effective in-lake management measures	2032
Chloride Reduction	10% of target reductions through implementation of "ready-to-go" projects	End of 2022
	25% of target reductions through beginning implementation of erosion control measures and livestock exclusion in key areas	End of 2025
	50% of target reductions through continued implementation of erosion control BMPs and adaptive management	End of 2029
	100% or target reductions achieved through implementation of most successful BMPs continuously identified through regular monitoring and adaptive management	2032

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Section 10

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Appendix A

Land Use Categories

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CDM Smith

Land Cover Code	Land Cover Class	Acres	Percent Watershed
1	Corn	137,054.50	37.1372
4	Sorghum	1.94	0.0005
5	Soybeans	104,626.72	28.3504
12	Sweet Corn	1.11	0.0003
13	Pop or Orn Corn	1.26	0.0003
24	Winter Wheat	456.28	0.1236
26	Dbl Crop WinWht/Soybeans	36.65	0.0099
27	Rye	24.01	0.0065
28	Oats	118.38	0.0321
36	Alfalfa	1,079.29	0.2925
37	Other Hay/Non Alfalfa	271.00	0.0734
57	Herbs	0.22	0.0001
58	Clover/Wildflowers	10.94	0.0030
59	Sod/Grass Seed	0.22	0.0001
61	Fallow/Idle Cropland	18.37	0.0050
69	Grapes	0.56	0.0002
76	Walnuts	65.31	0.0177
111	Open Water	823.91	0.2233
121	Developed/Open Space	7,331.39	1.9866
122	Developed/Low Intensity	11,458.12	3.1048
123	Developed/Med Intensity	2,505.07	0.6788
124	Developed/High Intensity	469.95	0.1273
131	Barren	142.18	0.0385
141	Deciduous Forest	59,763.62	16.1940
142	Evergreen Forest	1.43	0.0004
152	Shrubland	0.36	0.0001
176	Grass/Pasture	42,463.41	11.5062
190	Woody Wetlands	231.00	0.0626
195	Herbaceous Wetlands	28.40	0.0077
205	Triticale	11.99	0.0032
225	Dbl Crop WinWht/Corn	29.58	0.0080
229	Pumpkins	21.57	0.0058
Total		**369,048.73**	**100**

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Appendix B

SSURGO Soil Series

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SSURGO Soil Series Code	SSURGO Soil Series Code Definition	Dominant Hydrologic Soil Group	Acres	Percent of Watershed	ksat_l	ksat_r	ksat_h	kwfact	kffact
1334A	Birds silt loam, undrained, 0 to 2 percent slopes, frequently flooded	A	594.27	0.16	14.11	28.23	42.34		
3304A	Landes loam, 0 to 2 percent slopes, frequently flooded	A	26.16	0.01	14.11	28.23	42.34	0.37	0.37
11900	Elco silt loam, 18 to 25 percent slopes, eroded	B	670.96	0.18	4.23	9.17	14.11	0.32	0.32
134B	Camden silt loam, 2 to 5 percent slopes	B	151.13	0.04	4.23	9.17	14.11	0.43	0.43
17B	Keomah silt loam, 2 to 5 percent slopes	B	1,703.04	0.46	4.23	9.17	14.11	0.49	0.49
250D2	Velma silt loam, 10 to 18 percent slopes, eroded	B	540.87	0.15	4.23	9.17	14.11	0.32	0.32
274C2	Seaton silt loam, 5 to 10 percent slopes, eroded	B	18.80	0.01	4.23	9.17	14.11	0.55	0.55
275A	Joy silt loam, 0 to 2 percent slopes	B	27.93	0.01	4.23	9.17	14.11	0.37	0.37
279C2	Rozetta silt loam, 5 to 10 percent slopes, eroded	B	18,044.76	4.89	4.23	9.17	14.11	0.43	0.43
279C3	Rozetta silty clay loam, 5 to 10 percent slopes, severely eroded	B	161.95	0.04	4.23	9.17	14.11	0.43	0.43
280D2	Fayette silt loam, 10 to 18 percent slopes, eroded	B	853.17	0.23	4.23	9.17	14.11	0.37	0.37
280F	Fayette silt loam, 18 to 35 percent slopes	B	119.29	0.03	4.23	9.17	14.11	0.49	0.49
3077A	Huntsville silt loam, 0 to 2 percent slopes, frequently flooded	B	74.33	0.02	4.23	9.17	14.11	0.32	0.32
3107A	Sawmill silty clay loam, 0 to 2 percent slopes, frequently flooded	B	4,513.04	1.22	4.23	9.17	14.11	0.2	0.2
3284A	Tice silty clay loam, 0 to 2 percent slopes, frequently flooded	B	494.69	0.13	4.23	9.17	14.11	0.43	0.43
37B	Worthen silt loam, 2 to 5 percent slopes	B	13.54	0.00	4.23	9.17	14.11	0.37	0.37
440B	Jasper loam, 2 to 5 percent slopes	B	18.27	0.00	4.23	9.17	14.11	0.49	0.49
440C2	Jasper fine sandy loam, 5 to 10 percent slopes, eroded	B	18.09	0.00	4.23	9.17	14.11	0.24	0.24
51B	Muscatune silt loam, 2 to 5 percent slopes	B	525.77	0.14	4.23	9.17	14.11	0.32	0.32
549G	Marseilles silt loam, 35 to 60 percent slopes	B	1,514.66	0.41	4.23	9.17	14.11	0.37	0.37
61A	Atterberry silt loam, 0 to 2 percent slopes	B	2,476.76	0.67	4.23	9.17	14.11	0.37	0.37
675B	Greenbush silt loam, 2 to 5 percent slopes	B	6,420.48	1.74	4.23	9.17	14.11	0.37	0.37
7037B	Worthen silt loam, 2 to 5 percent slopes, rarely flooded	B	53.76	0.01	4.23	9.17	14.11	0.37	0.37
7134B	Camden silt loam, 2 to 5 percent slopes, rarely flooded	B	117.44	0.03	4.23	9.17	14.11	0.55	0.55
724D2	Rozetta-Elco silt loams, 10 to 18 percent slopes, eroded	B	114.49	0.03	4.23	9.17	14.11	0.37	0.37
86D2	Osco silt loam, 10 to 18 percent slopes, eroded	B	98.32	0.03	4.23	9.17	14.11	0.37	0.37
8F	Hickory silt loam, 18 to 35 percent slopes	B	21,469.24	5.82	4.23	9.17	14.11	0.32	0.32
8G	Hickory silt loam, 35 to 60 percent slopes	B	4,013.55	1.09	4.23	9.17	14.11	0.32	0.32

SSURGO Soil Series Code	SSURGO Soil Series Code Definition	Dominant Hydrologic Soil Group	Acres	Percent of Watershed	ksat_l	ksat_r	ksat_h	kwfact	kffact
9086B	Osco silt loam, terrace, 2 to 5 percent slopes	B	37.34	0.01	4.23	9.17	14.11	0.43	0.43
9279B	Rozetta silt loam, terrace, 2 to 5 percent slopes	B	518.98	0.14	4.23	9.17	14.11	0.37	0.37
936D3	Fayette-Hickory complex, 18 to 35 percent slopes, severely eroded	B	44.13	0.01	4.23	9.17	14.11	0.43	0.43
936F	Fayette-Hickory silt loams, 18 to 35 percent slopes	B	657.69	0.18	4.23	9.17	14.11	0.37	0.37
936G	Fayette-Hickory silt loams, 35 to 60 percent slopes	B	12.80	0.00	4.23	9.17	14.11	0.37	0.37
134C2	Camden silt loam, 5 to 10 percent slopes, eroded	B/D	123.02	0.03	4.23	9.17	14.11	0.32	0.32
17B2	Keomah silt loam, 2 to 5 percent slopes, eroded	B/D	3,936.25	1.07	4.23	9.17	14.11	0.49	0.49
257B2	Clarksdale silt loam, 2 to 5 percent slopes, eroded	B/D	5,653.35	1.53	4.23	9.17	14.11	0.24	0.24
259D2	Assumption silt loam, 10 to 18 percent slopes, eroded	B/D	244.51	0.07	4.23	9.17	14.11	0.49	0.49
278B	Stronghurst silt loam, 2 to 5 percent slopes	B/D	264.95	0.07	4.23	9.17	14.11	0.37	0.37
3074A	Radford silt loam, 0 to 2 percent slopes, frequently flooded	B/D	1,562.31	0.42	4.23	9.17	14.11	0.43	0.43
3107A+	Sawmill silt loam, 0 to 2 percent slopes, frequently flooded, overwash	B/D	107.33	0.03	4.23	9.17	14.11	0.32	0.32
3333A	Wakeland silt loam, 0 to 2 percent slopes, frequently flooded	B/D	4,738.26	1.28	4.23	9.17	14.11	0.37	0.37
3334A	Birds silt loam, 0 to 2 percent slopes, frequently flooded	B/D	475.38	0.13	4.23	9.17	14.11	0.37	0.37
3415A	Orion silt loam, 0 to 2 percent slopes, frequently flooded	B/D	102.16	0.03	4.23	9.17	14.11	0.32	0.32
3428A	Coffeen silt loam, 0 to 2 percent slopes, frequently flooded	B/D	4,669.13	1.27	4.23	9.17	14.11	0.37	0.37
3451A	Lawson silt loam, 0 to 2 percent slopes, frequently flooded	B/D	6,623.91	1.79	4.23	9.17	14.11	0.32	0.32
3725A	Otter-Lawson silt loams, 0 to 2 percent slopes, frequently flooded	B/D	26.26	0.01	4.23	9.17	14.11	0.37	0.37
43B	Ipava silt loam, 2 to 5 percent slopes	B/D	4,487.95	1.22	4.23	9.17	14.11	0.24	0.24
51A	Muscatune silt loam, 0 to 2 percent slopes	B/D	21,412.17	5.80	4.23	9.17	14.11	0.32	0.32
51B2	Muscatune silt loam, 2 to 5 percent slopes, eroded	B/D	4,330.63	1.17	4.23	9.17	14.11	0.49	0.49
61B	Atterberry silt loam, 2 to 5 percent slopes	B/D	287.99	0.08	4.23	9.17	14.11	0.55	0.55
61B2	Atterberry silt loam, 2 to 5 percent slopes, eroded	B/D	1,398.06	0.38	4.23	9.17	14.11	0.49	0.49
675C2	Greenbush silt loam, 5 to 10 percent slopes, eroded	B/D	87.40	0.02	4.23	9.17	14.11	0.37	0.37
7242A	Kendall silt loam, 0 to 2 percent slopes, rarely flooded	B/D	73.71	0.02	4.23	9.17	14.11	0.49	0.49
8107A	Sawmill silty clay loam, 0 to 2 percent slopes, occasionally flooded	B/D	157.55	0.04	4.23	9.17	14.11	0.32	0.32
8284A	Tice silt loam, 0 to 2 percent slopes, occasionally flooded	B/D	175.10	0.05	4.23	9.17	14.11	0.32	0.32
8415A	Orion silt loam, 0 to 2 percent slopes, occasionally flooded	B/D	253.39	0.07	4.23	9.17	14.11	0.32	0.32

SSURGO Soil Series Code	SSURGO Soil Series Code Definition	Dominant Hydrologic Soil Group	Acres	Percent of Watershed	ksat_l	ksat_r	ksat_h	kwfact	kffact
8451A	Lawson silt loam, 0 to 2 percent slopes, occasionally flooded	B/D	301.87	0.08	4.23	9.17	14.11	0.32	0.32
86B	Osco silt loam, 2 to 5 percent slopes	B/D	15,724.50	4.26	4.23	9.17	14.11	0.24	0.24
86C3	Osco silty clay loam, 5 to 10 percent slopes, severely eroded	B/D	22.45	0.01	4.23	9.17	14.11	0.32	0.32
9017B	Keomah silt loam, terrace, 2 to 5 percent slopes	B/D	243.97	0.07	4.23	9.17	14.11		
957D3	Elco-Atlas silty clay loams, 10 to 18 percent slopes, severely eroded	B/D	197.32	0.05	4.23	9.17	14.11	0.43	0.43
119C2	Elco silt loam, 5 to 10 percent slopes, eroded	C	1,651.17	0.45	4.23	9.17	14.11	0.37	0.37
249A	Edinburg silty clay loam, 0 to 2 percent slopes	C	886.34	0.24	4.23	9.17	14.11	0.43	0.43
68A+	Sable silt loam, 0 to 2 percent slopes, overwash	C	138.12	0.04	4.23	9.17	14.11	0.37	0.37
705B	Buckhart silt loam, 2 to 5 percent slopes	C	247.49	0.07	4.23	9.17	14.11	0.37	0.37
802B	Orthents, loamy, undulating	C	826.06	0.22	1.41	2.82	4.23	0.37	0.37
802E	Orthents, loamy, hilly	C	511.40	0.14	1.41	2.82	4.23	0.28	0.28
8D3	Hickory clay loam, 10 to 18 percent slopes, severely eroded	C	18.09	0.00	4.23	9.17	14.11	0.43	0.43
915D2	Elco-Ursa complex, 10 to 18 percent slopes, eroded	C	3,250.00	0.88	4.23	9.17	14.11	0.49	0.49
957D2	Elco-Atlas silt loams, 10 to 18 percent slopes, eroded	C	364.71	0.10	4.23	9.17	14.11	0.37	0.37
1070A	Beaucoup silty clay loam, 0 to 2 percent slopes, undrained, occasionally flooded	C/D	177.66	0.05	1.41	2.82	4.23	0.43	0.43
111A	Rubio silt loam, 0 to 2 percent slopes	C/D	821.14	0.22	1.41	2.82	4.23	0.37	0.37
138A	Shiloh silty clay loam, 0 to 2 percent slopes	C/D	433.33	0.12	1.41	2.82	4.23	0.28	0.28
17A	Keomah silt loam, 0 to 2 percent slopes	C/D	6,326.49	1.71	4.23	9.17	14.11	0.49	0.49
278A	Stronghurst silt loam, 0 to 2 percent slopes	C/D	905.89	0.25	4.23	9.17	14.11	0.49	0.49
279B	Rozetta silt loam, 2 to 5 percent slopes	C/D	16,859.57	4.57	4.23	9.17	14.11	0.49	0.49
280B	Fayette silt loam, 2 to 5 percent slopes	C/D	4.53	0.00	4.23	9.17	14.11	0.32	0.32
3070A	Beaucoup silty clay loam, 0 to 2 percent slopes, frequently flooded	C/D	732.16	0.20	1.41	2.82	4.23	0.37	0.37
43A	Ipava silt loam, 0 to 2 percent slopes	C/D	62,724.94	17.00	4.23	9.17	14.11	0.32	0.32
43B2	Ipava silt loam, 2 to 5 percent slopes, eroded	C/D	10,482.83	2.84	4.23	9.17	14.11	0.49	0.49
470C2	Keller silt loam, 5 to 10 percent slopes, eroded	C/D	4,779.38	1.30	4.23	9.17	14.11	0.49	0.49
50A	Virden silty clay loam, 0 to 2 percent slopes	C/D	14,381.95	3.90	4.23	9.17	14.11	0.28	0.28
675A	Greenbush silt loam, 0 to 2 percent slopes	C/D	5.88	0.00	4.23	9.17	14.11	0.32	0.32

SSURGO Soil Series Code	SSURGO Soil Series Code Definition	Dominant Hydrologic Soil Group	Acres	Percent of Watershed	ksat_l	ksat_r	ksat_h	kwfact	kffact
699A	Timewell silt loam, 0 to 2 percent slopes	C/D	3,183.60	0.86	4.23	9.17	14.11	0.32	0.32
6C2	Fishhook silt loam, 5 to 10 percent slopes, eroded	C/D	5,143.51	1.39	0.42	0.92	1.41	0.32	0.32
705B2	Buckhart silt loam, 2 to 5 percent slopes, eroded	C/D	24.76	0.01	4.23	9.17	14.11	0.37	0.37
8070A	Beaucoup silty clay loam, 0 to 2 percent slopes, occasionally flooded	C/D	134.24	0.04	1.41	2.82	4.23	0.28	0.28
8077A	Huntsville silt loam, 0 to 2 percent slopes, occasionally flooded	C/D	55.25	0.01	1.41	2.82	4.23	0.32	0.32
8304A	Landes loam, 0 to 2 percent slopes, occasionally flooded	C/D	37.64	0.01	1.41	2.82	4.23	0.37	0.37
855A	Timewell and Ipava soils, 0 to 2 percent slopes	C/D	717.56	0.19	4.23	9.17	14.11	0.49	0.49
9017A	Keomah silt loam, terrace, 0 to 2 percent slopes	C/D	91.28	0.02	1.41	2.82	4.23	0.55	0.55
9043A	Ipava silt loam, terrace, 0 to 2 percent slopes	C/D	198.06	0.05	1.41	2.82	4.23	0.37	0.37
9050A	Virden silty clay loam, terrace, 0 to 2 percent slopes	C/D	476.23	0.13	4.23	9.17	14.11	0.28	0.28
9111A	Rubio silt loam, terrace, 0 to 2 percent slopes	C/D	5.76	0.00	4.23	9.17	14.11	0.43	0.43
9257A	Clarksdale silt loam, terrace, 0 to 2 percent slopes	C/D	360.11	0.10	4.23	9.17	14.11	0.37	0.37
9257B2	Clarksdale silt loam, terrace, 2 to 5 percent slopes, eroded	C/D	101.47	0.03	1.41	2.82	4.23	0.37	0.37
605000	Ursa clay loam, 18 to 25 percent slopes, severely eroded	D	451.10	0.12	0.42	0.92	1.41	0.32	0.32
119D2	Elco silt loam, 10 to 18 percent slopes, eroded	D	2,809.36	0.76	0.07	0.25	0.42	0.32	0.32
16A	Rushville silt loam, 0 to 2 percent slopes	D	37.60	0.01	0.07	0.25	0.42	0.43	0.43
259C2	Assumption silt loam, 5 to 10 percent slopes, eroded	D	2,745.32	0.74	0.07	0.25	0.42	0.32	0.32
280D3	Fayette silty clay loam, 10 to 18 percent slopes, severely eroded	D	57.34	0.02	1.41	2.82	4.23	0.43	0.43
417G	Derinda silt loam, 35 to 60 percent slopes	D	304.81	0.08	0.42	0.92	1.41	0.43	0.43
549F	Marseilles silt loam, 18 to 35 percent slopes	D	228.23	0.06	0.07	0.74	1.40		
605C2	Ursa silt loam, 5 to 10 percent slopes, eroded	D	50.61	0.01	4.23	9.17	14.11	0.43	0.43
605D2	Ursa silt loam, 10 to 18 percent slopes, eroded	D	733.25	0.20	4.23	9.17	14.11	0.43	0.43
660C3	Coatsburg silty clay loam, 5 to 10 percent slopes, severely eroded	D	162.58	0.04	1.41	2.82	4.23	0.32	0.32
6D2	Fishhook silt loam, 10 to 18 percent slopes, eroded	D	621.95	0.17	4.23	9.17	14.11	0.37	0.37
7C3	Atlas silty clay loam, 5 to 10 percent slopes, severely eroded	D	1,135.59	0.31	0.07	0.21	0.42	0.37	0.37
7D3	Atlas silty clay loam, 10 to 18 percent slopes, severely eroded	D	574.22	0.16	0.07	0.21	0.42	0.37	0.37
971D3	Fishhook-Atlas silty clay loams, 10 to 18 percent slopes, severely eroded	D	1,704.18	0.46	0.42	0.92	1.41	0.37	0.37
864	Pits, quarries		64.86	0.02	0.00	0.00	0.00		

SSURGO Soil Series Code	SSURGO Soil Series Code Definition	Dominant Hydrologic Soil Group	Acres	Percent of Watershed	ksat_l	ksat_r	ksat_h	kwfact	kffact
257A	Clarksdale silt loam, 0 to 2 percent slopes		9,267.87	2.51	0.00	0.00	0.00		
257B	Clarksdale silt loam, 2 to 5 percent slopes		2,051.60	0.56	0.00	0.00	0.00		
279D2	Rozetta silt loam, 10 to 18 percent slopes, eroded		1,632.46	0.44	0.00	0.00	0.00		
45A	Denny silt loam, 0 to 2 percent slopes		674.10	0.18	0.00	0.00	0.00		
68A	Sable silty clay loam, 0 to 2 percent slopes		38,784.84	10.51	0.00	0.00	0.00		
86B2	Osco silt loam, 2 to 5 percent slopes, eroded		11,658.11	3.16	0.00	0.00	0.00		
86C2	Osco silt loam, 5 to 10 percent slopes, eroded		6,711.00	1.82	0.00	0.00	0.00		
8D	Hickory silt loam, 10 to 18 percent slopes		507.28	0.14	0.00	0.00	0.00		
8D2	Hickory silt loam, 10 to 18 percent slopes, eroded		3,754.22	1.02	0.00	0.00	0.00		
9279C2	Rozetta silt loam, terrace, 5 to 10 percent slopes, eroded		407.52	0.11	0.00	0.00	0.00		
M-W	Miscellaneous water		63.12	0.02	0.00	0.00	0.00		
W	Water		996.49	0.27	0.00	0.00	0.00		
Total			**369,048.74**	**100**					

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Appendix C

Historical Water Quality Data

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CDM Smith

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	7/18/2012	10:06	2,4-D	Total	Water	0.43	ug/l	9 ft
RLE-1	6/11/2012	10:53	2,4-D	Total	Water	0.33	ug/l	9 ft
RLE-1	4/14/2009	11:18	2,4-D, Dichlorophenoxyacetic acid	Total	Water	0.27	ug/l	9 ft
RLE-1	6/3/2009	12:05	2,4-D, Dichlorophenoxyacetic acid	Total	Water	0.27	ug/l	9 ft
RLE-1	06/04/2003	10:48	Acetochlor		Water	0.15	ug/l	11 ft
RLE-1	6/3/2009	12:05	Acetochlor	Total	Water	0.073	ug/l	9 ft
RLE-1	6/11/2012	10:53	Acetochlor	Total	Water	0.046	ug/l	9 ft
RLE-1	8/11/2009	11:10	Acetochlor	Total	Water	0.028	ug/l	9 ft
RLE-1	10/14/2009	11:10	Acetochlor	Total	Water	0.028	ug/l	9 ft
RLE-1	4/17/2012	10:33	Acetochlor	Total	Water	0.023	ug/l	9 ft
RLE-1	7/22/2009	11:10	Acetochlor	Total	Water	0.022	ug/l	9 ft
RLE-1	7/18/2012	10:06	Acetochlor	Total	Water	0.017	ug/l	9 ft
RLE-1	8/22/2012	10:26	Acetochlor	Total	Water	0.013	ug/l	9 ft
RLE-1	08/07/2003	10:41	Alkalinity, Carbonate as CaCO3	Total	Water	20	mg/l	1 ft
RLE-2	08/07/2003	11:21	Alkalinity, Carbonate as CaCO3	Total	Water	20	mg/l	1 ft
RLE-3	08/07/2003	11:38	Alkalinity, Carbonate as CaCO3	Total	Water	20	mg/l	1 ft
RLE-2	07/23/2003	11:28	Alkalinity, Carbonate as CaCO3	Total	Water	15	mg/l	1 ft
RLE-3	07/23/2003	11:48	Alkalinity, Carbonate as CaCO3	Total	Water	15	mg/l	1 ft
RLE-1	07/23/2003	10:36	Alkalinity, Carbonate as CaCO3	Total	Water	5	mg/l	1 ft
RLE-1	07/23/2003	10:36	Alkalinity, Carbonate as CaCO3	Total	Water	5	mg/l	9 ft
RLE-2	04/15/2003	11:06	Alkalinity, Carbonate as CaCO3	Total	Water	5	mg/l	1 ft
RLE-3	04/15/2003	11:20	Alkalinity, Carbonate as CaCO3	Total	Water	5	mg/l	1 ft
RLE-1	10/15/2003	11:10	Alkalinity, Carbonate as CaCO3	Total	Water	0	mg/l	1 ft
RLE-1	06/04/2003	10:48	Alkalinity, Carbonate as CaCO3	Total	Water	0	mg/l	1 ft
RLE-1	04/15/2003	10:30	Alkalinity, Carbonate as CaCO3	Total	Water	0	mg/l	1 ft
RLE-1	08/07/2003	10:41	Alkalinity, Carbonate as CaCO3	Total	Water	0	mg/l	11 ft
RLE-1	06/04/2003	10:48	Alkalinity, Carbonate as CaCO3	Total	Water	0	mg/l	11 ft
RLE-1	04/15/2003	10:30	Alkalinity, Carbonate as CaCO3	Total	Water	0	mg/l	11 ft
RLE-1	10/15/2003	11:10	Alkalinity, Carbonate as CaCO3	Total	Water	0	mg/l	14 ft
RLE-1	07/23/2003	10:36	Alkalinity, Carbonate as CaCO3	Total	Water	0	mg/l	17 ft
RLE-1	06/04/2003	10:48	Alkalinity, Carbonate as CaCO3	Total	Water	0	mg/l	18 ft
RLE-1	10/15/2003	11:10	Alkalinity, Carbonate as CaCO3	Total	Water	0	mg/l	7 ft
RLE-1	08/07/2003	10:41	Alkalinity, Carbonate as CaCO3	Total	Water	0	mg/l	7 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	04/15/2003	10:30	Alkalinity, Carbonate as CaCO3	Total	Water	0	mg/l	7 ft
RLE-2	10/15/2003	11:45	Alkalinity, Carbonate as CaCO3	Total	Water	0	mg/l	1 ft
RLE-2	06/04/2003	11:37	Alkalinity, Carbonate as CaCO3	Total	Water	0	mg/l	1 ft
RLE-3	10/15/2003	12:00	Alkalinity, Carbonate as CaCO3	Total	Water	0	mg/l	1 ft
RLE-3	06/04/2003	12:03	Alkalinity, Carbonate as CaCO3	Total	Water	0	mg/l	1 ft
DGP-01	9/11/2002	13:00	ALKALINITY, CARBONATE AS CACO3,Total mg/l		Water	307	mg/l	
DGLC-01	8/12/2002	15:30	ALKALINITY, CARBONATE AS CACO3,Total mg/l		Water	236	mg/l	
DGP-01	8/8/2002	12:45	ALKALINITY, CARBONATE AS CACO3,Total mg/l		Water	222	mg/l	
DGLC-01	9/11/2002	14:30	ALKALINITY, CARBONATE AS CACO3,Total mg/l		Water	208	mg/l	
DGLC-01	6/10/2002	9:00	ALKALINITY, CARBONATE AS CACO3,Total mg/l		Water	177	mg/l	
DGP-01	6/11/2002	9:00	ALKALINITY, CARBONATE AS CACO3,Total mg/l		Water	155	mg/l	
DGO-01	6/11/2002	10:45	ALKALINITY, CARBONATE AS CACO3,Total mg/l		Water	41	mg/l	
DGLC-01	8/22/2007	9:45	Alkalinity, total		Water	455	mg/l	
DGLC-01	9/26/2007	12:10	Alkalinity, total		Water	410	mg/l	
DGLC-01	9/18/2012	10:14	Alkalinity, total		Water	350	mg/l	
DGPC-01	9/25/2007	13:40	Alkalinity, total		Water	350	mg/l	
DGPC-01	8/20/2007	11:00	Alkalinity, total		Water	316	mg/l	
DGLC-01	7/10/2012	8:29	Alkalinity, total		Water	295	mg/l	
DGP-01	9/17/2012	10:59	Alkalinity, total		Water	260	mg/l	
DGP-01	8/20/2007	11:40	Alkalinity, total		Water	250	mg/l	
DGP-01	9/25/2007	12:20	Alkalinity, total		Water	250	mg/l	
DGO-01	8/20/2007	12:20	Alkalinity, total		Water	240	mg/l	
DGLC-01	7/16/2007	9:45	Alkalinity, total		Water	216	mg/l	
DGPC-01	6/12/2007	9:00	Alkalinity, total		Water	202	mg/l	
DGLC-01	6/18/2007	14:15	Alkalinity, total		Water	202	mg/l	
DGO-01	7/3/2007	12:00	Alkalinity, total		Water	184	mg/l	
DGLC-01	5/14/2012	9:30	Alkalinity, total		Water	180	mg/l	
DGP-01	5/15/2012	11:29	Alkalinity, total		Water	180	mg/l	
DGP-01	7/18/2007	10:45	Alkalinity, total		Water	180	mg/l	
RLE-1	8/11/2009	11:25	Alkalinity, total		Water	140	mg/l	16 ft
RLE-1	7/22/2009	10:59	Alkalinity, total		Water	140	mg/l	18 ft
RLE-1	4/17/2012	10:33	Alkalinity, total		Water	120	mg/l	9 ft
RLE-1	6/11/2012	10:53	Alkalinity, total		Water	120	mg/l	9 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	4/17/2012	10:32	Alkalinity, total		Water	115	mg/l	1 ft
RLE-1	10/14/2009	11:00	Alkalinity, total		Water	115	mg/l	1 ft
RLE-1	10/14/2009	11:10	Alkalinity, total		Water	115	mg/l	9 ft
RLE-1	10/14/2009	11:20	Alkalinity, total		Water	115	mg/l	17 ft
RLE-1	6/11/2012	10:49	Alkalinity, total		Water	110	mg/l	1 ft
RLE-1	8/22/2012	10:24	Alkalinity, total		Water	110	mg/l	1 ft
RLE-1	8/22/2012	10:26	Alkalinity, total		Water	110	mg/l	9 ft
RLE-1	8/11/2009	11:10	Alkalinity, total		Water	110	mg/l	9 ft
RLE-1	8/22/2012	10:27	Alkalinity, total		Water	110	mg/l	14 ft
RLE-1	7/18/2012	10:07	Alkalinity, total		Water	110	mg/l	15 ft
DGO-01	5/15/2012	10:45	Alkalinity, total		Water	110	mg/l	
RLE-1	7/18/2012	10:06	Alkalinity, total		Water	105	mg/l	1 ft
RLE-1	7/18/2012	10:06	Alkalinity, total		Water	105	mg/l	9 ft
RLE-1	4/17/2012	10:35	Alkalinity, total		Water	105	mg/l	15 ft
RLE-1	6/11/2012	11:00	Alkalinity, total		Water	105	mg/l	16 ft
RLE-1	7/22/2009	10:51	Alkalinity, total		Water	100	mg/l	1 ft
RLE-1	8/11/2009	11:00	Alkalinity, total		Water	100	mg/l	1 ft
RLE-1	7/22/2009	11:10	Alkalinity, total		Water	100	mg/l	9 ft
RLE-1	6/3/2009	11:40	Alkalinity, total		Water	100	mg/l	17 ft
RLE-1	4/14/2009	11:28	Alkalinity, total		Water	81	mg/l	18 ft
RLE-1	4/14/2009	11:08	Alkalinity, total		Water	80	mg/l	1 ft
RLE-1	4/14/2009	11:18	Alkalinity, total		Water	80	mg/l	9 ft
RLE-1	6/3/2009	12:05	Alkalinity, total		Water	79	mg/l	9 ft
RLE-1	6/3/2009	11:30	Alkalinity, total		Water	77	mg/l	1 ft
RLE-1	07/23/2003	10:36	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	170	mg/l	17 ft
RLE-1	10/15/2003	11:10	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	150	mg/l	1 ft
RLE-1	06/04/2003	10:48	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	150	mg/l	18 ft
RLE-2	10/15/2003	11:45	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	150	mg/l	1 ft
RLE-1	06/04/2003	10:48	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	140	mg/l	11 ft
RLE-1	10/15/2003	11:10	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	140	mg/l	7 ft
RLE-3	10/15/2003	12:00	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	140	mg/l	1 ft
RLE-1	08/07/2003	10:41	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	130	mg/l	1 ft
RLE-1	06/04/2003	10:48	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	130	mg/l	1 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	10/15/2003	11:10	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	130	mg/l	14 ft
RLE-1	07/23/2003	10:36	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	130	mg/l	9 ft
RLE-2	08/07/2003	11:21	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	130	mg/l	1 ft
RLE-2	07/23/2003	11:28	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	130	mg/l	1 ft
RLE-2	06/04/2003	11:37	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	130	mg/l	1 ft
RLE-3	08/07/2003	11:38	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	130	mg/l	1 ft
RLE-3	06/04/2003	12:03	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	130	mg/l	1 ft
RLE-1	08/07/2003	10:41	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	125	mg/l	11 ft
RLE-2	04/15/2003	11:06	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	125	mg/l	1 ft
RLE-3	04/15/2003	11:20	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	115	mg/l	1 ft
RLE-1	07/23/2003	10:36	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	110	mg/l	1 ft
RLE-1	04/15/2003	10:30	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	105	mg/l	1 ft
RLE-1	04/15/2003	10:30	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	105	mg/l	11 ft
RLE-1	04/15/2003	10:30	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	105	mg/l	7 ft
RLE-1	08/07/2003	10:41	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	100	mg/l	7 ft
RLE-3	07/23/2003	11:48	Alkalinity, Total (total hydroxide+carbonate+bicarbonate)	Total	Water	100	mg/l	1 ft
DGLC-01	9/18/2012	10:14	Aluminum	Total	Water	1870	ug/l	
RLE-1	6/3/2009	12:05	Aluminum	Total	Water	1720	ug/l	9 ft
DGLC-01	8/22/2007	9:45	Aluminum	Total	Water	1700	ug/l	
RLE-1	4/14/2009	11:18	Aluminum	Total	Water	1470	ug/l	9 ft
RLE-1	8/22/2012	10:26	Aluminum	Total	Water	1020	ug/l	9 ft
DGLC-01	9/26/2007	12:10	Aluminum	Total	Water	1010	ug/l	
RLE-1	7/18/2012	10:06	Aluminum	Total	Water	862	ug/l	9 ft
RLE-1	7/22/2009	11:10	Aluminum	Total	Water	862	ug/l	9 ft
DGLC-BU-C2	9/5/2007	11:45	Aluminum	Total	Water	820	ug/l	
DGLC-01	5/14/2012	9:30	Aluminum	Total	Water	767	ug/l	
RLE-1	4/17/2012	10:33	Aluminum	Total	Water	627	ug/l	9 ft
DGP-01	5/15/2012	11:29	Aluminum	Total	Water	627	ug/l	
DGLC-01	7/10/2012	8:29	Aluminum	Total	Water	609	ug/l	
DGP-01	7/18/2007	10:45	Aluminum	Total	Water	570	ug/l	
RLE-1	10/14/2009	11:10	Aluminum	Total	Water	529	ug/l	9 ft
DGLC-BU-C1	9/5/2007	10:00	Aluminum	Total	Water	450	ug/l	
RLE-1	6/11/2012	10:53	Aluminum	Total	Water	431	ug/l	9 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	10/15/2003	11:10	Aluminum	Total	Water	320	ug/l	7 ft
DGP-01	8/20/2007	11:40	Aluminum	Total	Water	270	ug/l	
RLE-1	06/04/2003	10:48	Aluminum	Total	Water	210	ug/l	11 ft
DGO-01	7/3/2007	12:00	Aluminum	Total	Water	190	ug/l	
DGPC-01	8/20/2007	11:00	Aluminum	Total	Water	190	ug/l	
DGLC-01	9/26/2007	12:10	Aluminum	Dissolved	Water	175	ug/l	
DGO-01	8/20/2007	12:20	Aluminum	Total	Water	170	ug/l	
DGLC-01	6/18/2007	14:15	Aluminum	Total	Water	160	ug/l	
RLE-1	8/11/2009	11:10	Aluminum	Total	Water	133	ug/l	9 ft
RLE-1	08/07/2003	10:41	Aluminum	Total	Water	110	ug/l	7 ft
DGLC-BU-E1	9/5/2007	11:10	Aluminum	Total	Water	110	ug/l	
DGLC-01	7/16/2007	9:45	Aluminum	Total	Water	100	ug/l	
DGO-01	5/15/2012	10:45	Aluminum	Total	Water	98.2	ug/l	
DGPC-01	6/12/2007	9:00	Aluminum	Total	Water	90	ug/l	
DGP-01	9/25/2007	12:20	Aluminum	Total	Water	90	ug/l	
DGLC-01	8/22/2007	9:45	Aluminum	Dissolved	Water	59	ug/l	
DGLC-01	7/10/2012	8:29	Aluminum	Dissolved	Water	25.8	ug/l	
DGPC-01	9/25/2007	13:40	Aluminum	Dissolved	Water	10	ug/l	
DGLC-01	9/18/2012	10:14	Aluminum	Dissolved	Water	5.28	ug/l	
DGPC-01	9/25/2007	13:40	Aluminum	Total	Water	4.2	ug/l	
DGP-01	9/25/2007	12:20	Aluminum	Dissolved	Water	1.8	ug/l	
DGO-01	6/11/2002	10:45	ALUMINUM,Dissolved ug/l	Dissolved	Water	340	ug/l	
DGLC-01	8/12/2002	15:30	ALUMINUM,Dissolved ug/l	Dissolved	Water	100	ug/l	
DGP-01	8/8/2002	12:45	ALUMINUM,Dissolved ug/l	Dissolved	Water	100	ug/l	
DGLC-01	6/10/2002	9:00	ALUMINUM,Dissolved ug/l	Dissolved	Water	100	ug/l	
DGP-01	6/11/2002	9:00	ALUMINUM,Dissolved ug/l	Dissolved	Water	100	ug/l	
DGP-01	9/11/2002	13:00	ALUMINUM,Dissolved ug/l	Dissolved	Water	100	ug/l	
DGLC-01	9/11/2002	14:30	ALUMINUM,Dissolved ug/l	Dissolved	Water	100	ug/l	
DGO-01	6/11/2002	10:45	ALUMINUM,Total ug/l	Total	Water	27000	ug/l	
DGP-01	6/11/2002	9:00	ALUMINUM,Total ug/l	Total	Water	2600	ug/l	
DGLC-01	6/10/2002	9:00	ALUMINUM,Total ug/l	Total	Water	2100	ug/l	
DGLC-01	8/12/2002	15:30	ALUMINUM,Total ug/l	Total	Water	1500	ug/l	
DGLC-01	9/11/2002	14:30	ALUMINUM,Total ug/l	Total	Water	1100	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGP-01	8/8/2002	12:45	ALUMINUM,Total ug/l	Total	Water	280	ug/l	
DGP-01	9/11/2002	13:00	ALUMINUM,Total ug/l	Total	Water	120	ug/l	
RLE-1	4/17/2012	10:32	Ammonia-nitrogen	Total	Water	0.58	mg/l	1 ft
RLE-1	8/22/2012	10:27	Ammonia-nitrogen	Total	Water	0.58	mg/l	14 ft
RLE-1	8/22/2012	10:26	Ammonia-nitrogen	Total	Water	0.52	mg/l	9 ft
RLE-1	8/22/2012	10:24	Ammonia-nitrogen	Total	Water	0.45	mg/l	1 ft
RLE-1	7/18/2012	10:07	Ammonia-nitrogen	Total	Water	0.3	mg/l	15 ft
DGLC-01	9/18/2012	8:39	Ammonia-nitrogen	Total	Water	0.21	mg/l	
RLE-1	6/11/2012	11:00	Ammonia-nitrogen	Total	Water	0.16	mg/l	16 ft
DGP-01	7/17/2012	8:06	Ammonia-nitrogen	Total	Water	0.12	mg/l	
DGLC-01	9/18/2012	10:14	Ammonia-nitrogen	Total	Water	0.12	mg/l	
RLE-1	7/18/2012	10:06	Ammonia-nitrogen	Total	Water	0.1	mg/l	9 ft
DGLC-01	8/22/2007	9:45	Arsenic	Total	Water	11	ug/l	
DGLC-01	7/10/2012	8:29	Arsenic	Total	Water	10.4	ug/l	
DGLC-01	7/10/2012	8:29	Arsenic	Dissolved	Water	9.94	ug/l	
RLE-3	07/23/2003	11:48	Arsenic	Total	Sediment	8.4	mg/kg	15 ft
DGLC-01	9/26/2007	12:10	Arsenic	Total	Water	8.24	ug/l	
RLE-1	07/23/2003	10:36	Arsenic	Total	Sediment	8	mg/kg	19 ft
DGLC-01	9/26/2007	12:10	Arsenic	Dissolved	Water	6.59	ug/l	
DGLC-01	9/18/2012	10:14	Arsenic	Total	Water	6.16	ug/l	
DGLC-01	9/18/2012	10:14	Arsenic	Dissolved	Water	6.1	ug/l	
DGO-01	8/20/2007	12:20	Arsenic	Total	Water	5.9	ug/l	
RLE-1	8/22/2012	10:26	Arsenic	Total	Water	3.31	ug/l	9 ft
DGPC-01	9/25/2007	13:40	Arsenic	Dissolved	Water	3.2	ug/l	
RLE-1	7/22/2009	11:10	Arsenic	Total	Water	3.12	ug/l	9 ft
RLE-1	10/14/2009	11:10	Arsenic	Total	Water	3.06	ug/l	9 ft
RLE-1	08/07/2003	10:41	Arsenic	Total	Water	3	ug/l	7 ft
DGPC-01	9/25/2007	13:40	Arsenic	Total	Water	3	ug/l	
RLE-1	07/23/2003	10:36	Arsenic	Total	Water	2.8	ug/l	9 ft
DGP-01	8/20/2007	11:40	Arsenic	Total	Water	2.8	ug/l	
DGPC-01	8/20/2007	11:00	Arsenic	Total	Water	2.7	ug/l	
RLE-1	7/18/2012	10:06	Arsenic	Total	Water	2.62	ug/l	9 ft
DGLC-01	6/18/2007	14:15	Arsenic	Total	Water	2.5	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGP-01	9/17/2012	10:59	Arsenic	Dissolved	Water	2.33	ug/l	
DGP-01	9/25/2007	12:20	Arsenic	Total	Water	2.3	ug/l	
DGP-01	9/17/2012	10:59	Arsenic	Total	Water	2.26	ug/l	
DGLC-01	7/16/2007	9:45	Arsenic	Total	Water	2.2	ug/l	
DGP-01	5/15/2012	11:29	Arsenic	Total	Water	1.88	ug/l	
RLE-1	10/15/2003	11:10	Arsenic	Total	Water	1.8	ug/l	7 ft
DGP-01	9/25/2007	12:20	Arsenic	Dissolved	Water	1.6	ug/l	
DGPC-01	6/12/2007	9:00	Arsenic	Total	Water	1.6	ug/l	
RLE-1	06/04/2003	10:48	Arsenic	Total	Water	1.4	ug/l	11 ft
RLE-1	6/3/2009	12:05	Arsenic	Total	Water	1.31	ug/l	9 ft
DGO-01	7/3/2007	12:00	Arsenic	Dissolved	Water	1.3	ug/l	
RLE-1	8/11/2009	11:10	Arsenic	Total	Water	1.27	ug/l	9 ft
DGP-01	7/18/2007	10:45	Arsenic	Total	Water	1.2	ug/l	
RLE-1	04/15/2003	10:30	Arsenic	Total	Water	1.1	ug/l	7 ft
DGO-01	7/3/2007	12:00	Arsenic	Total	Water	0.57	ug/l	
DGLC-01	8/12/2002	15:30	ARSENIC,Total	Total	Water	5.8	ug/l	
DGO-01	6/11/2002	10:45	ARSENIC,Total	Total	Water	2.9	ug/l	
DGLC-01	9/11/2002	14:30	ARSENIC,Total	Total	Water	2.6	ug/l	
DGP-01	8/8/2002	12:45	ARSENIC,Total	Total	Water	1.6	ug/l	
DGP-01	6/11/2002	9:00	ARSENIC,Total	Total	Water	1.5	ug/l	
DGP-01	9/11/2002	13:00	ARSENIC,Total	Total	Water	1.4	ug/l	
DGLC-01	6/10/2002	9:00	ARSENIC,Total	Total	Water	0.82	ug/l	
RLE-1	6/3/2009	12:05	Atrazine	Total	Water	5	ug/l	9 ft
RLE-1	7/22/2009	11:10	Atrazine	Total	Water	3.3	ug/l	9 ft
RLE-1	8/11/2009	11:10	Atrazine	Total	Water	3.1	ug/l	9 ft
RLE-1	10/14/2009	11:10	Atrazine	Total	Water	1.6	ug/l	9 ft
RLE-1	08/07/2003	10:41	Atrazine	Total	Water	1	ug/l	7 ft
RLE-1	6/11/2012	10:53	Atrazine	Total	Water	0.88	ug/l	9 ft
RLE-1	06/04/2003	10:48	Atrazine	Total	Water	0.84	ug/l	11 ft
RLE-1	06/04/2003	10:48	Atrazine	Total	Water	0.75	ug/l	11 ft
RLE-1	7/18/2012	10:06	Atrazine	Total	Water	0.74	ug/l	9 ft
RLE-1	04/15/2003	10:30	Atrazine	Total	Water	0.67	ug/l	427 ft
RLE-1	07/23/2003	10:36	Atrazine	Total	Water	0.67	ug/l	9 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	04/15/2003	10:30	Atrazine	Total	Water	0.63	ug/l	427 ft
RLE-1	8/22/2012	10:26	Atrazine	Total	Water	0.61	ug/l	9 ft
RLE-1	08/07/2003	10:41	Atrazine	Total	Water	0.6	ug/l	7 ft
RLE-1	4/17/2012	10:33	Atrazine	Total	Water	0.4	ug/l	9 ft
RLE-1	10/15/2003	11:10	Atrazine	Total	Water	0.34	ug/l	7 ft
RLE-1	10/15/2003	11:10	Atrazine	Total	Water	0.32	ug/l	7 ft
RLE-1	4/14/2009	11:18	Atrazine	Total	Water	0.051	ug/l	9 ft
DGLC-01	8/22/2007	9:45	Barium	Total	Water	310	ug/l	
RLE-1	07/23/2003	10:36	Barium	Total	Sediment	280	mg/kg	19 ft
RLE-1	7/22/2009	10:51	Barium	Total	Sediment	270	mg/kg	20 ft
DGLC-01	9/18/2012	10:14	Barium	Total	Water	270	ug/l	
DGLC-01	8/22/2007	9:45	Barium	Dissolved	Water	260	ug/l	
DGLC-01	9/18/2012	10:14	Barium	Dissolved	Water	242	ug/l	
RLE-3	07/23/2003	11:48	Barium	Total	Sediment	220	mg/kg	15 ft
DGLC-01	9/26/2007	12:10	Barium	Total	Water	211	ug/l	
DGLC-BU-C2	9/5/2007	11:45	Barium	Total	Water	200	ug/l	
DGLC-01	9/26/2007	12:10	Barium	Dissolved	Water	199	ug/l	
DGPC-01	8/20/2007	11:00	Barium	Total	Water	190	ug/l	
DGPC-01	8/20/2007	11:00	Barium	Dissolved	Water	170	ug/l	
DGPC-01	9/25/2007	13:40	Barium	Total	Water	160	ug/l	
DGPC-01	9/25/2007	13:40	Barium	Dissolved	Water	140	ug/l	
DGO-01	8/20/2007	12:20	Barium	Total	Water	140	ug/l	
DGLC-01	7/10/2012	8:29	Barium	Total	Water	137	ug/l	
DGO-01	8/20/2007	12:20	Barium	Dissolved	Water	130	ug/l	
DGP-01	8/20/2007	11:40	Barium	Total	Water	130	ug/l	
DGO-01	7/3/2007	12:00	Barium	Dissolved	Water	120	ug/l	
DGP-01	8/20/2007	11:40	Barium	Dissolved	Water	120	ug/l	
DGO-01	7/3/2007	12:00	Barium	Total	Water	120	ug/l	
DGP-01	7/18/2007	10:45	Barium	Total	Water	120	ug/l	
DGP-01	9/25/2007	12:20	Barium	Total	Water	120	ug/l	
DGLC-01	7/10/2012	8:29	Barium	Dissolved	Water	114	ug/l	
DGO-01	5/15/2012	10:45	Barium	Total	Water	111	ug/l	
DGPC-01	6/12/2007	9:00	Barium	Dissolved	Water	110	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGP-01	9/25/2007	12:20	Barium	Dissolved	Water	110	ug/l	
DGPC-01	6/12/2007	9:00	Barium	Total	Water	110	ug/l	
DGLC-01	7/16/2007	9:45	Barium	Total	Water	110	ug/l	
DGLC-BU-C1	9/5/2007	10:00	Barium	Total	Water	110	ug/l	
DGP-01	5/15/2012	11:29	Barium	Total	Water	109	ug/l	
RLE-1	8/22/2012	10:26	Barium	Total	Water	107	ug/l	9 ft
DGO-01	5/15/2012	10:45	Barium	Dissolved	Water	103	ug/l	
DGP-01	9/17/2012	10:59	Barium	Total	Water	102	ug/l	
DGP-01	5/15/2012	11:29	Barium	Dissolved	Water	99.3	ug/l	
DGLC-01	5/14/2012	9:30	Barium	Total	Water	99.2	ug/l	
DGLC-01	6/18/2007	14:15	Barium	Total	Water	98	ug/l	
DGP-01	9/17/2012	10:59	Barium	Dissolved	Water	96.7	ug/l	
DGLC-01	6/18/2007	14:15	Barium	Dissolved	Water	93	ug/l	
RLE-1	4/17/2012	10:33	Barium	Total	Water	90.9	ug/l	9 ft
DGLC-01	5/14/2012	9:30	Barium	Dissolved	Water	89.8	ug/l	
RLE-1	7/18/2012	10:06	Barium	Total	Water	89	ug/l	9 ft
RLE-1	6/3/2009	12:05	Barium	Total	Water	85.9	ug/l	9 ft
RLE-1	4/14/2009	11:18	Barium	Total	Water	80.8	ug/l	9 ft
RLE-1	6/11/2012	10:53	Barium	Total	Water	80.3	ug/l	9 ft
RLE-1	7/22/2009	11:10	Barium	Total	Water	79.3	ug/l	9 ft
RLE-1	06/04/2003	10:48	Barium	Total	Water	79	ug/l	11 ft
RLE-1	10/14/2009	11:10	Barium	Total	Water	75.1	ug/l	9 ft
RLE-1	10/15/2003	11:10	Barium	Total	Water	75	ug/l	7 ft
RLE-1	04/15/2003	10:30	Barium	Total	Water	70	ug/l	7 ft
RLE-1	08/07/2003	10:41	Barium	Total	Water	61	ug/l	7 ft
RLE-1	8/11/2009	11:10	Barium	Total	Water	60.6	ug/l	9 ft
RLE-1	07/23/2003	10:36	Barium	Total	Water	60	ug/l	9 ft
DGLC-BU-E1	9/5/2007	11:10	Barium	Total	Water	41	ug/l	
DGLC-01	6/10/2002	9:00	BARIUM,Dissolved ug/l	Dissolved	Water	330	ug/l	
DGLC-01	8/12/2002	15:30	BARIUM,Dissolved ug/l	Dissolved	Water	120	ug/l	
DGLC-01	9/11/2002	14:30	BARIUM,Dissolved ug/l	Dissolved	Water	120	ug/l	
DGP-01	8/8/2002	12:45	BARIUM,Dissolved ug/l	Dissolved	Water	110	ug/l	
DGP-01	9/11/2002	13:00	BARIUM,Dissolved ug/l	Dissolved	Water	110	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGP-01	6/11/2002	9:00	BARIUM,Dissolved ug/l	Dissolved	Water	100	ug/l	
DGO-01	6/11/2002	10:45	BARIUM,Dissolved ug/l	Dissolved	Water	61	ug/l	
DGO-01	6/11/2002	10:45	BARIUM,Total ug/l	Total	Water	540	ug/l	
DGLC-01	8/12/2002	15:30	BARIUM,Total ug/l	Total	Water	150	ug/l	
DGLC-01	6/10/2002	9:00	BARIUM,Total ug/l	Total	Water	140	ug/l	
DGP-01	6/11/2002	9:00	BARIUM,Total ug/l	Total	Water	140	ug/l	
DGLC-01	9/11/2002	14:30	BARIUM,Total ug/l	Total	Water	130	ug/l	
DGP-01	8/8/2002	12:45	BARIUM,Total ug/l	Total	Water	120	ug/l	
DGP-01	9/11/2002	13:00	BARIUM,Total ug/l	Total	Water	110	ug/l	
RLE-1	8/22/2012	10:26	Beryllium	Total	Water	0.19	ug/l	9 ft
RLE-1	4/17/2012	10:33	Beryllium	Total	Water	0.18	ug/l	9 ft
DGLC-01	8/12/2002	15:30	BERYLLIUM,Dissolved ug/l	Dissolved	Water	1	ug/l	
DGP-01	8/8/2002	12:45	BERYLLIUM,Dissolved ug/l	Dissolved	Water	1	ug/l	
DGLC-01	6/10/2002	9:00	BERYLLIUM,Dissolved ug/l	Dissolved	Water	1	ug/l	
DGP-01	6/11/2002	9:00	BERYLLIUM,Dissolved ug/l	Dissolved	Water	1	ug/l	
DGO-01	6/11/2002	10:45	BERYLLIUM,Dissolved ug/l	Dissolved	Water	1	ug/l	
DGP-01	9/11/2002	13:00	BERYLLIUM,Dissolved ug/l	Dissolved	Water	1	ug/l	
DGLC-01	9/11/2002	14:30	BERYLLIUM,Dissolved ug/l	Dissolved	Water	1	ug/l	
DGO-01	6/11/2002	10:45	BERYLLIUM,Total ug/l	Total	Water	3	ug/l	
DGLC-01	8/12/2002	15:30	BERYLLIUM,Total ug/l	Total	Water	1	ug/l	
DGP-01	8/8/2002	12:45	BERYLLIUM,Total ug/l	Total	Water	1	ug/l	
DGLC-01	6/10/2002	9:00	BERYLLIUM,Total ug/l	Total	Water	1	ug/l	
DGP-01	6/11/2002	9:00	BERYLLIUM,Total ug/l	Total	Water	1	ug/l	
DGP-01	9/11/2002	13:00	BERYLLIUM,Total ug/l	Total	Water	1	ug/l	
DGLC-01	9/11/2002	14:30	BERYLLIUM,Total ug/l	Total	Water	1	ug/l	
RLE-1	6/11/2012	10:53	BHC-alpha	Total	Water	0.0026	ug/l	9 ft
RLE-1	4/14/2009	11:18	BHC-alpha	Total	Water	0.0013	ug/l	9 ft
RLE-1	7/18/2012	10:06	BHC-alpha	Total	Water	0.0012	ug/l	9 ft
DGLC-BU-E1	9/5/2007	11:10	BOD, Biochemical oxygen demand	Total	Water	11	mg/l	
DGLC-BU-C2	9/5/2007	11:45	BOD, Biochemical oxygen demand	Total	Water	11	mg/l	
DGLC-BU-C1	9/5/2007	10:00	BOD, Biochemical oxygen demand	Total	Water	10	mg/l	
DGP-01	9/25/2007	10:45	BOD, Biochemical oxygen demand	Total	Water	3.93	mg/l	
DGLC-BU-E1	9/5/2007	11:10	BOD, carbonaceous	Total	Water	11	mg/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGLC-BU-C2	9/5/2007	11:45	BOD, carbonaceous	Total	Water	11	mg/l	
DGLC-BU-C1	9/5/2007	10:00	BOD, carbonaceous	Total	Water	10	mg/l	
DGP-01	9/25/2007	10:45	BOD, carbonaceous	Total	Water	5.7	mg/l	
DGP-01	7/16/2007	11:00	BOD, carbonaceous	Total	Water	2	mg/l	
DGP-01	9/17/2007	10:45	BOD, carbonaceous	Total	Water	2	mg/l	
DGLC-BU-E1	9/5/2007	11:10	Boron	Total	Water	1700	ug/l	
DGLC-BU-C1	9/5/2007	10:00	Boron	Total	Water	1500	ug/l	
DGLC-BU-C2	9/5/2007	11:45	Boron	Total	Water	1500	ug/l	
DGLC-01	9/26/2007	12:10	Boron	Total	Water	1430	ug/l	
DGLC-01	9/26/2007	12:10	Boron	Dissolved	Water	1390	ug/l	
DGLC-01	9/18/2012	10:14	Boron	Total	Water	1280	ug/l	
DGLC-01	9/18/2012	10:14	Boron	Dissolved	Water	1220	ug/l	
DGLC-01	8/22/2007	9:45	Boron	Total	Water	1100	ug/l	
DGLC-01	8/22/2007	9:45	Boron	Dissolved	Water	1000	ug/l	
DGLC-01	7/10/2012	8:29	Boron	Total	Water	332	ug/l	
DGLC-01	7/10/2012	8:29	Boron	Dissolved	Water	326	ug/l	
DGLC-01	7/16/2007	9:45	Boron	Total	Water	130	ug/l	
DGPC-01	9/25/2007	13:40	Boron	Total	Water	72	ug/l	
DGPC-01	8/20/2007	11:00	Boron	Dissolved	Water	65	ug/l	
DGPC-01	8/20/2007	11:00	Boron	Total	Water	60	ug/l	
DGPC-01	9/25/2007	13:40	Boron	Dissolved	Water	53	ug/l	
DGLC-01	6/18/2007	14:15	Boron	Total	Water	51	ug/l	
DGLC-01	6/18/2007	14:15	Boron	Dissolved	Water	50	ug/l	
DGO-01	8/20/2007	12:20	Boron	Dissolved	Water	36	ug/l	
DGP-01	8/20/2007	11:40	Boron	Dissolved	Water	34	ug/l	
DGP-01	9/25/2007	12:20	Boron	Total	Water	34	ug/l	
DGP-01	8/20/2007	11:40	Boron	Total	Water	32	ug/l	
DGO-01	8/20/2007	12:20	Boron	Total	Water	31	ug/l	
DGP-01	9/25/2007	12:20	Boron	Dissolved	Water	28	ug/l	
DGP-01	9/17/2012	10:59	Boron	Total	Water	26.2	ug/l	
RLE-1	06/04/2003	10:48	Boron	Total	Water	26	ug/l	11 ft
DGP-01	9/17/2012	10:59	Boron	Dissolved	Water	25.7	ug/l	
DGPC-01	6/12/2007	9:00	Boron	Total	Water	24	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGP-01	7/18/2007	10:45	Boron	Total	Water	24	ug/l	
DGPC-01	6/12/2007	9:00	Boron	Dissolved	Water	22	ug/l	
DGO-01	7/3/2007	12:00	Boron	Dissolved	Water	21	ug/l	
RLE-1	10/15/2003	11:10	Boron	Total	Water	16	ug/l	7 ft
DGO-01	7/3/2007	12:00	Boron	Total	Water	16	ug/l	
RLE-1	08/07/2003	10:41	Boron	Total	Water	12	ug/l	7 ft
RLE-1	07/23/2003	10:36	Boron	Total	Water	10	ug/l	9 ft
RLE-1	8/11/2009	11:10	Boron	Total	Water	9.06	ug/l	9 ft
RLE-1	4/14/2009	11:18	Boron	Total	Water	7.19	ug/l	9 ft
RLE-1	7/22/2009	11:10	Boron	Total	Water	4.07	ug/l	9 ft
DGLC-01	8/12/2002	15:30	BORON,Dissolved ug/l	Dissolved	Water	200	ug/l	
DGLC-01	6/10/2002	9:00	BORON,Dissolved ug/l	Dissolved	Water	170	ug/l	
DGLC-01	9/11/2002	14:30	BORON,Dissolved ug/l	Dissolved	Water	170	ug/l	
DGP-01	8/8/2002	12:45	BORON,Dissolved ug/l	Dissolved	Water	24	ug/l	
DGO-01	6/11/2002	10:45	BORON,Dissolved ug/l	Dissolved	Water	17	ug/l	
DGP-01	9/11/2002	13:00	BORON,Dissolved ug/l	Dissolved	Water	17	ug/l	
DGP-01	6/11/2002	9:00	BORON,Dissolved ug/l	Dissolved	Water	14	ug/l	
DGLC-01	8/12/2002	15:30	BORON,Total ug/l	Total	Water	220	ug/l	
DGLC-01	9/11/2002	14:30	BORON,Total ug/l	Total	Water	170	ug/l	
DGO-01	6/11/2002	10:45	BORON,Total ug/l	Total	Water	49	ug/l	
DGP-01	8/8/2002	12:45	BORON,Total ug/l	Total	Water	29	ug/l	
DGLC-01	6/10/2002	9:00	BORON,Total ug/l	Total	Water	20	ug/l	
DGP-01	9/11/2002	13:00	BORON,Total ug/l	Total	Water	18	ug/l	
DGP-01	6/11/2002	9:00	BORON,Total ug/l	Total	Water	17	ug/l	
RLE-1	7/22/2009	10:51	Cadmium	Total	Sediment	2.96	mg/kg	20 ft
RLE-1	10/14/2009	11:10	Cadmium	Total	Water	1.49	ug/l	9 ft
DGP-01	9/25/2007	12:20	Cadmium	Dissolved	Water	0.82	ug/l	
RLE-1	4/14/2009	11:18	Cadmium	Total	Water	0.76	ug/l	9 ft
DGLC-01	9/26/2007	12:10	Cadmium	Total	Water	0.68	ug/l	
DGP-01	9/25/2007	12:20	Cadmium	Total	Water	0.46	ug/l	
DGP-01	9/17/2012	10:59	Cadmium	Total	Water	0.4	ug/l	
RLE-1	6/11/2012	10:53	Cadmium	Total	Water	0.38	ug/l	9 ft
DGLC-01	9/26/2007	12:10	Cadmium	Dissolved	Water	0.37	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGLC-01	9/18/2012	10:14	Cadmium	Total	Water	0.37	ug/l	
DGLC-01	5/14/2012	9:30	Cadmium	Total	Water	0.35	ug/l	
RLE-1	7/22/2009	11:10	Cadmium	Total	Water	0.34	ug/l	9 ft
RLE-1	8/11/2009	11:10	Cadmium	Total	Water	0.32	ug/l	9 ft
DGP-01	9/17/2012	10:59	Cadmium	Dissolved	Water	0.26	ug/l	
DGLC-01	9/18/2012	10:14	Cadmium	Dissolved	Water	0.25	ug/l	
DGPC-01	9/25/2007	13:40	Cadmium	Dissolved	Water	0.08	ug/l	
DGP-01	8/8/2002	12:45	CADMIUM,Dissolved ug/l	Dissolved	Water	6	ug/l	
DGLC-01	8/12/2002	15:30	CADMIUM,Dissolved ug/l	Dissolved	Water	3	ug/l	
DGLC-01	6/10/2002	9:00	CADMIUM,Dissolved ug/l	Dissolved	Water	3	ug/l	
DGP-01	6/11/2002	9:00	CADMIUM,Dissolved ug/l	Dissolved	Water	3	ug/l	
DGO-01	6/11/2002	10:45	CADMIUM,Dissolved ug/l	Dissolved	Water	3	ug/l	
DGP-01	9/11/2002	13:00	CADMIUM,Dissolved ug/l	Dissolved	Water	3	ug/l	
DGLC-01	9/11/2002	14:30	CADMIUM,Dissolved ug/l	Dissolved	Water	3	ug/l	
DGP-01	8/8/2002	12:45	CADMIUM,Total ug/l	Total	Water	4	ug/l	
DGLC-01	8/12/2002	15:30	CADMIUM,Total ug/l	Total	Water	3	ug/l	
DGLC-01	6/10/2002	9:00	CADMIUM,Total ug/l	Total	Water	3	ug/l	
DGP-01	6/11/2002	9:00	CADMIUM,Total ug/l	Total	Water	3	ug/l	
DGO-01	6/11/2002	10:45	CADMIUM,Total ug/l	Total	Water	3	ug/l	
DGP-01	9/11/2002	13:00	CADMIUM,Total ug/l	Total	Water	3	ug/l	
DGLC-01	9/11/2002	14:30	CADMIUM,Total ug/l	Total	Water	3	ug/l	
DGLC-BU-E1	9/5/2007	11:10	Calcium	Total	Water	210000	ug/l	
DGLC-BU-C1	9/5/2007	10:00	Calcium	Total	Water	200000	ug/l	
DGLC-BU-C2	9/5/2007	11:45	Calcium	Total	Water	190000	ug/l	
DGLC-01	9/26/2007	12:10	Calcium	Total	Water	172000	ug/l	
DGLC-01	9/26/2007	12:10	Calcium	Dissolved	Water	162000	ug/l	
DGLC-01	8/22/2007	9:45	Calcium	Total	Water	160000	ug/l	
DGLC-01	8/22/2007	9:45	Calcium	Dissolved	Water	150000	ug/l	
DGLC-01	9/18/2012	10:14	Calcium	Total	Water	144000	ug/l	
DGLC-01	9/18/2012	10:14	Calcium	Dissolved	Water	140000	ug/l	
DGLC-01	7/10/2012	8:29	Calcium	Total	Water	79800	ug/l	
DGPC-01	9/25/2007	13:40	Calcium	Total	Water	77000	ug/l	
DGLC-01	7/10/2012	8:29	Calcium	Dissolved	Water	76100	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGPC-01	8/20/2007	11:00	Calcium	Dissolved	Water	72000	ug/l	
DGPC-01	8/20/2007	11:00	Calcium	Total	Water	71000	ug/l	
DGO-01	8/20/2007	12:20	Calcium	Total	Water	69000	ug/l	
DGO-01	8/20/2007	12:20	Calcium	Dissolved	Water	68000	ug/l	
DGLC-01	7/16/2007	9:45	Calcium	Total	Water	68000	ug/l	
DGP-01	8/20/2007	11:40	Calcium	Dissolved	Water	66000	ug/l	
DGPC-01	9/25/2007	13:40	Calcium	Dissolved	Water	64000	ug/l	
DGP-01	8/20/2007	11:40	Calcium	Total	Water	64000	ug/l	
DGP-01	9/25/2007	12:20	Calcium	Total	Water	62000	ug/l	
DGPC-01	6/12/2007	9:00	Calcium	Dissolved	Water	61000	ug/l	
DGLC-01	6/18/2007	14:15	Calcium	Dissolved	Water	61000	ug/l	
DGPC-01	6/12/2007	9:00	Calcium	Total	Water	61000	ug/l	
DGLC-01	6/18/2007	14:15	Calcium	Total	Water	61000	ug/l	
DGP-01	9/25/2007	12:20	Calcium	Dissolved	Water	60000	ug/l	
DGP-01	5/15/2012	11:29	Calcium	Total	Water	59200	ug/l	
DGP-01	5/15/2012	11:29	Calcium	Dissolved	Water	59100	ug/l	
DGO-01	7/3/2007	12:00	Calcium	Dissolved	Water	59000	ug/l	
DGP-01	7/18/2007	10:45	Calcium	Total	Water	58000	ug/l	
DGLC-01	5/14/2012	9:30	Calcium	Dissolved	Water	55400	ug/l	
DGLC-01	5/14/2012	9:30	Calcium	Total	Water	55100	ug/l	
DGO-01	7/3/2007	12:00	Calcium	Total	Water	55000	ug/l	
DGP-01	9/17/2012	10:59	Calcium	Dissolved	Water	49600	ug/l	
DGP-01	9/17/2012	10:59	Calcium	Total	Water	49500	ug/l	
DGO-01	5/15/2012	10:45	Calcium	Total	Water	44700	ug/l	
DGO-01	5/15/2012	10:45	Calcium	Dissolved	Water	41900	ug/l	
RLE-1	4/17/2012	10:33	Calcium	Total	Water	36100	ug/l	9 ft
RLE-1	6/11/2012	10:53	Calcium	Total	Water	33200	ug/l	9 ft
RLE-1	8/22/2012	10:26	Calcium	Total	Water	33100	ug/l	9 ft
RLE-1	10/14/2009	11:10	Calcium	Total	Water	29800	ug/l	9 ft
RLE-1	4/14/2009	11:18	Calcium	Total	Water	29400	ug/l	9 ft
RLE-1	7/18/2012	10:06	Calcium	Total	Water	29000	ug/l	9 ft
RLE-1	7/22/2009	11:10	Calcium	Total	Water	28300	ug/l	9 ft
RLE-1	8/11/2009	11:10	Calcium	Total	Water	28200	ug/l	9 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	6/3/2009	12:05	Calcium	Total	Water	28100	ug/l	9 ft
RLE-1	06/04/2003	10:48	Calcium	Total	Water	34	mg/l	11 ft
RLE-1	04/15/2003	10:30	Calcium	Total	Water	32	mg/l	7 ft
RLE-1	10/15/2003	11:10	Calcium	Total	Water	29	mg/l	7 ft
RLE-1	08/07/2003	10:41	Calcium	Total	Water	25	mg/l	7 ft
RLE-1	07/23/2003	10:36	Calcium	Total	Water	24	mg/l	9 ft
DGP-01	9/11/2002	13:00	CALCIUM,Dissolved mg/l	Dissolved	Water	68	ug/l	
DGP-01	8/8/2002	12:45	CALCIUM,Dissolved mg/l	Dissolved	Water	62	ug/l	
DGLC-01	8/12/2002	15:30	CALCIUM,Dissolved mg/l	Dissolved	Water	59	ug/l	
DGLC-01	6/10/2002	9:00	CALCIUM,Dissolved mg/l	Dissolved	Water	58	ug/l	
DGP-01	6/11/2002	9:00	CALCIUM,Dissolved mg/l	Dissolved	Water	54	ug/l	
DGLC-01	9/11/2002	14:30	CALCIUM,Dissolved mg/l	Dissolved	Water	53	ug/l	
DGO-01	6/11/2002	10:45	CALCIUM,Dissolved mg/l	Dissolved	Water	18	ug/l	
DGP-01	9/11/2002	13:00	CALCIUM,Total mg/l	Total	Water	67	ug/l	
DGLC-01	8/12/2002	15:30	CALCIUM,Total mg/l	Total	Water	66	ug/l	
DGP-01	8/8/2002	12:45	CALCIUM,Total mg/l	Total	Water	63	ug/l	
DGLC-01	6/10/2002	9:00	CALCIUM,Total mg/l	Total	Water	63	ug/l	
DGP-01	6/11/2002	9:00	CALCIUM,Total mg/l	Total	Water	55	ug/l	
DGLC-01	9/11/2002	14:30	CALCIUM,Total mg/l	Total	Water	54	ug/l	
DGO-01	6/11/2002	10:45	CALCIUM,Total mg/l	Total	Water	30	ug/l	
DGLC-BU-C2	9/5/2007	11:45	Carbon, organic	Total	Water	11.4	mg/l	
DGLC-01	8/22/2007	9:45	Carbon, organic	Total	Water	10.6	mg/l	
DGLC-BU-E1	9/5/2007	11:10	Carbon, organic	Total	Water	9.7	mg/l	
DGLC-BU-C1	9/5/2007	10:00	Carbon, organic	Total	Water	9.53	mg/l	
DGLC-01	9/26/2007	12:10	Carbon, organic	Total	Water	7.32	mg/l	
DGO-01	8/20/2007	12:20	Carbon, organic	Total	Water	6.66	mg/l	
DGPC-01	8/20/2007	11:00	Carbon, organic	Total	Water	6.22	mg/l	
DGP-01	9/25/2007	12:20	Carbon, organic	Total	Water	6.07	mg/l	
DGP-01	8/20/2007	11:40	Carbon, organic	Total	Water	5.83	mg/l	
DGPC-01	9/25/2007	13:40	Carbon, organic	Total	Water	5.77	mg/l	
DGP-01	7/18/2007	10:45	Carbon, organic	Total	Water	4.41	mg/l	
DGLC-01	7/16/2007	9:45	Carbon, organic	Total	Water	3.77	mg/l	
DGPC-01	6/12/2007	9:00	Carbon, organic	Total	Water	2.85	mg/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGO-01	7/3/2007	12:00	Carbon, organic	Total	Water	2.72	mg/l	
DGLC-01	6/18/2007	14:15	Carbon, organic	Total	Water	2.54	mg/l	
RLE-3	07/23/2003	11:48	Carbon, Total Organic (Toc)		Sediment	0.6	%	15 ft
RLE-1	07/23/2003	10:36	Carbon, Total Organic (Toc)		Sediment	0.5	%	19 ft
DGO-01	6/11/2002	10:45	CARBON, TOTAL ORGANIC mg/l		Water	8.2	mg/l	
DGLC-01	8/12/2002	15:30	CARBON, TOTAL ORGANIC mg/l		Water	6.5	mg/l	
DGP-01	8/8/2002	12:45	CARBON, TOTAL ORGANIC mg/l		Water	5	mg/l	
DGLC-01	9/11/2002	14:30	CARBON, TOTAL ORGANIC mg/l		Water	5	mg/l	
DGLC-01	6/10/2002	9:00	CARBON, TOTAL ORGANIC mg/l		Water	4.5	mg/l	
DGP-01	9/11/2002	13:00	CARBON, TOTAL ORGANIC mg/l		Water	4.5	mg/l	
DGP-01	6/11/2002	9:00	CARBON, TOTAL ORGANIC mg/l		Water	3.6	mg/l	
DGLC-BU-E1	9/5/2007	11:10	Chloride	Total	Water	762	mg/l	
DGLC-BU-C1	9/5/2007	10:00	Chloride	Total	Water	708	mg/l	
DGLC-BU-E1	9/5/2007	11:10	Chloride	Total	Water	692	mg/l	
DGLC-BU-C2	9/5/2007	11:45	Chloride	Total	Water	680	mg/l	
DGLC-BU-C1	9/5/2007	10:00	Chloride	Total	Water	652	mg/l	
DGLC-01	9/26/2007	12:10	Chloride	Total	Water	636	mg/l	
DGLC-BU-C2	9/5/2007	11:45	Chloride	Total	Water	602	mg/l	
DGLC-01	8/22/2007	9:45	Chloride	Total	Water	493	mg/l	
DGLC-01	7/10/2012	8:29	Chloride	Total	Water	171	mg/l	
DGLC-01	7/16/2007	9:45	Chloride	Total	Water	65.8	mg/l	
DGLC-01	6/18/2007	14:15	Chloride	Total	Water	40.6	mg/l	
DGPC-01	6/12/2007	9:00	Chloride	Total	Water	29.6	mg/l	
DGO-01	7/3/2007	12:00	Chloride	Total	Water	27.6	mg/l	
DGLC-01	5/14/2012	9:30	Chloride	Total	Water	26.5	mg/l	
RLE-1	4/14/2009	11:28	Chloride	Total	Water	25.7	mg/l	18 ft
DGP-01	5/15/2012	11:29	Chloride	Total	Water	24.1	mg/l	
DGO-01	8/20/2007	12:20	Chloride	Total	Water	24.1	mg/l	
DGP-01	7/18/2007	10:45	Chloride	Total	Water	24	mg/l	
RLE-1	4/14/2009	11:18	Chloride	Total	Water	23.5	mg/l	9 ft
DGO-01	5/15/2012	10:45	Chloride	Total	Water	23.3	mg/l	
RLE-1	8/22/2012	10:26	Chloride	Total	Water	23	mg/l	9 ft
RLE-1	4/14/2009	11:08	Chloride	Total	Water	22.5	mg/l	1 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	7/18/2012	10:06	Chloride	Total	Water	21.6	mg/l	9 ft
DGP-01	8/20/2007	11:40	Chloride	Total	Water	21.1	mg/l	
RLE-1	8/11/2009	11:00	Chloride	Total	Water	21	mg/l	1 ft
RLE-1	6/11/2012	10:53	Chloride	Total	Water	21	mg/l	9 ft
RLE-1	8/11/2009	11:10	Chloride	Total	Water	20.9	mg/l	9 ft
RLE-1	7/22/2009	10:51	Chloride	Total	Water	20.3	mg/l	1 ft
RLE-1	7/22/2009	11:10	Chloride	Total	Water	20.3	mg/l	9 ft
RLE-1	10/14/2009	11:20	Chloride	Total	Water	19.7	mg/l	17 ft
RLE-1	10/14/2009	11:00	Chloride	Total	Water	19	mg/l	1 ft
RLE-1	4/17/2012	10:33	Chloride	Total	Water	18.8	mg/l	9 ft
RLE-1	10/14/2009	11:10	Chloride	Total	Water	18.7	mg/l	9 ft
RLE-1	8/11/2009	11:25	Chloride	Total	Water	17.9	mg/l	16 ft
DGPC-01	8/20/2007	11:00	Chloride	Total	Water	17.7	mg/l	
RLE-1	7/22/2009	10:59	Chloride	Total	Water	17.5	mg/l	18 ft
RLE-1	6/3/2009	11:40	Chloride	Total	Water	17.2	mg/l	17 ft
RLE-1	6/3/2009	11:30	Chloride	Total	Water	15.8	mg/l	1 ft
RLE-1	6/3/2009	12:05	Chloride	Total	Water	15	mg/l	9 ft
DGP-01	9/25/2007	12:20	Chloride	Total	Water	13.8	mg/l	
DGPC-01	9/25/2007	13:40	Chloride	Total	Water	13.1	mg/l	
DGP-01	9/17/2012	10:59	Chloride	Total	Water	9.55	mg/l	
DGLC-01	8/12/2002	15:30	CHLORIDE,Total mg/l	Total	Water	79.6	mg/l	
DGLC-01	9/11/2002	14:30	CHLORIDE,Total mg/l	Total	Water	60.3	mg/l	
DGLC-01	6/10/2002	9:00	CHLORIDE,Total mg/l	Total	Water	24.2	mg/l	
DGP-01	6/11/2002	9:00	CHLORIDE,Total mg/l	Total	Water	20.2	mg/l	
DGO-01	6/11/2002	10:45	CHLORIDE,Total mg/l	Total	Water	20	mg/l	
DGP-01	9/11/2002	13:00	CHLORIDE,Total mg/l	Total	Water	16.5	mg/l	
DGP-01	8/8/2002	12:45	CHLORIDE,Total mg/l	Total	Water	16.4	mg/l	
RLE-1	04/15/2003	10:30	Chlorophyll (a+b+c)	Filterable	Water	300	ug/l	6 ft
RLE-1	07/23/2003	10:36	Chlorophyll (a+b+c)	Filterable	Water	300	ug/l	6 ft
RLE-2	07/23/2003	10:36	Chlorophyll (a+b+c)	Filterable	Water	300	ug/l	5 ft
RLE-3	04/15/2003	11:20	Chlorophyll (a+b+c)	Filterable	Water	300	ug/l	6 ft
RLE-3	08/07/2003	11:38	Chlorophyll (a+b+c)	Filterable	Water	225	ug/l	5 ft
RLE-1	10/15/2003	11:10	Chlorophyll (a+b+c)	Filterable	Water	200	ug/l	4 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	08/07/2003	10:41	Chlorophyll (a+b+c)	Filterable	Water	200	ug/l	5 ft
RLE-1	06/04/2003	10:48	Chlorophyll (a+b+c)	Filterable	Water	200	ug/l	5 ft
RLE-2	10/15/2003	11:45	Chlorophyll (a+b+c)	Filterable	Water	200	ug/l	4 ft
RLE-2	04/15/2003	11:06	Chlorophyll (a+b+c)	Filterable	Water	200	ug/l	5 ft
RLE-2	08/07/2003	11:21	Chlorophyll (a+b+c)	Filterable	Water	200	ug/l	5 ft
RLE-2	06/04/2003	11:37	Chlorophyll (a+b+c)	Filterable	Water	200	ug/l	5 ft
RLE-3	07/23/2003	11:48	Chlorophyll (a+b+c)	Filterable	Water	200	ug/l	5 ft
RLE-3	06/04/2003	12:03	Chlorophyll (a+b+c)	Filterable	Water	200	ug/l	5 ft
RLE-3	10/15/2003	12:00	Chlorophyll (a+b+c)	Filterable	Water	100	ug/l	3 ft
DGP-01	9/11/2002	13:00	CHLOROPHYLL (A+B+C),Filterable	Filterable	Water	480	ug/l	
DGP-01	8/8/2002	12:45	CHLOROPHYLL (A+B+C),Filterable	Filterable	Water	370	ug/l	
DGLC-01	6/10/2002	9:00	CHLOROPHYLL (A+B+C),Filterable	Filterable	Water	325	ug/l	
DGLC-01	8/12/2002	15:30	CHLOROPHYLL (A+B+C),Filterable	Filterable	Water	210	ug/l	
DGLC-01	9/11/2002	14:30	CHLOROPHYLL (A+B+C),Filterable	Filterable	Water	210	ug/l	
DGP-01	6/11/2002	9:00	CHLOROPHYLL (A+B+C),Filterable	Filterable	Water	175	ug/l	
DGO-01	6/11/2002	10:45	CHLOROPHYLL (A+B+C),Filterable	Filterable	Water	50	ug/l	
RLE-1	7/22/2009	10:51	Chlorophyll a, corrected for pheophytin	Total	Water	88.6	ug/l	4 ft
RLE-3	07/23/2003	11:48	Chlorophyll a, corrected for pheophytin		Water	63.3	ug/l	5 ft
RLE-2	07/23/2003	10:36	Chlorophyll a, corrected for pheophytin		Water	59.4	ug/l	5 ft
RLE-1	07/23/2003	10:36	Chlorophyll a, corrected for pheophytin		Water	56.5	ug/l	6 ft
RLE-1	08/07/2003	10:41	Chlorophyll a, corrected for pheophytin		Water	30.6	ug/l	5 ft
DGO-01	8/20/2007	12:20	Chlorophyll a, corrected for pheophytin	Total	Water	26.3	ug/l	
DGLC-01	9/26/2007	12:10	Chlorophyll a, corrected for pheophytin	Total	Water	26.2	ug/l	
RLE-3	04/15/2003	11:20	Chlorophyll a, corrected for pheophytin		Water	25.8	ug/l	6 ft
RLE-3	08/07/2003	11:38	Chlorophyll a, corrected for pheophytin		Water	23.1	ug/l	5 ft
RLE-2	06/04/2003	11:37	Chlorophyll a, corrected for pheophytin		Water	21.5	ug/l	5 ft
RLE-1	10/15/2003	11:10	Chlorophyll a, corrected for pheophytin		Water	21.1	ug/l	4 ft
RLE-2	10/15/2003	11:45	Chlorophyll a, corrected for pheophytin		Water	20.5	ug/l	4 ft
RLE-3	10/15/2003	12:00	Chlorophyll a, corrected for pheophytin		Water	20.2	ug/l	3 ft
RLE-2	08/07/2003	11:21	Chlorophyll a, corrected for pheophytin		Water	19.2	ug/l	5 ft
RLE-3	06/04/2003	12:03	Chlorophyll a, corrected for pheophytin		Water	18.7	ug/l	5 ft
DGLC-01	8/22/2007	9:45	Chlorophyll a, corrected for pheophytin	Total	Water	17.5	ug/l	
RLE-1	06/04/2003	10:48	Chlorophyll a, corrected for pheophytin		Water	16.9	ug/l	5 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	4/14/2009	11:08	Chlorophyll a, corrected for pheophytin	Total	Water	15.3	ug/l	2 ft
RLE-2	04/15/2003	11:06	Chlorophyll a, corrected for pheophytin		Water	13.5	ug/l	5 ft
DGLC-01	7/16/2007	9:45	Chlorophyll a, corrected for pheophytin	Total	Water	11.9	ug/l	
DGP-01	9/25/2007	10:45	Chlorophyll a, corrected for pheophytin	Total	Water	11.4	ug/l	
DGP-01	7/9/2007	11:20	Chlorophyll a, corrected for pheophytin	Total	Water	11	ug/l	
RLE-1	04/15/2003	10:30	Chlorophyll a, corrected for pheophytin		Water	10.7	ug/l	6 ft
RLE-1	10/14/2009	11:00	Chlorophyll a, corrected for pheophytin	Total	Water	10.7	ug/l	4 ft
DGP-01	7/18/2007	10:45	Chlorophyll a, corrected for pheophytin	Total	Water	10	ug/l	
DGP-01	9/17/2007	10:45	Chlorophyll a, corrected for pheophytin	Total	Water	10	ug/l	
DGPC-01	8/20/2007	11:00	Chlorophyll a, corrected for pheophytin	Total	Water	9.88	ug/l	
DGP-01	7/16/2007	11:00	Chlorophyll a, corrected for pheophytin	Total	Water	6	ug/l	
RLE-1	6/3/2009	11:30	Chlorophyll a, corrected for pheophytin	Total	Water	5.94	ug/l	4 ft
DGP-01	8/20/2007	11:40	Chlorophyll a, corrected for pheophytin	Total	Water	5	ug/l	
DGPC-01	9/25/2007	13:40	Chlorophyll a, corrected for pheophytin	Total	Water	4.48	ug/l	
DGP-01	9/25/2007	12:20	Chlorophyll a, corrected for pheophytin	Total	Water	4.24	ug/l	
RLE-1	4/17/2012	10:32	Chlorophyll a, corrected for pheophytin	Total	Water	3.67	ug/l	3 ft
DGLC-01	5/14/2012	9:30	Chlorophyll a, corrected for pheophytin	Total	Water	1.87	ug/l	1 ft
DGLC-01	6/18/2007	14:15	Chlorophyll a, corrected for pheophytin	Total	Water	1.44	ug/l	
DGP-01	5/15/2012	11:29	Chlorophyll a, corrected for pheophytin	Total	Water	1.05	ug/l	1 ft
DGO-01	5/15/2012	10:45	Chlorophyll a, corrected for pheophytin	Total	Water	0.97	ug/l	1 ft
DGLC-01	9/11/2002	14:30	CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN ug/l		Water	30.8	ug/l	
DGO-01	6/11/2002	10:45	CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN ug/l		Water	26.2	ug/l	
DGLC-01	8/12/2002	15:30	CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN ug/l		Water	23.2	ug/l	
DGLC-01	6/10/2002	9:00	CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN ug/l		Water	18	ug/l	
DGP-01	8/8/2002	12:45	CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN ug/l		Water	10.6	ug/l	
DGP-01	9/11/2002	13:00	CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN ug/l		Water	3.71	ug/l	
DGP-01	6/11/2002	9:00	CHLOROPHYLL A, CORRECTED FOR PHEOPHYTIN ug/l		Water	3.43	ug/l	
RLE-1	7/22/2009	10:51	Chlorophyll a, uncorrected for pheophytin	Total	Water	94.3	ug/l	4 ft
RLE-3	07/23/2003	11:48	Chlorophyll a, uncorrected for pheophytin		Water	60.7	ug/l	5 ft
RLE-2	07/23/2003	10:36	Chlorophyll a, uncorrected for pheophytin		Water	56.8	ug/l	5 ft
RLE-1	07/23/2003	10:36	Chlorophyll a, uncorrected for pheophytin		Water	54	ug/l	6 ft
DGLC-01	9/26/2007	12:10	Chlorophyll a, uncorrected for pheophytin	Total	Water	30.2	ug/l	
RLE-1	08/07/2003	10:41	Chlorophyll a, uncorrected for pheophytin		Water	29.8	ug/l	5 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGO-01	8/20/2007	12:20	Chlorophyll a, uncorrected for pheophytin	Total	Water	28	ug/l	
DGLC-01	8/22/2007	9:45	Chlorophyll a, uncorrected for pheophytin	Total	Water	25.6	ug/l	
RLE-3	04/15/2003	11:20	Chlorophyll a, uncorrected for pheophytin		Water	25.3	ug/l	6 ft
RLE-3	08/07/2003	11:38	Chlorophyll a, uncorrected for pheophytin		Water	21.6	ug/l	5 ft
RLE-2	06/04/2003	11:37	Chlorophyll a, uncorrected for pheophytin		Water	21.3	ug/l	5 ft
RLE-1	10/15/2003	11:10	Chlorophyll a, uncorrected for pheophytin		Water	20.7	ug/l	4 ft
RLE-2	10/15/2003	11:45	Chlorophyll a, uncorrected for pheophytin		Water	19.3	ug/l	4 ft
RLE-3	06/04/2003	12:03	Chlorophyll a, uncorrected for pheophytin		Water	19.1	ug/l	5 ft
RLE-1	06/04/2003	10:48	Chlorophyll a, uncorrected for pheophytin		Water	17.6	ug/l	5 ft
RLE-3	10/15/2003	12:00	Chlorophyll a, uncorrected for pheophytin		Water	17.3	ug/l	3 ft
RLE-2	08/07/2003	11:21	Chlorophyll a, uncorrected for pheophytin		Water	17.2	ug/l	5 ft
RLE-1	4/14/2009	11:08	Chlorophyll a, uncorrected for pheophytin	Total	Water	15.3	ug/l	2 ft
RLE-2	04/15/2003	11:06	Chlorophyll a, uncorrected for pheophytin		Water	12.7	ug/l	5 ft
DGPC-01	8/20/2007	11:00	Chlorophyll a, uncorrected for pheophytin	Total	Water	12.2	ug/l	
DGP-01	9/25/2007	10:45	Chlorophyll a, uncorrected for pheophytin	Total	Water	11.5	ug/l	
RLE-1	10/14/2009	11:00	Chlorophyll a, uncorrected for pheophytin	Total	Water	10.9	ug/l	4 ft
RLE-1	04/15/2003	10:30	Chlorophyll a, uncorrected for pheophytin		Water	10.8	ug/l	6 ft
DGLC-01	7/16/2007	9:45	Chlorophyll a, uncorrected for pheophytin	Total	Water	10.8	ug/l	
RLE-1	6/3/2009	11:30	Chlorophyll a, uncorrected for pheophytin	Total	Water	6.23	ug/l	4 ft
DGPC-01	9/25/2007	13:40	Chlorophyll a, uncorrected for pheophytin	Total	Water	5.3	ug/l	
DGP-01	9/25/2007	12:20	Chlorophyll a, uncorrected for pheophytin	Total	Water	4.29	ug/l	
RLE-1	4/17/2012	10:32	Chlorophyll a, uncorrected for pheophytin	Total	Water	4.1	ug/l	3 ft
DGLC-01	5/14/2012	9:30	Chlorophyll a, uncorrected for pheophytin	Total	Water	2.98	ug/l	1 ft
DGLC-01	6/18/2007	14:15	Chlorophyll a, uncorrected for pheophytin	Total	Water	1.68	ug/l	
DGO-01	5/15/2012	10:45	Chlorophyll a, uncorrected for pheophytin	Total	Water	0.97	ug/l	1 ft
DGLC-01	9/11/2002	14:30	CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN,Fixed	Fixed	Water	33.1	ug/l	
DGLC-01	8/12/2002	15:30	CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN,Fixed	Fixed	Water	25.1	ug/l	
DGO-01	6/11/2002	10:45	CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN,Fixed	Fixed	Water	22.3	ug/l	
DGLC-01	6/10/2002	9:00	CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN,Fixed	Fixed	Water	18.2	ug/l	
DGP-01	8/8/2002	12:45	CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN,Fixed	Fixed	Water	10.4	ug/l	
DGP-01	6/11/2002	9:00	CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN,Fixed	Fixed	Water	3.61	ug/l	
DGP-01	9/11/2002	13:00	CHLOROPHYLL A, UNCORRECTED FOR PHEOPHYTIN,Fixed	Fixed	Water	3.4	ug/l	
RLE-1	7/22/2009	10:51	Chlorophyll-b	Total	Water	22.6	ug/l	4 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGP-01	7/9/2007	11:20	Chlorophyll-b	Total	Water	11	ug/l	
RLE-1	08/07/2003	10:41	Chlorophyll-b	Total	Water	7.84	ug/l	5 ft
RLE-3	08/07/2003	11:38	Chlorophyll-b	Total	Water	4.63	ug/l	5 ft
DGP-01	9/17/2007	10:45	Chlorophyll-b	Total	Water	4	ug/l	
RLE-2	06/04/2003	11:37	Chlorophyll-b	Total	Water	3.47	ug/l	5 ft
RLE-3	06/04/2003	12:03	Chlorophyll-b	Total	Water	3.25	ug/l	5 ft
RLE-2	08/07/2003	11:21	Chlorophyll-b	Total	Water	3.14	ug/l	5 ft
RLE-1	06/04/2003	10:48	Chlorophyll-b	Total	Water	3	ug/l	5 ft
DGLC-01	8/22/2007	9:45	Chlorophyll-b	Total	Water	2.59	ug/l	
RLE-1	07/23/2003	10:36	Chlorophyll-b	Total	Water	2.47	ug/l	6 ft
DGPC-01	8/20/2007	11:00	Chlorophyll-b	Total	Water	2.34	ug/l	
RLE-2	10/15/2003	11:45	Chlorophyll-b	Total	Water	1.93	ug/l	4 ft
RLE-1	10/15/2003	11:10	Chlorophyll-b	Total	Water	1.76	ug/l	4 ft
DGO-01	8/20/2007	12:20	Chlorophyll-b	Total	Water	1.57	ug/l	
RLE-2	07/23/2003	10:36	Chlorophyll-b	Total	Water	1.32	ug/l	5 ft
DGLC-01	9/26/2007	12:10	Chlorophyll-b	Total	Water	1.26	ug/l	
RLE-1	10/14/2009	11:00	Chlorophyll-b	Total	Water	1.14	ug/l	4 ft
DGLC-01	9/11/2002	14:30	CHLOROPHYLL-B		Water	3.14	ug/l	
DGLC-01	8/12/2002	15:30	CHLOROPHYLL-B		Water	2.52	ug/l	
DGP-01	8/8/2002	12:45	CHLOROPHYLL-B		Water	1	ug/l	
DGLC-01	6/10/2002	9:00	CHLOROPHYLL-B		Water	1	ug/l	
DGP-01	6/11/2002	9:00	CHLOROPHYLL-B		Water	1	ug/l	
DGO-01	6/11/2002	10:45	CHLOROPHYLL-B		Water	1	ug/l	
DGP-01	9/11/2002	13:00	CHLOROPHYLL-B		Water	1	ug/l	
DGLC-01	7/16/2007	9:45	Chlorophyll-c	Total	Water	8.09	ug/l	
DGP-01	7/9/2007	11:20	Chlorophyll-c	Total	Water	6	ug/l	
RLE-1	7/22/2009	10:51	Chlorophyll-c	Total	Water	4.61	ug/l	4 ft
DGP-01	7/16/2007	11:00	Chlorophyll-c	Total	Water	4	ug/l	
DGP-01	7/18/2007	10:45	Chlorophyll-c	Total	Water	4	ug/l	
RLE-3	07/23/2003	11:48	Chlorophyll-c	Total	Water	3.83	ug/l	5 ft
RLE-3	04/15/2003	11:20	Chlorophyll-c	Total	Water	3.29	ug/l	6 ft
DGLC-01	9/26/2007	12:10	Chlorophyll-c	Total	Water	2.87	ug/l	
RLE-1	4/14/2009	11:08	Chlorophyll-c	Total	Water	2.53	ug/l	2 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-2	07/23/2003	10:36	Chlorophyll-c	Total	Water	1.68	ug/l	5 ft
DGO-01	8/20/2007	12:20	Chlorophyll-c	Total	Water	1.68	ug/l	
RLE-1	10/14/2009	11:00	Chlorophyll-c	Total	Water	1.57	ug/l	4 ft
RLE-1	07/23/2003	10:36	Chlorophyll-c	Total	Water	1.38	ug/l	6 ft
RLE-1	04/15/2003	10:30	Chlorophyll-c	Total	Water	1.34	ug/l	6 ft
RLE-1	08/07/2003	10:41	Chlorophyll-c	Total	Water	1.2	ug/l	5 ft
RLE-2	04/15/2003	11:06	Chlorophyll-c	Total	Water	1.2	ug/l	5 ft
RLE-1	6/3/2009	11:30	Chlorophyll-c	Total	Water	0.71	ug/l	4 ft
DGLC-01	9/11/2002	14:30	CHLOROPHYLL-C		Water	2.36	ug/l	
DGLC-01	8/12/2002	15:30	CHLOROPHYLL-C		Water	1	ug/l	
DGP-01	8/8/2002	12:45	CHLOROPHYLL-C		Water	1	ug/l	
DGLC-01	6/10/2002	9:00	CHLOROPHYLL-C		Water	1	ug/l	
DGP-01	6/11/2002	9:00	CHLOROPHYLL-C		Water	1	ug/l	
DGO-01	6/11/2002	10:45	CHLOROPHYLL-C		Water	1	ug/l	
DGP-01	9/11/2002	13:00	CHLOROPHYLL-C		Water	1	ug/l	
RLE-1	07/23/2003	10:36	Chromium	Total	Sediment	23	mg/kg	19 ft
RLE-3	07/23/2003	11:48	Chromium	Total	Sediment	20	mg/kg	15 ft
RLE-1	7/22/2009	10:51	Chromium	Total	Sediment	16.6	mg/kg	20 ft
DGO-01	7/3/2007	12:00	Chromium	Total	Water	2.9	ug/l	
RLE-1	7/22/2009	11:10	Chromium	Total	Water	2.26	ug/l	9 ft
DGLC-01	9/18/2012	10:14	Chromium	Total	Water	2.24	ug/l	
RLE-1	6/3/2009	12:05	Chromium	Total	Water	2.17	ug/l	9 ft
RLE-1	4/14/2009	11:18	Chromium	Total	Water	1.59	ug/l	9 ft
DGLC-01	9/26/2007	12:10	Chromium	Total	Water	1.33	ug/l	
RLE-1	10/14/2009	11:10	Chromium	Total	Water	1.24	ug/l	9 ft
DGPC-01	9/25/2007	13:40	Chromium	Total	Water	1.1	ug/l	
DGLC-01	9/26/2007	12:10	Chromium	Dissolved	Water	0.94	ug/l	
DGP-01	9/25/2007	12:20	Chromium	Total	Water	0.93	ug/l	
RLE-1	7/18/2012	10:06	Chromium	Total	Water	0.86	ug/l	9 ft
RLE-1	8/11/2009	11:10	Chromium	Total	Water	0.82	ug/l	9 ft
RLE-1	6/11/2012	10:53	Chromium	Total	Water	0.77	ug/l	9 ft
DGP-01	9/17/2012	10:59	Chromium	Total	Water	0.68	ug/l	
DGPC-01	9/25/2007	13:40	Chromium	Dissolved	Water	0.57	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGLC-01	5/14/2012	9:30	Chromium	Total	Water	0.57	ug/l	
RLE-1	8/22/2012	10:26	Chromium	Total	Water	0.51	ug/l	9 ft
DGLC-01	8/12/2002	15:30	CHROMIUM,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGP-01	8/8/2002	12:45	CHROMIUM,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGLC-01	6/10/2002	9:00	CHROMIUM,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGP-01	6/11/2002	9:00	CHROMIUM,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGO-01	6/11/2002	10:45	CHROMIUM,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGP-01	9/11/2002	13:00	CHROMIUM,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGLC-01	9/11/2002	14:30	CHROMIUM,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGO-01	6/11/2002	10:45	CHROMIUM,Total ug/l	Total	Water	34	ug/l	
DGP-01	9/11/2002	13:00	CHROMIUM,Total ug/l	Total	Water	13	ug/l	
DGLC-01	9/11/2002	14:30	CHROMIUM,Total ug/l	Total	Water	7	ug/l	
DGLC-01	8/12/2002	15:30	CHROMIUM,Total ug/l	Total	Water	5	ug/l	
DGP-01	8/8/2002	12:45	CHROMIUM,Total ug/l	Total	Water	5	ug/l	
DGLC-01	6/10/2002	9:00	CHROMIUM,Total ug/l	Total	Water	5	ug/l	
DGP-01	6/11/2002	9:00	CHROMIUM,Total ug/l	Total	Water	5	ug/l	
DGLC-01	5/14/2012	9:30	Cobalt	Dissolved	Water	3.26	ug/l	
DGLC-01	5/14/2012	9:30	Cobalt	Total	Water	3.18	ug/l	
DGLC-01	9/18/2012	10:14	Cobalt	Total	Water	1.51	ug/l	
DGPC-01	9/25/2007	13:40	Cobalt	Total	Water	1.2	ug/l	
RLE-1	6/11/2012	10:53	Cobalt	Total	Water	0.93	ug/l	9 ft
DGP-01	5/15/2012	11:29	Cobalt	Total	Water	0.91	ug/l	
DGP-01	9/25/2007	12:20	Cobalt	Total	Water	0.89	ug/l	
RLE-1	4/14/2009	11:18	Cobalt	Total	Water	0.86	ug/l	9 ft
RLE-1	7/18/2012	10:06	Cobalt	Total	Water	0.79	ug/l	9 ft
RLE-1	8/22/2012	10:26	Cobalt	Total	Water	0.79	ug/l	9 ft
DGO-01	5/15/2012	10:45	Cobalt	Dissolved	Water	0.77	ug/l	
DGPC-01	9/25/2007	13:40	Cobalt	Dissolved	Water	0.77	ug/l	
DGLC-01	9/26/2007	12:10	Cobalt	Total	Water	0.68	ug/l	
DGP-01	5/15/2012	11:29	Cobalt	Dissolved	Water	0.67	ug/l	
DGP-01	9/25/2007	12:20	Cobalt	Dissolved	Water	0.6	ug/l	
RLE-1	6/3/2009	12:05	Cobalt	Total	Water	0.57	ug/l	9 ft
DGLC-01	9/18/2012	10:14	Cobalt	Dissolved	Water	0.55	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGLC-01	9/26/2007	12:10	Cobalt	Dissolved	Water	0.44	ug/l	
DGP-01	9/17/2012	10:59	Cobalt	Dissolved	Water	0.35	ug/l	
DGP-01	9/17/2012	10:59	Cobalt	Total	Water	0.33	ug/l	
RLE-1	8/11/2009	11:10	Cobalt	Total	Water	0.28	ug/l	9 ft
DGLC-01	8/12/2002	15:30	COBALT,Dissolved ug/l	Dissolved	Water	10	ug/l	
DGP-01	8/8/2002	12:45	COBALT,Dissolved ug/l	Dissolved	Water	10	ug/l	
DGLC-01	6/10/2002	9:00	COBALT,Dissolved ug/l	Dissolved	Water	10	ug/l	
DGP-01	6/11/2002	9:00	COBALT,Dissolved ug/l	Dissolved	Water	10	ug/l	
DGO-01	6/11/2002	10:45	COBALT,Dissolved ug/l	Dissolved	Water	10	ug/l	
DGP-01	9/11/2002	13:00	COBALT,Dissolved ug/l	Dissolved	Water	10	ug/l	
DGLC-01	9/11/2002	14:30	COBALT,Dissolved ug/l	Dissolved	Water	10	ug/l	
DGLC-01	8/12/2002	15:30	COBALT,Total ug/l	Total	Water	10	ug/l	
DGP-01	8/8/2002	12:45	COBALT,Total ug/l	Total	Water	10	ug/l	
DGLC-01	6/10/2002	9:00	COBALT,Total ug/l	Total	Water	10	ug/l	
DGP-01	6/11/2002	9:00	COBALT,Total ug/l	Total	Water	10	ug/l	
DGO-01	6/11/2002	10:45	COBALT,Total ug/l	Total	Water	10	ug/l	
DGP-01	9/11/2002	13:00	COBALT,Total ug/l	Total	Water	10	ug/l	
DGLC-01	9/11/2002	14:30	COBALT,Total ug/l	Total	Water	10	ug/l	
DGLC-01	8/12/2002	15:30	CONDUCTANCE, SPECIFIC umho/cm		Water	835	umho/cm	
DGLC-01	9/11/2002	14:30	CONDUCTANCE, SPECIFIC umho/cm		Water	718	umho/cm	
DGP-01	9/11/2002	13:00	CONDUCTANCE, SPECIFIC umho/cm		Water	570	umho/cm	
DGLC-01	6/10/2002	9:00	CONDUCTANCE, SPECIFIC umho/cm		Water	548	umho/cm	
DGP-01	8/8/2002	12:45	CONDUCTANCE, SPECIFIC umho/cm		Water	523	umho/cm	
DGP-01	6/11/2002	9:00	CONDUCTANCE, SPECIFIC umho/cm		Water	487	umho/cm	
DGO-01	6/11/2002	10:45	CONDUCTANCE, SPECIFIC umho/cm		Water	180	umho/cm	
RLE-1	7/22/2009	10:51	Copper	Total	Sediment	274	mg/kg	20 ft
RLE-1	07/23/2003	10:36	Copper	Total	Sediment	230	mg/kg	19 ft
RLE-3	07/23/2003	11:48	Copper	Total	Sediment	180	mg/kg	15 ft
RLE-1	10/15/2003	11:10	Copper	Total	Water	23	ug/l	7 ft
RLE-1	7/22/2009	11:10	Copper	Total	Water	22.1	ug/l	9 ft
RLE-1	08/07/2003	10:41	Copper	Total	Water	19	ug/l	7 ft
RLE-1	06/04/2003	10:48	Copper	Total	Water	16	ug/l	11 ft
RLE-1	4/14/2009	11:18	Copper	Total	Water	13.3	ug/l	9 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	8/11/2009	11:10	Copper	Total	Water	11.5	ug/l	9 ft
RLE-1	7/18/2012	10:06	Copper	Total	Water	11.2	ug/l	9 ft
DGLC-01	9/18/2012	10:14	Copper	Total	Water	11.2	ug/l	
RLE-1	8/22/2012	10:26	Copper	Total	Water	10.6	ug/l	9 ft
RLE-1	6/11/2012	10:53	Copper	Total	Water	10.5	ug/l	9 ft
DGLC-01	9/18/2012	10:14	Copper	Dissolved	Water	9.65	ug/l	
DGLC-01	9/26/2007	12:10	Copper	Total	Water	9.52	ug/l	
DGLC-01	9/26/2007	12:10	Copper	Dissolved	Water	9.34	ug/l	
RLE-1	4/17/2012	10:33	Copper	Total	Water	9.17	ug/l	9 ft
DGLC-BU-E1	9/5/2007	11:10	Copper	Total	Water	8.2	ug/l	
DGLC-BU-C1	9/5/2007	10:00	Copper	Total	Water	7.9	ug/l	
RLE-1	6/3/2009	12:05	Copper	Total	Water	6.88	ug/l	9 ft
RLE-1	10/14/2009	11:10	Copper	Total	Water	6.83	ug/l	9 ft
DGLC-BU-C2	9/5/2007	11:45	Copper	Total	Water	6	ug/l	
DGLC-01	8/22/2007	9:45	Copper	Total	Water	4.6	ug/l	
DGP-01	9/17/2012	10:59	Copper	Total	Water	3.34	ug/l	
DGP-01	9/17/2012	10:59	Copper	Dissolved	Water	3.07	ug/l	
DGP-01	9/25/2007	12:20	Copper	Total	Water	1.8	ug/l	
DGLC-01	5/14/2012	9:30	Copper	Total	Water	1.59	ug/l	
DGPC-01	9/25/2007	13:40	Copper	Total	Water	1.4	ug/l	
DGP-01	9/25/2007	12:20	Copper	Dissolved	Water	1.2	ug/l	
DGLC-01	5/14/2012	9:30	Copper	Dissolved	Water	0.82	ug/l	
DGPC-01	9/25/2007	13:40	Copper	Dissolved	Water	0.76	ug/l	
DGLC-01	8/12/2002	15:30	COPPER,Dissolved ug/l	Dissolved	Water	10	ug/l	
DGP-01	8/8/2002	12:45	COPPER,Dissolved ug/l	Dissolved	Water	10	ug/l	
DGLC-01	6/10/2002	9:00	COPPER,Dissolved ug/l	Dissolved	Water	10	ug/l	
DGP-01	6/11/2002	9:00	COPPER,Dissolved ug/l	Dissolved	Water	10	ug/l	
DGO-01	6/11/2002	10:45	COPPER,Dissolved ug/l	Dissolved	Water	10	ug/l	
DGP-01	9/11/2002	13:00	COPPER,Dissolved ug/l	Dissolved	Water	10	ug/l	
DGLC-01	9/11/2002	14:30	COPPER,Dissolved ug/l	Dissolved	Water	10	ug/l	
DGO-01	6/11/2002	10:45	COPPER,Total ug/l	Total	Water	35	ug/l	
DGLC-01	8/12/2002	15:30	COPPER,Total ug/l	Total	Water	10	ug/l	
DGP-01	8/8/2002	12:45	COPPER,Total ug/l	Total	Water	10	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGLC-01	6/10/2002	9:00	COPPER,Total ug/l	Total	Water	10	ug/l	
DGP-01	6/11/2002	9:00	COPPER,Total ug/l	Total	Water	10	ug/l	
DGP-01	9/11/2002	13:00	COPPER,Total ug/l	Total	Water	10	ug/l	
DGLC-01	9/11/2002	14:30	COPPER,Total ug/l	Total	Water	10	ug/l	
RLE-1	4/17/2012	10:33	Cyanazine	Total	Water	0.1	ug/l	9 ft
DGO-01	7/3/2007	12:00	Cyanide	Weak Acid Diss	Water	0.016	mg/l	
DGPC-01	6/12/2007	9:00	Cyanide	Weak Acid Diss	Water	0.006	mg/l	
DGO-01	8/20/2007	12:20	Cyanide	Weak Acid Diss	Water	0.006	mg/l	
DGLC-01	9/18/2012	10:14	Cyanide	Total	Water	0.003	mg/l	
DGP-01	9/17/2012	10:59	Cyanide	Total	Water	0.002	mg/l	
DGLC-01	6/10/2002	9:00	CYANIDE		Water	0.01	mg/l	
DGP-01	6/11/2002	9:00	CYANIDE		Water	0.01	mg/l	
DGO-01	6/11/2002	10:45	CYANIDE		Water	0.01	mg/l	
RLE-1	7/22/2009	10:51	DDT, p,p'-	Total	Sediment	0.24	ug/kg	20 ft
RLE-1	7/22/2009	11:10	DDT, p,p'-	Total	Water	0.0022	ug/l	9 ft
RLE-1	07/23/2003	10:36	Depth		Sediment	19	ft	19 ft
RLE-1	07/23/2003	10:36	Depth		Sediment	19	ft	19 ft
RLE-1	06/04/2003	10:48	Depth		Water	18	ft	18 ft
RLE-1	07/23/2003	10:36	Depth		Water	17	ft	17 ft
RLE-3	07/23/2003	11:48	Depth		Sediment	15	ft	15 ft
RLE-3	07/23/2003	11:48	Depth		Sediment	15	ft	15 ft
RLE-1	10/15/2003	11:10	Depth		Water	14	ft	14 ft
RLE-1	08/07/2003	10:41	Depth		Water	11	ft	11 ft
RLE-1	06/04/2003	10:48	Depth		Water	11	ft	11 ft
RLE-1	06/04/2003	10:48	Depth		Water	11	ft	11 ft
RLE-1	06/04/2003	10:48	Depth		Water	11	ft	11 ft
RLE-1	04/15/2003	10:30	Depth		Water	11	ft	11 ft
RLE-1	07/23/2003	10:36	Depth		Water	9	ft	9 ft
RLE-1	07/23/2003	10:36	Depth		Water	9	ft	9 ft
RLE-1	07/23/2003	10:36	Depth		Water	9	ft	9 ft
RLE-1	04/15/2003	10:30	Depth		Water	7	ft	7 ft
RLE-1	10/15/2003	11:10	Depth		Water	7	ft	7 ft
RLE-1	10/15/2003	11:10	Depth		Water	7	ft	7 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	10/15/2003	11:10	Depth		Water	7	ft	7 ft
RLE-1	08/07/2003	10:41	Depth		Water	7	ft	7 ft
RLE-1	08/07/2003	10:41	Depth		Water	7	ft	7 ft
RLE-1	08/07/2003	10:41	Depth		Water	7	ft	7 ft
RLE-1	04/15/2003	10:30	Depth		Water	7	ft	7 ft
RLE-1	04/15/2003	10:30	Depth		Water	6	ft	6 ft
RLE-1	07/23/2003	10:36	Depth		Water	6	ft	6 ft
RLE-3	04/15/2003	11:20	Depth		Water	6	ft	6 ft
RLE-1	08/07/2003	10:41	Depth		Water	5	ft	5 ft
RLE-1	06/04/2003	10:48	Depth		Water	5	ft	5 ft
RLE-2	04/15/2003	11:06	Depth		Water	5	ft	5 ft
RLE-2	08/07/2003	11:21	Depth		Water	5	ft	5 ft
RLE-2	07/23/2003	10:36	Depth		Water	5	ft	5 ft
RLE-2	06/04/2003	11:37	Depth		Water	5	ft	5 ft
RLE-3	08/07/2003	11:38	Depth		Water	5	ft	5 ft
RLE-3	07/23/2003	11:48	Depth		Water	5	ft	5 ft
RLE-3	06/04/2003	12:03	Depth		Water	5	ft	5 ft
RLE-1	10/15/2003	11:10	Depth		Water	4	ft	4 ft
RLE-2	10/15/2003	11:45	Depth		Water	4	ft	4 ft
RLE-3	10/15/2003	12:00	Depth		Water	3	ft	3 ft
RLE-1	10/15/2003	11:10	Depth		Water	1	ft	1 ft
RLE-1	08/07/2003	10:41	Depth		Water	1	ft	1 ft
RLE-1	07/23/2003	10:36	Depth		Water	1	ft	1 ft
RLE-1	06/04/2003	10:48	Depth		Water	1	ft	1 ft
RLE-1	04/15/2003	10:30	Depth		Water	1	ft	1 ft
RLE-2	10/15/2003	11:45	Depth		Water	1	ft	1 ft
RLE-2	08/07/2003	11:21	Depth		Water	1	ft	1 ft
RLE-2	07/23/2003	11:28	Depth		Water	1	ft	1 ft
RLE-2	06/04/2003	11:37	Depth		Water	1	ft	1 ft
RLE-2	04/15/2003	11:06	Depth		Water	1	ft	1 ft
RLE-3	10/15/2003	12:00	Depth		Water	1	ft	1 ft
RLE-3	08/07/2003	11:38	Depth		Water	1	ft	1 ft
RLE-3	07/23/2003	11:48	Depth		Water	1	ft	1 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-3	06/04/2003	12:03	Depth		Water	1	ft	1 ft
RLE-3	04/15/2003	11:20	Depth		Water	1	ft	1 ft
DGLC-01	8/12/2002	15:30	DEPTH ft		Water	1	ft	
DGP-01	8/8/2002	12:45	DEPTH ft		Water	1	ft	
DGLC-01	6/10/2002	9:00	DEPTH ft		Water	1	ft	
DGP-01	6/11/2002	9:00	DEPTH ft		Water	1	ft	
DGO-01	6/11/2002	10:45	DEPTH ft		Water	1	ft	
DGP-01	9/11/2002	13:00	DEPTH ft		Water	1	ft	
DGLC-01	9/11/2002	14:30	DEPTH ft		Water	1	ft	
RLE-1	06/04/2003	10:48	Depth, bottom		Water	20	ft	1 ft
RLE-1	06/04/2003	10:48	Depth, bottom		Water	20	ft	11 ft
RLE-1	06/04/2003	10:48	Depth, bottom		Water	20	ft	11 ft
RLE-1	06/04/2003	10:48	Depth, bottom		Water	20	ft	11 ft
RLE-1	06/04/2003	10:48	Depth, bottom		Water	20	ft	18 ft
RLE-1	07/23/2003	10:36	Depth, bottom		Water	19	ft	1 ft
RLE-1	07/23/2003	10:36	Depth, bottom		Water	19	ft	17 ft
RLE-1	07/23/2003	10:36	Depth, bottom		Water	19	ft	9 ft
RLE-1	07/23/2003	10:36	Depth, bottom		Water	19	ft	9 ft
RLE-1	07/23/2003	10:36	Depth, bottom		Water	19	ft	9 ft
RLE-1	10/15/2003	11:10	Depth, bottom		Water	16	ft	1 ft
RLE-1	10/15/2003	11:10	Depth, bottom		Water	16	ft	14 ft
RLE-1	10/15/2003	11:10	Depth, bottom		Water	16	ft	7 ft
RLE-1	10/15/2003	11:10	Depth, bottom		Water	16	ft	7 ft
RLE-1	10/15/2003	11:10	Depth, bottom		Water	16	ft	7 ft
RLE-3	07/23/2003	11:48	Depth, bottom		Water	15	ft	1 ft
RLE-2	06/04/2003	11:37	Depth, bottom		Water	14	ft	1 ft
RLE-1	08/07/2003	10:41	Depth, bottom		Water	13	ft	1 ft
RLE-1	04/15/2003	10:30	Depth, bottom		Water	13	ft	1 ft
RLE-1	08/07/2003	10:41	Depth, bottom		Water	13	ft	11 ft
RLE-1	04/15/2003	10:30	Depth, bottom		Water	13	ft	11 ft
RLE-1	04/15/2003	10:30	Depth, bottom		Water	13	ft	7 ft
RLE-1	08/07/2003	10:41	Depth, bottom		Water	13	ft	7 ft
RLE-1	08/07/2003	10:41	Depth, bottom		Water	13	ft	7 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	08/07/2003	10:41	Depth, bottom		Water	13	ft	7 ft
RLE-1	04/15/2003	10:30	Depth, bottom		Water	13	ft	7 ft
RLE-2	07/23/2003	11:28	Depth, bottom		Water	13	ft	1 ft
RLE-2	10/15/2003	11:45	Depth, bottom		Water	12	ft	1 ft
RLE-2	08/07/2003	11:21	Depth, bottom		Water	11	ft	1 ft
RLE-2	04/15/2003	11:06	Depth, bottom		Water	11	ft	1 ft
RLE-3	10/15/2003	12:00	Depth, bottom		Water	10	ft	1 ft
RLE-3	06/04/2003	12:03	Depth, bottom		Water	10	ft	1 ft
RLE-3	08/07/2003	11:38	Depth, bottom		Water	8	ft	1 ft
RLE-3	04/15/2003	11:20	Depth, bottom		Water	8	ft	1 ft
RLE-1	04/15/2003	10:30	Depth, Secchi Disk Depth		Water	36	in	1 ft
RLE-3	04/15/2003	11:20	Depth, Secchi Disk Depth		Water	36	in	1 ft
RLE-1	07/23/2003	10:36	Depth, Secchi Disk Depth		Water	32	in	1 ft
RLE-1	08/07/2003	10:41	Depth, Secchi Disk Depth		Water	30	in	1 ft
RLE-2	08/07/2003	11:21	Depth, Secchi Disk Depth		Water	30	in	1 ft
RLE-2	07/23/2003	11:28	Depth, Secchi Disk Depth		Water	30	in	1 ft
RLE-3	08/07/2003	11:38	Depth, Secchi Disk Depth		Water	30	in	1 ft
RLE-2	04/15/2003	11:06	Depth, Secchi Disk Depth		Water	28	in	1 ft
RLE-3	07/23/2003	11:48	Depth, Secchi Disk Depth		Water	28	in	1 ft
RLE-2	06/04/2003	11:37	Depth, Secchi Disk Depth		Water	26	in	1 ft
RLE-1	06/04/2003	10:48	Depth, Secchi Disk Depth		Water	25	in	1 ft
RLE-3	06/04/2003	12:03	Depth, Secchi Disk Depth		Water	25	in	1 ft
RLE-2	10/15/2003	11:45	Depth, Secchi Disk Depth		Water	20	in	1 ft
RLE-1	10/15/2003	11:10	Depth, Secchi Disk Depth		Water	19	in	1 ft
RLE-3	10/15/2003	12:00	Depth, Secchi Disk Depth		Water	18	in	1 ft
RLE-1	07/23/2003	10:36	Diazinon		Water	0.48	ug/l	9 ft
RLE-1	08/07/2003	10:41	Diazinon		Water	0.25	ug/l	7 ft
RLE-1	10/15/2003	11:10	Diazinon		Water	0.05	ug/l	7 ft
RLE-1	7/22/2009	11:10	Dicamba	Total	Water	0.22	ug/l	9 ft
RLE-1	8/11/2009	11:10	Dicamba	Total	Water	0.16	ug/l	9 ft
RLE-1	07/23/2003	10:36	Dieldrin		Sediment	1.2	ug/kg	19 ft
RLE-3	07/23/2003	11:48	Dieldrin		Sediment	1.2	ug/kg	15 ft
RLE-1	7/22/2009	10:51	Dieldrin	Total	Sediment	0.43	ug/kg	20 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	6/3/2009	12:05	Dieldrin	Total	Water	0.0025	ug/l	9 ft
DGLC-BU-C1	9/5/2007	10:00	Dissolved oxygen (DO)		Water	14.58	mg/l	
DGLC-BU-C2	9/5/2007	11:45	Dissolved oxygen (DO)		Water	14.18	mg/l	
DGLC-01	6/18/2007	14:15	Dissolved oxygen (DO)		Water	12.3	mg/l	
DGLC-01	9/26/2007	12:10	Dissolved oxygen (DO)		Water	11.42	mg/l	
DGLC-01	8/22/2007	9:45	Dissolved oxygen (DO)		Water	10.94	mg/l	
DGO-01	5/15/2012	10:45	Dissolved oxygen (DO)		Water	10.6	mg/l	
DGLC-01	5/14/2012	9:30	Dissolved oxygen (DO)		Water	9.9	mg/l	
DGLC-01	9/18/2012	10:15	Dissolved oxygen (DO)		Water	9.3	mg/l	
DGP-01	5/15/2012	11:30	Dissolved oxygen (DO)		Water	9.1	mg/l	
DGPC-01	6/12/2007	9:00	Dissolved oxygen (DO)		Water	8.29	mg/l	
DGO-01	7/3/2007	12:00	Dissolved oxygen (DO)		Water	8.1	mg/l	
DGLC-BU-E1	9/5/2007	11:10	Dissolved oxygen (DO)		Water	6.9	mg/l	
DGP-01	7/18/2007	10:45	Dissolved oxygen (DO)		Water	6.79	mg/l	
DGLC-01	7/16/2007	9:45	Dissolved oxygen (DO)		Water	6.49	mg/l	
DGP-01	9/17/2012	11:00	Dissolved oxygen (DO)		Water	5.8	mg/l	
DGLC-01	7/10/2012	8:30	Dissolved oxygen (DO)		Water	5.73	mg/l	
DGP-01	8/20/2007	11:40	Dissolved oxygen (DO)		Water	4.1	mg/l	
DGPC-01	8/20/2007	11:00	Dissolved oxygen (DO)		Water	3.36	mg/l	
DGO-01	8/20/2007	12:20	Dissolved oxygen (DO)		Water	2.63	mg/l	
DGPC-01	9/25/2007	13:40	Dissolved oxygen (DO)		Water	1.75	mg/l	
DGP-01	9/25/2007	12:20	Dissolved oxygen (DO)		Water	1.5	mg/l	
DGLC-01	9/11/2002	14:30	DISSOLVED OXYGEN (DO) mg/l		Water	11	mg/l	
DGP-01	8/8/2002	12:45	DISSOLVED OXYGEN (DO) mg/l		Water	7.8	mg/l	
DGP-01	9/11/2002	13:00	DISSOLVED OXYGEN (DO) mg/l		Water	7.8	mg/l	
DGP-01	6/11/2002	9:00	DISSOLVED OXYGEN (DO) mg/l		Water	7.59	mg/l	
DGLC-01	6/10/2002	9:00	DISSOLVED OXYGEN (DO) mg/l		Water	7.01	mg/l	
DGLC-01	8/12/2002	15:30	DISSOLVED OXYGEN (DO) mg/l		Water	6.9	mg/l	
DGO-01	6/11/2002	10:45	DISSOLVED OXYGEN (DO) mg/l		Water	6.8	mg/l	
DGO-01	5/15/2012	10:45	Dissolved oxygen saturation		Water	109.5	%	
DGLC-01	9/18/2012	10:15	Dissolved oxygen saturation		Water	97.2	%	
DGLC-01	5/14/2012	9:30	Dissolved oxygen saturation		Water	97	%	
DGP-01	5/15/2012	11:30	Dissolved oxygen saturation		Water	96	%	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGLC-01	7/10/2012	8:30	Dissolved oxygen saturation		Water	70.3	%	
DGP-01	9/17/2012	11:00	Dissolved oxygen saturation		Water	61.5	%	
RLE-1	7/22/2009	11:10	Endrin	Total	Water	0.0014	ug/l	9 ft
DGLC-01	9/18/2012	10:14	Fluoride	Total	Water	3.83	mg/l	
DGLC-01	7/10/2012	8:29	Fluoride	Total	Water	1.35	mg/l	
DGLC-01	5/14/2012	9:30	Fluoride	Total	Water	0.4	mg/l	
DGO-01	5/15/2012	10:45	Fluoride	Total	Water	0.32	mg/l	
RLE-1	8/22/2012	10:26	Fluoride	Total	Water	0.27	mg/l	9 ft
RLE-1	7/18/2012	10:06	Fluoride	Total	Water	0.25	mg/l	9 ft
DGP-01	9/17/2012	10:59	Fluoride	Total	Water	0.25	mg/l	
DGP-01	5/15/2012	11:29	Fluoride	Total	Water	0.24	mg/l	
RLE-1	6/11/2012	10:53	Fluoride	Total	Water	0.23	mg/l	9 ft
RLE-1	4/17/2012	10:33	Fluoride	Total	Water	0.14	mg/l	9 ft
DGLC-01	7/16/2007	9:45	Fluorides	Total	Water	0.369	mg/l	
DGLC-01	6/18/2007	14:15	Fluorides	Total	Water	0.364	mg/l	
DGO-01	7/3/2007	12:00	Fluorides	Total	Water	0.31	mg/l	
DGPC-01	9/25/2007	13:40	Fluorides	Total	Water	0.301	mg/l	
DGPC-01	6/12/2007	9:00	Fluorides	Total	Water	0.265	mg/l	
DGP-01	9/25/2007	12:20	Fluorides	Total	Water	0.26	mg/l	
DGO-01	8/20/2007	12:20	Fluorides	Total	Water	0.227	mg/l	
DGP-01	8/20/2007	11:40	Fluorides	Total	Water	0.193	mg/l	
DGP-01	7/18/2007	10:45	Fluorides	Total	Water	0.191	mg/l	
DGPC-01	8/20/2007	11:00	Fluorides	Total	Water	0.182	mg/l	
DGLC-01	8/12/2002	15:30	FLUORIDES		Water	0.53	mg/l	
DGLC-01	9/11/2002	14:30	FLUORIDES		Water	0.48	mg/l	
DGP-01	8/8/2002	12:45	FLUORIDES		Water	0.3	mg/l	
DGLC-01	6/10/2002	9:00	FLUORIDES		Water	0.29	mg/l	
DGP-01	9/11/2002	13:00	FLUORIDES		Water	0.26	mg/l	
DGP-01	6/11/2002	9:00	FLUORIDES		Water	0.25	mg/l	
DGO-01	6/11/2002	10:45	FLUORIDES		Water	0.25	mg/l	
RLE-1	10/14/2009	11:10	Hardness, Ca + Mg	Total	Water	114000	ug/l	9 ft
RLE-1	4/14/2009	11:18	Hardness, Ca + Mg	Total	Water	110000	ug/l	9 ft
RLE-1	7/22/2009	11:10	Hardness, Ca + Mg	Total	Water	108000	ug/l	9 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	8/11/2009	11:10	Hardness, Ca + Mg	Total	Water	108000	ug/l	9 ft
RLE-1	6/3/2009	12:05	Hardness, Ca + Mg	Total	Water	106000	ug/l	9 ft
DGLC-01	9/26/2007	12:10	Hardness, Ca + Mg	Total	Water	766	mg/l	
DGLC-01	8/22/2007	9:45	Hardness, Ca + Mg	Total	Water	700	mg/l	
DGLC-01	7/16/2007	9:45	Hardness, Ca + Mg	Total	Water	310	mg/l	
DGPC-01	8/20/2007	11:00	Hardness, Ca + Mg	Total	Water	300	mg/l	
DGPC-01	6/12/2007	9:00	Hardness, Ca + Mg	Total	Water	270	mg/l	
DGLC-01	6/18/2007	14:15	Hardness, Ca + Mg	Total	Water	270	mg/l	
DGPC-01	9/25/2007	13:40	Hardness, Ca + Mg	Total	Water	270	mg/l	
DGO-01	8/20/2007	12:20	Hardness, Ca + Mg	Total	Water	260	mg/l	
DGP-01	8/20/2007	11:40	Hardness, Ca + Mg	Total	Water	260	mg/l	
DGP-01	7/18/2007	10:45	Hardness, Ca + Mg	Total	Water	250	mg/l	
DGP-01	9/25/2007	12:20	Hardness, Ca + Mg	Total	Water	240	mg/l	
DGO-01	7/3/2007	12:00	Hardness, Ca + Mg	Total	Water	220	mg/l	
RLE-1	06/04/2003	10:48	Hardness, Ca + Mg		Water	125	mg/l	11 ft
RLE-1	10/15/2003	11:10	Hardness, Ca + Mg		Water	108	mg/l	7 ft
RLE-1	08/07/2003	10:41	Hardness, Ca + Mg		Water	97	mg/l	7 ft
RLE-1	07/23/2003	10:36	Hardness, Ca + Mg		Water	90	mg/l	9 ft
RLE-1	8/22/2012	10:26	Hardness, Ca, Mg		Water	131000	ug/l	9 ft
RLE-1	4/17/2012	10:33	Hardness, Ca, Mg		Water	130000	ug/l	9 ft
RLE-1	6/11/2012	10:53	Hardness, Ca, Mg		Water	124000	ug/l	9 ft
RLE-1	7/18/2012	10:06	Hardness, Ca, Mg		Water	117000	ug/l	9 ft
DGLC-01	9/18/2012	10:14	Hardness, Ca, Mg		Water	669	mg/l	
DGLC-01	7/10/2012	8:29	Hardness, Ca, Mg		Water	391	mg/l	
DGP-01	5/15/2012	11:29	Hardness, Ca, Mg		Water	257	mg/l	
DGLC-01	5/14/2012	9:30	Hardness, Ca, Mg		Water	246	mg/l	
DGP-01	9/17/2012	10:59	Hardness, Ca, Mg		Water	226	mg/l	
DGO-01	5/15/2012	10:45	Hardness, Ca, Mg		Water	183	mg/l	
DGLC-01	8/12/2002	15:30	HARDNESS, CA,MG mg/l		Water	291	mg/l	
DGP-01	9/11/2002	13:00	HARDNESS, CA,MG mg/l		Water	288	mg/l	
DGLC-01	6/10/2002	9:00	HARDNESS, CA,MG mg/l		Water	279	mg/l	
DGP-01	8/8/2002	12:45	HARDNESS, CA,MG mg/l		Water	265	mg/l	
DGLC-01	9/11/2002	14:30	HARDNESS, CA,MG mg/l		Water	248	mg/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGP-01	6/11/2002	9:00	HARDNESS, CA,MG mg/l		Water	238	mg/l	
DGO-01	6/11/2002	10:45	HARDNESS, CA,MG mg/l		Water	128	mg/l	
RLE-1	8/22/2012	10:26	Heptachlor	Total	Water	0.00076	ug/l	9 ft
DGO-01	5/15/2012	10:45	Inorganic nitrogen (nitrate and nitrite)	Total	Water	12.8	mg/l	
DGLC-01	5/14/2012	9:30	Inorganic nitrogen (nitrate and nitrite)	Total	Water	10.8	mg/l	
DGP-01	5/15/2012	11:29	Inorganic nitrogen (nitrate and nitrite)	Total	Water	8.31	mg/l	
RLE-1	6/11/2012	10:49	Inorganic nitrogen (nitrate and nitrite)	Total	Water	1.33	mg/l	1 ft
RLE-1	6/11/2012	10:53	Inorganic nitrogen (nitrate and nitrite)	Total	Water	1.25	mg/l	9 ft
RLE-1	6/11/2012	11:00	Inorganic nitrogen (nitrate and nitrite)	Total	Water	1.24	mg/l	16 ft
RLE-1	4/17/2012	10:33	Inorganic nitrogen (nitrate and nitrite)	Total	Water	0.331	mg/l	9 ft
RLE-1	4/17/2012	10:32	Inorganic nitrogen (nitrate and nitrite)	Total	Water	0.322	mg/l	1 ft
RLE-1	4/17/2012	10:35	Inorganic nitrogen (nitrate and nitrite)	Total	Water	0.321	mg/l	15 ft
DGLC-01	7/16/2012	11:35	Inorganic nitrogen (nitrate and nitrite)	Total	Water	0.074	mg/l	
RLE-1	7/18/2012	10:06	Inorganic nitrogen (nitrate and nitrite)	Total	Water	0.033	mg/l	9 ft
DGLC-01	9/18/2012	10:14	Inorganic nitrogen (nitrate and nitrite)	Total	Water	0.019	mg/l	
RLE-1	7/18/2012	10:07	Inorganic nitrogen (nitrate and nitrite)	Total	Water	0.018	mg/l	15 ft
RLE-1	7/22/2009	10:51	Iron	Total	Sediment	29600	mg/kg	20 ft
RLE-1	07/23/2003	10:36	Iron	Total	Sediment	29000	mg/kg	19 ft
RLE-3	07/23/2003	11:48	Iron	Total	Sediment	24000	mg/kg	15 ft
DGLC-01	8/22/2007	9:45	Iron	Total	Water	2200	ug/l	
RLE-1	6/3/2009	12:05	Iron	Total	Water	1940	ug/l	9 ft
RLE-1	4/14/2009	11:18	Iron	Total	Water	1700	ug/l	9 ft
DGLC-01	9/18/2012	10:14	Iron	Total	Water	1690	ug/l	
RLE-1	7/22/2009	11:10	Iron	Total	Water	1440	ug/l	9 ft
RLE-1	8/22/2012	10:26	Iron	Total	Water	1410	ug/l	9 ft
DGPC-01	8/20/2007	11:00	Iron	Total	Water	1400	ug/l	
DGP-01	5/15/2012	11:29	Iron	Total	Water	1160	ug/l	
DGLC-01	5/14/2012	9:30	Iron	Total	Water	990	ug/l	
DGP-01	7/18/2007	10:45	Iron	Total	Water	950	ug/l	
DGLC-BU-C2	9/5/2007	11:45	Iron	Total	Water	950	ug/l	
RLE-1	7/18/2012	10:06	Iron	Total	Water	943	ug/l	9 ft
DGPC-01	9/25/2007	13:40	Iron	Dissolved	Water	940	ug/l	
DGLC-01	7/10/2012	8:29	Iron	Total	Water	907	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	4/17/2012	10:33	Iron	Total	Water	887	ug/l	9 ft
DGLC-01	9/26/2007	12:10	Iron	Total	Water	884	ug/l	
RLE-1	10/14/2009	11:10	Iron	Total	Water	836	ug/l	9 ft
DGP-01	8/20/2007	11:40	Iron	Total	Water	810	ug/l	
DGLC-BU-C1	9/5/2007	10:00	Iron	Total	Water	700	ug/l	
RLE-1	10/15/2003	11:10	Iron	Total	Water	650	ug/l	7 ft
RLE-1	6/11/2012	10:53	Iron	Total	Water	550	ug/l	9 ft
DGP-01	9/25/2007	12:20	Iron	Total	Water	550	ug/l	
DGO-01	8/20/2007	12:20	Iron	Total	Water	540	ug/l	
DGP-01	9/17/2012	10:59	Iron	Total	Water	479	ug/l	
RLE-1	06/04/2003	10:48	Iron	Total	Water	330	ug/l	11 ft
RLE-1	8/11/2009	11:10	Iron	Total	Water	296	ug/l	9 ft
DGLC-01	6/18/2007	14:15	Iron	Total	Water	260	ug/l	
DGO-01	7/3/2007	12:00	Iron	Total	Water	210	ug/l	
DGPC-01	6/12/2007	9:00	Iron	Total	Water	200	ug/l	
RLE-1	08/07/2003	10:41	Iron	Total	Water	190	ug/l	7 ft
RLE-1	07/23/2003	10:36	Iron	Total	Water	180	ug/l	9 ft
RLE-1	04/15/2003	10:30	Iron	Total	Water	170	ug/l	7 ft
DGO-01	5/15/2012	10:45	Iron	Total	Water	156	ug/l	
DGLC-BU-E1	9/5/2007	11:10	Iron	Total	Water	150	ug/l	
DGLC-01	7/16/2007	9:45	Iron	Total	Water	140	ug/l	
DGLC-01	7/10/2012	8:29	Iron	Dissolved	Water	56.4	ug/l	
DGPC-01	9/25/2007	13:40	Iron	Total	Water	42	ug/l	
DGLC-01	5/14/2012	9:30	Iron	Dissolved	Water	38.3	ug/l	
DGPC-01	8/20/2007	11:00	Iron	Dissolved	Water	33	ug/l	
DGP-01	5/15/2012	11:29	Iron	Dissolved	Water	21.1	ug/l	
DGLC-01	9/26/2007	12:10	Iron	Dissolved	Water	19.5	ug/l	
DGP-01	9/25/2007	12:20	Iron	Dissolved	Water	18	ug/l	
DGO-01	5/15/2012	10:45	Iron	Dissolved	Water	4.61	ug/l	
DGO-01	6/11/2002	10:45	IRON,Dissolved ug/l	Dissolved	Water	290	ug/l	
DGLC-01	6/10/2002	9:00	IRON,Dissolved ug/l	Dissolved	Water	270	ug/l	
DGLC-01	8/12/2002	15:30	IRON,Dissolved ug/l	Dissolved	Water	50	ug/l	
DGP-01	8/8/2002	12:45	IRON,Dissolved ug/l	Dissolved	Water	50	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGP-01	6/11/2002	9:00	IRON,Dissolved ug/l	Dissolved	Water	50	ug/l	
DGP-01	9/11/2002	13:00	IRON,Dissolved ug/l	Dissolved	Water	50	ug/l	
DGLC-01	9/11/2002	14:30	IRON,Dissolved ug/l	Dissolved	Water	50	ug/l	
DGO-01	6/11/2002	10:45	IRON,Total ug/l	Total	Water	30000	ug/l	
DGP-01	6/11/2002	9:00	IRON,Total ug/l	Total	Water	3200	ug/l	
DGLC-01	8/12/2002	15:30	IRON,Total ug/l	Total	Water	2000	ug/l	
DGLC-01	6/10/2002	9:00	IRON,Total ug/l	Total	Water	2000	ug/l	
DGLC-01	9/11/2002	14:30	IRON,Total ug/l	Total	Water	1300	ug/l	
DGP-01	8/8/2002	12:45	IRON,Total ug/l	Total	Water	680	ug/l	
DGP-01	9/11/2002	13:00	IRON,Total ug/l	Total	Water	540	ug/l	
DGLC-01	9/18/2012	8:39	Kjeldahl nitrogen	Total	Water	2.03	mg/l	
DGLC-01	9/18/2012	10:14	Kjeldahl nitrogen	Total	Water	1.99	mg/l	
RLE-1	8/22/2012	10:24	Kjeldahl nitrogen	Total	Water	1.26	mg/l	1 ft
RLE-1	8/22/2012	10:27	Kjeldahl nitrogen	Total	Water	1.15	mg/l	14 ft
RLE-1	8/22/2012	10:26	Kjeldahl nitrogen	Total	Water	1.09	mg/l	9 ft
RLE-1	7/18/2012	10:07	Kjeldahl nitrogen	Total	Water	0.931	mg/l	15 ft
RLE-1	7/18/2012	10:06	Kjeldahl nitrogen	Total	Water	0.92	mg/l	9 ft
RLE-1	7/18/2012	10:06	Kjeldahl nitrogen	Total	Water	0.899	mg/l	1 ft
DGP-01	9/18/2012	12:44	Kjeldahl nitrogen	Total	Water	0.863	mg/l	
DGP-01	7/17/2012	8:06	Kjeldahl nitrogen	Total	Water	0.858	mg/l	
DGP-01	9/17/2012	10:59	Kjeldahl nitrogen	Total	Water	0.798	mg/l	
RLE-1	4/17/2012	10:32	Kjeldahl nitrogen	Total	Water	0.713	mg/l	1 ft
DGO-01	7/17/2012	7:00	Kjeldahl nitrogen	Total	Water	0.66	mg/l	
RLE-1	6/11/2012	11:00	Kjeldahl nitrogen	Total	Water	0.562	mg/l	16 ft
RLE-1	6/11/2012	10:53	Kjeldahl nitrogen	Total	Water	0.557	mg/l	9 ft
DGLC-01	5/14/2012	9:30	Kjeldahl nitrogen	Total	Water	0.539	mg/l	
RLE-1	6/11/2012	10:49	Kjeldahl nitrogen	Total	Water	0.503	mg/l	1 ft
DGP-01	5/15/2012	11:29	Kjeldahl nitrogen	Total	Water	0.429	mg/l	
DGO-01	5/15/2012	10:45	Kjeldahl nitrogen	Total	Water	0.172	mg/l	
RLE-1	07/23/2003	10:36	Lead	Total	Sediment	22	mg/kg	19 ft
RLE-1	7/22/2009	10:51	Lead	Total	Sediment	21.2	mg/kg	20 ft
RLE-3	07/23/2003	11:48	Lead	Total	Sediment	19	mg/kg	15 ft
RLE-1	10/14/2009	11:10	Lead	Total	Water	7.27	ug/l	9 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	7/18/2012	10:06	Lead	Total	Water	3.3	ug/l	9 ft
RLE-1	6/3/2009	12:05	Lead	Total	Water	3.27	ug/l	9 ft
RLE-1	7/22/2009	11:10	Lead	Total	Water	3.2	ug/l	9 ft
DGLC-01	9/18/2012	10:14	Lead	Total	Water	2.67	ug/l	
RLE-1	4/14/2009	11:18	Lead	Total	Water	2.26	ug/l	9 ft
RLE-1	8/22/2012	10:26	Lead	Total	Water	1.64	ug/l	9 ft
DGO-01	5/15/2012	10:45	Lead	Dissolved	Water	1.62	ug/l	
DGP-01	5/15/2012	11:29	Lead	Total	Water	1.58	ug/l	
RLE-1	4/17/2012	10:33	Lead	Total	Water	1.18	ug/l	9 ft
DGP-01	5/15/2012	11:29	Lead	Dissolved	Water	1.13	ug/l	
DGLC-01	7/10/2012	8:29	Lead	Total	Water	0.85	ug/l	
DGP-01	9/25/2007	12:20	Lead	Total	Water	0.42	ug/l	
DGPC-01	9/25/2007	13:40	Lead	Total	Water	0.26	ug/l	
DGLC-01	9/26/2007	12:10	Lead	Total	Water	0.06	ug/l	
DGLC-01	8/12/2002	15:30	LEAD,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGP-01	8/8/2002	12:45	LEAD,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGLC-01	6/10/2002	9:00	LEAD,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGP-01	6/11/2002	9:00	LEAD,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGO-01	6/11/2002	10:45	LEAD,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGP-01	9/11/2002	13:00	LEAD,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGLC-01	9/11/2002	14:30	LEAD,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGO-01	6/11/2002	10:45	LEAD,Total ug/l	Total	Water	26	ug/l	
DGLC-01	8/12/2002	15:30	LEAD,Total ug/l	Total	Water	5	ug/l	
DGP-01	8/8/2002	12:45	LEAD,Total ug/l	Total	Water	5	ug/l	
DGLC-01	6/10/2002	9:00	LEAD,Total ug/l	Total	Water	5	ug/l	
DGP-01	6/11/2002	9:00	LEAD,Total ug/l	Total	Water	5	ug/l	
DGP-01	9/11/2002	13:00	LEAD,Total ug/l	Total	Water	5	ug/l	
DGLC-01	9/11/2002	14:30	LEAD,Total ug/l	Total	Water	5	ug/l	
DGLC-BU-E1	9/5/2007	11:10	Magnesium	Total	Water	88000	ug/l	
DGLC-BU-C1	9/5/2007	10:00	Magnesium	Total	Water	84000	ug/l	
DGLC-BU-C2	9/5/2007	11:45	Magnesium	Total	Water	82000	ug/l	
DGLC-01	9/26/2007	12:10	Magnesium	Total	Water	79600	ug/l	
DGLC-01	9/26/2007	12:10	Magnesium	Dissolved	Water	74900	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGLC-01	9/18/2012	10:14	Magnesium	Total	Water	74900	ug/l	
DGLC-01	9/18/2012	10:14	Magnesium	Dissolved	Water	72200	ug/l	
DGLC-01	8/22/2007	9:45	Magnesium	Total	Water	71000	ug/l	
DGLC-01	8/22/2007	9:45	Magnesium	Dissolved	Water	65000	ug/l	
DGLC-01	7/10/2012	8:29	Magnesium	Total	Water	46500	ug/l	
DGLC-01	7/10/2012	8:29	Magnesium	Dissolved	Water	44300	ug/l	
DGLC-01	7/16/2007	9:45	Magnesium	Total	Water	34000	ug/l	
DGPC-01	9/25/2007	13:40	Magnesium	Total	Water	32000	ug/l	
DGPC-01	8/20/2007	11:00	Magnesium	Dissolved	Water	30000	ug/l	
DGLC-01	6/18/2007	14:15	Magnesium	Dissolved	Water	29000	ug/l	
DGLC-01	6/18/2007	14:15	Magnesium	Total	Water	29000	ug/l	
DGPC-01	8/20/2007	11:00	Magnesium	Total	Water	29000	ug/l	
DGPC-01	6/12/2007	9:00	Magnesium	Dissolved	Water	28000	ug/l	
DGPC-01	6/12/2007	9:00	Magnesium	Total	Water	28000	ug/l	
DGPC-01	9/25/2007	13:40	Magnesium	Dissolved	Water	27000	ug/l	
DGP-01	5/15/2012	11:29	Magnesium	Total	Water	26400	ug/l	
DGLC-01	5/14/2012	9:30	Magnesium	Dissolved	Water	26300	ug/l	
DGLC-01	5/14/2012	9:30	Magnesium	Total	Water	26300	ug/l	
DGP-01	8/20/2007	11:40	Magnesium	Dissolved	Water	26000	ug/l	
DGP-01	5/15/2012	11:29	Magnesium	Dissolved	Water	25900	ug/l	
DGP-01	9/17/2012	10:59	Magnesium	Dissolved	Water	25100	ug/l	
DGP-01	9/17/2012	10:59	Magnesium	Total	Water	25000	ug/l	
DGP-01	7/18/2007	10:45	Magnesium	Total	Water	25000	ug/l	
DGP-01	8/20/2007	11:40	Magnesium	Total	Water	25000	ug/l	
DGP-01	9/25/2007	12:20	Magnesium	Dissolved	Water	23000	ug/l	
DGP-01	9/25/2007	12:20	Magnesium	Total	Water	23000	ug/l	
DGO-01	7/3/2007	12:00	Magnesium	Dissolved	Water	22000	ug/l	
DGO-01	8/20/2007	12:20	Magnesium	Dissolved	Water	22000	ug/l	
DGO-01	8/20/2007	12:20	Magnesium	Total	Water	21000	ug/l	
DGO-01	7/3/2007	12:00	Magnesium	Total	Water	20000	ug/l	
DGO-01	5/15/2012	10:45	Magnesium	Total	Water	17300	ug/l	
DGO-01	5/15/2012	10:45	Magnesium	Dissolved	Water	16300	ug/l	
RLE-1	8/22/2012	10:26	Magnesium	Total	Water	11800	ug/l	9 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	7/18/2012	10:06	Magnesium	Total	Water	10800	ug/l	9 ft
RLE-1	6/11/2012	10:53	Magnesium	Total	Water	9960	ug/l	9 ft
RLE-1	10/14/2009	11:10	Magnesium	Total	Water	9660	ug/l	9 ft
RLE-1	4/17/2012	10:33	Magnesium	Total	Water	9580	ug/l	9 ft
RLE-1	8/11/2009	11:10	Magnesium	Total	Water	9010	ug/l	9 ft
RLE-1	7/22/2009	11:10	Magnesium	Total	Water	8940	ug/l	9 ft
RLE-1	4/14/2009	11:18	Magnesium	Total	Water	8840	ug/l	9 ft
RLE-1	6/3/2009	12:05	Magnesium	Total	Water	8720	ug/l	9 ft
RLE-1	06/04/2003	10:48	Magnesium	Total	Water	9.8	mg/l	11 ft
RLE-1	04/15/2003	10:30	Magnesium	Total	Water	8.9	mg/l	7 ft
RLE-1	10/15/2003	11:10	Magnesium	Total	Water	8.7	mg/l	7 ft
RLE-1	08/07/2003	10:41	Magnesium	Total	Water	8.2	mg/l	7 ft
RLE-1	07/23/2003	10:36	Magnesium	Total	Water	7.7	mg/l	9 ft
DGP-01	9/11/2002	13:00	MAGNESIUM,Dissolved mg/l	Dissolved	Water	30	mg/l	
DGLC-01	8/12/2002	15:30	MAGNESIUM,Dissolved mg/l	Dissolved	Water	28	mg/l	
DGLC-01	9/11/2002	14:30	MAGNESIUM,Dissolved mg/l	Dissolved	Water	27	mg/l	
DGP-01	8/8/2002	12:45	MAGNESIUM,Dissolved mg/l	Dissolved	Water	26	mg/l	
DGP-01	6/11/2002	9:00	MAGNESIUM,Dissolved mg/l	Dissolved	Water	24	mg/l	
DGLC-01	6/10/2002	9:00	MAGNESIUM,Dissolved mg/l	Dissolved	Water	17	mg/l	
DGO-01	6/11/2002	10:45	MAGNESIUM,Dissolved mg/l	Dissolved	Water	6	mg/l	
DGLC-01	8/12/2002	15:30	MAGNESIUM,Total mg/l	Total	Water	31	mg/l	
DGLC-01	6/10/2002	9:00	MAGNESIUM,Total mg/l	Total	Water	30	mg/l	
DGP-01	9/11/2002	13:00	MAGNESIUM,Total mg/l	Total	Water	30	mg/l	
DGLC-01	9/11/2002	14:30	MAGNESIUM,Total mg/l	Total	Water	27	mg/l	
DGP-01	8/8/2002	12:45	MAGNESIUM,Total mg/l	Total	Water	26	mg/l	
DGP-01	6/11/2002	9:00	MAGNESIUM,Total mg/l	Total	Water	24	mg/l	
DGO-01	6/11/2002	10:45	MAGNESIUM,Total mg/l	Total	Water	13	mg/l	
RLE-1	10/15/2003	11:10	Malathion		Water	0.15	ug/l	7 ft
DGPC-01	9/25/2007	13:40	Manganese	Total	Water	1600	ug/l	
DGPC-01	8/20/2007	11:00	Manganese	Total	Water	1500	ug/l	
DGPC-01	8/20/2007	11:00	Manganese	Dissolved	Water	1400	ug/l	
DGP-01	8/20/2007	11:40	Manganese	Total	Water	1100	ug/l	
RLE-1	07/23/2003	10:36	Manganese	Total	Sediment	1000	mg/kg	19 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGP-01	8/20/2007	11:40	Manganese	Dissolved	Water	1000	ug/l	
DGP-01	9/25/2007	12:20	Manganese	Dissolved	Water	880	ug/l	
RLE-1	7/22/2009	10:51	Manganese	Total	Sediment	879	mg/kg	20 ft
RLE-3	07/23/2003	11:48	Manganese	Total	Sediment	860	mg/kg	15 ft
DGP-01	9/25/2007	12:20	Manganese	Total	Water	850	ug/l	
DGLC-01	8/22/2007	9:45	Manganese	Total	Water	810	ug/l	
DGLC-01	7/10/2012	8:29	Manganese	Total	Water	722	ug/l	
DGPC-01	9/25/2007	13:40	Manganese	Dissolved	Water	710	ug/l	
DGLC-01	9/18/2012	10:14	Manganese	Total	Water	637	ug/l	
DGO-01	8/20/2007	12:20	Manganese	Total	Water	610	ug/l	
DGLC-01	9/26/2007	12:10	Manganese	Total	Water	596	ug/l	
DGLC-01	8/22/2007	9:45	Manganese	Dissolved	Water	590	ug/l	
DGLC-01	9/18/2012	10:14	Manganese	Dissolved	Water	556	ug/l	
DGLC-01	9/26/2007	12:10	Manganese	Dissolved	Water	512	ug/l	
DGLC-01	7/10/2012	8:29	Manganese	Dissolved	Water	508	ug/l	
DGLC-BU-C2	9/5/2007	11:45	Manganese	Total	Water	480	ug/l	
RLE-1	8/22/2012	10:26	Manganese	Total	Water	462	ug/l	9 ft
DGO-01	8/20/2007	12:20	Manganese	Dissolved	Water	370	ug/l	
DGLC-BU-C1	9/5/2007	10:00	Manganese	Total	Water	340	ug/l	
RLE-1	4/17/2012	10:33	Manganese	Total	Water	275	ug/l	9 ft
DGP-01	9/17/2012	10:59	Manganese	Total	Water	244	ug/l	
RLE-1	6/11/2012	10:53	Manganese	Total	Water	229	ug/l	9 ft
RLE-1	7/18/2012	10:06	Manganese	Total	Water	211	ug/l	9 ft
RLE-1	10/14/2009	11:10	Manganese	Total	Water	209	ug/l	9 ft
RLE-1	6/3/2009	12:05	Manganese	Total	Water	190	ug/l	9 ft
RLE-1	8/11/2009	11:10	Manganese	Total	Water	190	ug/l	9 ft
RLE-1	7/22/2009	11:10	Manganese	Total	Water	188	ug/l	9 ft
RLE-1	10/15/2003	11:10	Manganese	Total	Water	180	ug/l	7 ft
DGP-01	9/17/2012	10:59	Manganese	Dissolved	Water	135	ug/l	
RLE-1	06/04/2003	10:48	Manganese	Total	Water	120	ug/l	11 ft
DGP-01	7/18/2007	10:45	Manganese	Total	Water	110	ug/l	
DGP-01	5/15/2012	11:29	Manganese	Total	Water	104	ug/l	
RLE-1	4/14/2009	11:18	Manganese	Total	Water	103	ug/l	9 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	04/15/2003	10:30	Manganese	Total	Water	100	ug/l	7 ft
DGPC-01	6/12/2007	9:00	Manganese	Total	Water	82	ug/l	
DGPC-01	6/12/2007	9:00	Manganese	Dissolved	Water	61	ug/l	
DGP-01	5/15/2012	11:29	Manganese	Dissolved	Water	47.1	ug/l	
RLE-1	07/23/2003	10:36	Manganese	Total	Water	44	ug/l	9 ft
DGLC-BU-E1	9/5/2007	11:10	Manganese	Total	Water	44	ug/l	
RLE-1	08/07/2003	10:41	Manganese	Total	Water	41	ug/l	7 ft
DGLC-01	5/14/2012	9:30	Manganese	Total	Water	33.9	ug/l	
DGO-01	7/3/2007	12:00	Manganese	Total	Water	26	ug/l	
DGLC-01	5/14/2012	9:30	Manganese	Dissolved	Water	21.7	ug/l	
DGLC-01	7/16/2007	9:45	Manganese	Total	Water	20	ug/l	
DGO-01	7/3/2007	12:00	Manganese	Dissolved	Water	19	ug/l	
DGLC-01	6/18/2007	14:15	Manganese	Total	Water	14	ug/l	
DGO-01	5/15/2012	10:45	Manganese	Total	Water	13.1	ug/l	
DGO-01	5/15/2012	10:45	Manganese	Dissolved	Water	9.91	ug/l	
DGLC-01	6/18/2007	14:15	Manganese	Dissolved	Water	8.5	ug/l	
DGP-01	8/8/2002	12:45	MANGANESE,Dissolved ug/l	Dissolved	Water	550	ug/l	
DGLC-01	8/12/2002	15:30	MANGANESE,Dissolved ug/l	Dissolved	Water	320	ug/l	
DGP-01	9/11/2002	13:00	MANGANESE,Dissolved ug/l	Dissolved	Water	320	ug/l	
DGLC-01	9/11/2002	14:30	MANGANESE,Dissolved ug/l	Dissolved	Water	48	ug/l	
DGP-01	6/11/2002	9:00	MANGANESE,Dissolved ug/l	Dissolved	Water	30	ug/l	
DGLC-01	6/10/2002	9:00	MANGANESE,Dissolved ug/l	Dissolved	Water	15	ug/l	
DGO-01	6/11/2002	10:45	MANGANESE,Dissolved ug/l	Dissolved	Water	15	ug/l	
DGO-01	6/11/2002	10:45	MANGANESE,Total ug/l	Total	Water	830	ug/l	
DGP-01	8/8/2002	12:45	MANGANESE,Total ug/l	Total	Water	580	ug/l	
DGLC-01	8/12/2002	15:30	MANGANESE,Total ug/l	Total	Water	410	ug/l	
DGP-01	9/11/2002	13:00	MANGANESE,Total ug/l	Total	Water	340	ug/l	
DGP-01	6/11/2002	9:00	MANGANESE,Total ug/l	Total	Water	190	ug/l	
DGLC-01	9/11/2002	14:30	MANGANESE,Total ug/l	Total	Water	100	ug/l	
DGLC-01	6/10/2002	9:00	MANGANESE,Total ug/l	Total	Water	74	ug/l	
RLE-1	07/23/2003	10:36	Mercury	Supernate	Sediment	0.18	mg/kg	19 ft
RLE-3	07/23/2003	11:48	Mercury	Supernate	Sediment	0.17	mg/kg	15 ft
RLE-1	7/22/2009	10:51	Mercury	Total	Sediment	0.07	mg/kg	20 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGLC-01	8/12/2002	15:30	MERCURY,Total	Total	Water	0.01	ug/l	
DGP-01	8/8/2002	12:45	MERCURY,Total	Total	Water	0.01	ug/l	
DGLC-01	6/10/2002	9:00	MERCURY,Total	Total	Water	0.01	ug/l	
DGP-01	6/11/2002	9:00	MERCURY,Total	Total	Water	0.01	ug/l	
DGP-01	9/11/2002	13:00	MERCURY,Total	Total	Water	0.01	ug/l	
DGLC-01	9/11/2002	14:30	MERCURY,Total	Total	Water	0.01	ug/l	
RLE-1	6/3/2009	12:05	Methoxychlor	Total	Water	0.011	ug/l	9 ft
RLE-1	7/22/2009	11:10	Methoxychlor	Total	Water	0.0046	ug/l	9 ft
RLE-1	6/11/2012	10:53	Metolachlor	Total	Water	0.49	ug/l	9 ft
RLE-1	7/18/2012	10:06	Metolachlor	Total	Water	0.14	ug/l	9 ft
RLE-1	8/22/2012	10:26	Metolachlor	Total	Water	0.11	ug/l	9 ft
RLE-1	7/22/2009	11:10	Metolachlor	Total	Water	0.11	ug/l	9 ft
RLE-1	6/3/2009	12:05	Metolachlor	Total	Water	0.096	ug/l	9 ft
RLE-1	8/11/2009	11:10	Metolachlor	Total	Water	0.063	ug/l	9 ft
RLE-1	4/17/2012	10:33	Metolachlor	Total	Water	0.042	ug/l	9 ft
RLE-1	6/11/2012	10:53	Metribuzin	Total	Water	0.024	ug/l	9 ft
RLE-1	8/22/2012	10:26	Metribuzin	Total	Water	0.016	ug/l	9 ft
RLE-1	4/17/2012	10:33	Metribuzin	Total	Water	0.015	ug/l	9 ft
RLE-1	7/18/2012	10:06	Metribuzin	Total	Water	0.0054	ug/l	9 ft
RLE-1	7/22/2009	10:51	Nickel	Total	Sediment	25	mg/kg	20 ft
RLE-1	07/23/2003	10:36	Nickel	Total	Sediment	22	mg/kg	19 ft
RLE-3	07/23/2003	11:48	Nickel	Total	Sediment	19	mg/kg	15 ft
DGP-01	9/25/2007	12:20	Nickel	Total	Water	5.4	ug/l	
DGPC-01	8/20/2007	11:00	Nickel	Total	Water	5.2	ug/l	
DGLC-01	9/18/2012	10:14	Nickel	Total	Water	5.01	ug/l	
DGP-01	8/20/2007	11:40	Nickel	Total	Water	5	ug/l	
DGP-01	9/25/2007	12:20	Nickel	Dissolved	Water	4.9	ug/l	
DGPC-01	9/25/2007	13:40	Nickel	Total	Water	4.9	ug/l	
DGPC-01	9/25/2007	13:40	Nickel	Dissolved	Water	4	ug/l	
DGLC-01	9/18/2012	10:14	Nickel	Dissolved	Water	3.18	ug/l	
DGLC-01	7/10/2012	8:29	Nickel	Total	Water	3.14	ug/l	
DGLC-01	9/26/2007	12:10	Nickel	Total	Water	2.92	ug/l	
DGLC-01	9/26/2007	12:10	Nickel	Dissolved	Water	2.68	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	4/14/2009	11:18	Nickel	Total	Water	2.25	ug/l	9 ft
RLE-1	8/22/2012	10:26	Nickel	Total	Water	2.2	ug/l	9 ft
RLE-1	6/3/2009	12:05	Nickel	Total	Water	2.17	ug/l	9 ft
DGP-01	9/17/2012	10:59	Nickel	Total	Water	2.16	ug/l	
DGP-01	9/17/2012	10:59	Nickel	Dissolved	Water	1.91	ug/l	
DGLC-01	7/10/2012	8:29	Nickel	Dissolved	Water	1.89	ug/l	
RLE-1	7/22/2009	11:10	Nickel	Total	Water	1.75	ug/l	9 ft
RLE-1	6/11/2012	10:53	Nickel	Total	Water	1.62	ug/l	9 ft
RLE-1	10/14/2009	11:10	Nickel	Total	Water	1.58	ug/l	9 ft
RLE-1	7/18/2012	10:06	Nickel	Total	Water	1.25	ug/l	9 ft
RLE-1	8/11/2009	11:10	Nickel	Total	Water	1.21	ug/l	9 ft
RLE-1	4/17/2012	10:33	Nickel	Total	Water	0.79	ug/l	9 ft
DGLC-01	8/12/2002	15:30	NICKEL,Dissolved ug/l	Dissolved	Water	25	ug/l	
DGP-01	8/8/2002	12:45	NICKEL,Dissolved ug/l	Dissolved	Water	25	ug/l	
DGLC-01	6/10/2002	9:00	NICKEL,Dissolved ug/l	Dissolved	Water	25	ug/l	
DGP-01	6/11/2002	9:00	NICKEL,Dissolved ug/l	Dissolved	Water	25	ug/l	
DGO-01	6/11/2002	10:45	NICKEL,Dissolved ug/l	Dissolved	Water	25	ug/l	
DGP-01	9/11/2002	13:00	NICKEL,Dissolved ug/l	Dissolved	Water	25	ug/l	
DGLC-01	9/11/2002	14:30	NICKEL,Dissolved ug/l	Dissolved	Water	25	ug/l	
DGO-01	6/11/2002	10:45	NICKEL,Total ug/l	Total	Water	43	ug/l	
DGLC-01	8/12/2002	15:30	NICKEL,Total ug/l	Total	Water	25	ug/l	
DGP-01	8/8/2002	12:45	NICKEL,Total ug/l	Total	Water	25	ug/l	
DGLC-01	6/10/2002	9:00	NICKEL,Total ug/l	Total	Water	25	ug/l	
DGP-01	6/11/2002	9:00	NICKEL,Total ug/l	Total	Water	25	ug/l	
DGP-01	9/11/2002	13:00	NICKEL,Total ug/l	Total	Water	25	ug/l	
DGLC-01	9/11/2002	14:30	NICKEL,Total ug/l	Total	Water	25	ug/l	
RLE-1	07/23/2003	10:36	Nitrogen, ammonia (NH3) as NH3	Total	Water	2.1	mg/l	17 ft
RLE-1	06/04/2003	10:48	Nitrogen, ammonia (NH3) as NH3	Total	Water	1.2	mg/l	18 ft
RLE-1	10/15/2003	11:10	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.38	mg/l	14 ft
RLE-1	10/15/2003	11:10	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.35	mg/l	1 ft
RLE-1	10/15/2003	11:10	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.35	mg/l	7 ft
RLE-2	10/15/2003	11:45	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.35	mg/l	1 ft
RLE-3	10/15/2003	12:00	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.31	mg/l	1 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	08/07/2003	10:41	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.15	mg/l	11 ft
RLE-3	06/04/2003	12:03	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.1	mg/l	1 ft
RLE-1	06/04/2003	10:48	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.09	mg/l	11 ft
RLE-1	08/07/2003	10:41	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.07	mg/l	1 ft
RLE-1	06/04/2003	10:48	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.07	mg/l	1 ft
RLE-2	06/04/2003	11:37	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.06	mg/l	1 ft
RLE-1	08/07/2003	10:41	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.05	mg/l	7 ft
RLE-2	08/07/2003	11:21	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.05	mg/l	1 ft
RLE-3	07/23/2003	11:48	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.03	mg/l	1 ft
RLE-1	07/23/2003	10:36	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.02	mg/l	1 ft
RLE-3	08/07/2003	11:38	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.02	mg/l	1 ft
RLE-1	07/23/2003	10:36	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.01	mg/l	9 ft
RLE-2	04/15/2003	11:06	Nitrogen, ammonia (NH3) as NH3	Total	Water	0.01	mg/l	1 ft
DGO-01	6/11/2002	10:45	NITROGEN, AMMONIA (NH3),Total mg/l	Total	Water	0.26	mg/l	
DGLC-01	6/10/2002	9:00	NITROGEN, AMMONIA (NH3),Total mg/l	Total	Water	0.08	mg/l	
DGP-01	9/11/2002	13:00	NITROGEN, AMMONIA (NH3),Total mg/l	Total	Water	0.07	mg/l	
DGP-01	8/8/2002	12:45	NITROGEN, AMMONIA (NH3),Total mg/l	Total	Water	0.04	mg/l	
DGP-01	6/11/2002	9:00	NITROGEN, AMMONIA (NH3),Total mg/l	Total	Water	0.04	mg/l	
DGLC-01	9/11/2002	14:30	NITROGEN, AMMONIA (NH3),Total mg/l	Total	Water	0.03	mg/l	
DGLC-01	8/12/2002	15:30	NITROGEN, AMMONIA (NH3),Total mg/l	Total	Water	0.01	mg/l	
RLE-1	8/11/2009	11:25	Nitrogen, ammonia as N	Total	Water	3.39	mg/l	16 ft
RLE-1	7/22/2009	10:59	Nitrogen, ammonia as N	Total	Water	2.52	mg/l	18 ft
DGPC-01	8/20/2007	11:00	Nitrogen, ammonia as N	Total	Water	1.37	mg/l	
RLE-1	6/3/2009	11:40	Nitrogen, ammonia as N	Total	Water	1.24	mg/l	17 ft
RLE-1	8/11/2009	11:00	Nitrogen, ammonia as N	Total	Water	0.547	mg/l	1 ft
DGPC-01	9/25/2007	13:40	Nitrogen, ammonia as N	Total	Water	0.509	mg/l	
RLE-1	6/3/2009	12:05	Nitrogen, ammonia as N	Total	Water	0.485	mg/l	9 ft
RLE-1	8/11/2009	11:10	Nitrogen, ammonia as N	Total	Water	0.3	mg/l	9 ft
RLE-1	10/14/2009	11:10	Nitrogen, ammonia as N	Total	Water	0.263	mg/l	9 ft
RLE-1	6/3/2009	11:30	Nitrogen, ammonia as N	Total	Water	0.194	mg/l	1 ft
RLE-1	10/14/2009	11:20	Nitrogen, ammonia as N	Total	Water	0.194	mg/l	17 ft
RLE-1	7/22/2009	11:10	Nitrogen, ammonia as N	Total	Water	0.189	mg/l	9 ft
DGLC-01	6/18/2007	14:15	Nitrogen, ammonia as N	Total	Water	0.182	mg/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	10/14/2009	11:00	Nitrogen, ammonia as N	Total	Water	0.181	mg/l	1 ft
DGLC-BU-C2	9/5/2007	11:45	Nitrogen, ammonia as N	Total	Water	0.171	mg/l	
DGLC-BU-E1	9/5/2007	11:10	Nitrogen, ammonia as N	Total	Water	0.157	mg/l	
RLE-1	4/14/2009	11:28	Nitrogen, ammonia as N	Total	Water	0.121	mg/l	18 ft
RLE-1	4/14/2009	11:08	Nitrogen, ammonia as N	Total	Water	0.118	mg/l	1 ft
RLE-1	4/14/2009	11:18	Nitrogen, ammonia as N	Total	Water	0.118	mg/l	9 ft
DGLC-BU-C1	9/5/2007	10:00	Nitrogen, ammonia as N	Total	Water	0.116	mg/l	
DGP-01	9/17/2007	10:45	Nitrogen, ammonia as N	Total	Water	0.11	mg/l	
RLE-1	7/22/2009	10:51	Nitrogen, ammonia as N	Total	Water	0.0745	mg/l	1 ft
DGO-01	7/3/2007	12:00	Nitrogen, ammonia as N	Total	Water	0.064	mg/l	
DGP-01	7/16/2007	11:00	Nitrogen, ammonia as N	Total	Water	0.04	mg/l	
RLE-3	07/23/2003	11:48	Nitrogen, Kjeldahl	Total	Sediment	15000	mg/kg	15 ft
RLE-1	07/23/2003	10:36	Nitrogen, Kjeldahl	Total	Sediment	13000	mg/kg	19 ft
RLE-1	7/22/2009	10:51	Nitrogen, Kjeldahl	Total	Sediment	4560	mg/kg	20 ft
RLE-1	7/22/2009	10:59	Nitrogen, Kjeldahl	Total	Water	3.69	mg/l	18 ft
RLE-1	8/11/2009	11:25	Nitrogen, Kjeldahl	Total	Water	3.09	mg/l	16 ft
RLE-1	07/23/2003	10:36	Nitrogen, Kjeldahl	Total	Water	2.82	mg/l	17 ft
DGLC-BU-E1	9/5/2007	11:10	Nitrogen, Kjeldahl	Total	Water	2.74	mg/l	
RLE-1	06/04/2003	10:48	Nitrogen, Kjeldahl	Total	Water	2.2	mg/l	18 ft
RLE-1	6/3/2009	11:40	Nitrogen, Kjeldahl	Total	Water	1.9	mg/l	17 ft
DGLC-01	8/22/2007	9:45	Nitrogen, Kjeldahl	Total	Water	1.85	mg/l	
DGLC-BU-C1	9/5/2007	10:00	Nitrogen, Kjeldahl	Total	Water	1.68	mg/l	
DGLC-BU-C2	9/5/2007	11:45	Nitrogen, Kjeldahl	Total	Water	1.59	mg/l	
RLE-1	7/22/2009	10:51	Nitrogen, Kjeldahl	Total	Water	1.46	mg/l	1 ft
RLE-1	10/15/2003	11:10	Nitrogen, Kjeldahl	Total	Water	1.4	mg/l	1 ft
DGLC-01	9/26/2007	12:10	Nitrogen, Kjeldahl	Total	Water	1.37	mg/l	
RLE-1	08/07/2003	10:41	Nitrogen, Kjeldahl	Total	Water	1.31	mg/l	11 ft
RLE-1	10/15/2003	11:10	Nitrogen, Kjeldahl	Total	Water	1.3	mg/l	14 ft
RLE-1	08/07/2003	10:41	Nitrogen, Kjeldahl	Total	Water	1.29	mg/l	7 ft
RLE-1	7/22/2009	11:10	Nitrogen, Kjeldahl	Total	Water	1.26	mg/l	9 ft
RLE-1	10/15/2003	11:10	Nitrogen, Kjeldahl	Total	Water	1.2	mg/l	7 ft
RLE-3	07/23/2003	11:48	Nitrogen, Kjeldahl	Total	Water	1.19	mg/l	1 ft
RLE-1	6/3/2009	12:05	Nitrogen, Kjeldahl	Total	Water	1.15	mg/l	9 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-2	10/15/2003	11:45	Nitrogen, Kjeldahl	Total	Water	1.1	mg/l	1 ft
RLE-3	10/15/2003	12:00	Nitrogen, Kjeldahl	Total	Water	1.1	mg/l	1 ft
RLE-2	07/23/2003	11:28	Nitrogen, Kjeldahl	Total	Water	1.06	mg/l	1 ft
DGPC-01	9/25/2007	13:40	Nitrogen, Kjeldahl	Total	Water	1.05	mg/l	
RLE-1	06/04/2003	10:48	Nitrogen, Kjeldahl	Total	Water	1	mg/l	11 ft
RLE-2	06/04/2003	11:37	Nitrogen, Kjeldahl	Total	Water	1	mg/l	1 ft
RLE-1	07/23/2003	10:36	Nitrogen, Kjeldahl	Total	Water	0.97	mg/l	1 ft
RLE-1	4/14/2009	11:28	Nitrogen, Kjeldahl	Total	Water	0.957	mg/l	18 ft
RLE-1	07/23/2003	10:36	Nitrogen, Kjeldahl	Total	Water	0.93	mg/l	9 ft
DGP-01	7/18/2007	10:45	Nitrogen, Kjeldahl	Total	Water	0.93	mg/l	
DGO-01	8/20/2007	12:20	Nitrogen, Kjeldahl	Total	Water	0.921	mg/l	
RLE-1	10/14/2009	11:00	Nitrogen, Kjeldahl	Total	Water	0.911	mg/l	1 ft
RLE-2	08/07/2003	11:21	Nitrogen, Kjeldahl	Total	Water	0.89	mg/l	1 ft
RLE-1	4/14/2009	11:18	Nitrogen, Kjeldahl	Total	Water	0.886	mg/l	9 ft
RLE-1	6/3/2009	11:30	Nitrogen, Kjeldahl	Total	Water	0.874	mg/l	1 ft
RLE-1	08/07/2003	10:41	Nitrogen, Kjeldahl	Total	Water	0.84	mg/l	1 ft
RLE-3	08/07/2003	11:38	Nitrogen, Kjeldahl	Total	Water	0.84	mg/l	1 ft
RLE-1	06/04/2003	10:48	Nitrogen, Kjeldahl	Total	Water	0.81	mg/l	1 ft
RLE-3	06/04/2003	12:03	Nitrogen, Kjeldahl	Total	Water	0.81	mg/l	1 ft
DGP-01	8/20/2007	11:40	Nitrogen, Kjeldahl	Total	Water	0.801	mg/l	
RLE-1	10/14/2009	11:20	Nitrogen, Kjeldahl	Total	Water	0.78	mg/l	17 ft
RLE-1	4/14/2009	11:08	Nitrogen, Kjeldahl	Total	Water	0.75	mg/l	1 ft
RLE-1	8/11/2009	11:10	Nitrogen, Kjeldahl	Total	Water	0.703	mg/l	9 ft
DGPC-01	6/12/2007	9:00	Nitrogen, Kjeldahl	Total	Water	0.623	mg/l	
RLE-1	10/14/2009	11:10	Nitrogen, Kjeldahl	Total	Water	0.548	mg/l	9 ft
DGP-01	7/16/2007	11:00	Nitrogen, Kjeldahl	Total	Water	0.516	mg/l	
RLE-1	8/11/2009	11:00	Nitrogen, Kjeldahl	Total	Water	0.503	mg/l	1 ft
DGO-01	7/3/2007	12:00	Nitrogen, Kjeldahl	Total	Water	0.5	mg/l	
DGP-01	7/9/2007	11:20	Nitrogen, Kjeldahl	Total	Water	0.494	mg/l	
DGLC-01	7/16/2007	9:45	Nitrogen, Kjeldahl	Total	Water	0.49	mg/l	
DGP-01	9/17/2007	10:45	Nitrogen, Kjeldahl	Total	Water	0.425	mg/l	
DGLC-01	6/18/2007	14:15	Nitrogen, Kjeldahl	Total	Water	0.36	mg/l	
DGP-01	9/25/2007	10:45	Nitrogen, Kjeldahl	Total	Water	0.343	mg/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGLC-01	6/18/2007	14:15	Nitrogen, Nitrate (NO3) as N	Total	Water	9.65	mg/l	
DGPC-01	6/12/2007	9:00	Nitrogen, Nitrate (NO3) as N	Total	Water	7.05	mg/l	
DGO-01	7/3/2007	12:00	Nitrogen, Nitrate (NO3) as N	Total	Water	6.86	mg/l	
DGP-01	7/18/2007	10:45	Nitrogen, Nitrate (NO3) as N	Total	Water	3.71	mg/l	
DGLC-01	7/16/2007	9:45	Nitrogen, Nitrate (NO3) as N	Total	Water	3.44	mg/l	
DGLC-BU-E1	9/5/2007	11:10	Nitrogen, Nitrate (NO3) as N	Total	Water	1.71	mg/l	
DGLC-BU-C1	9/5/2007	10:00	Nitrogen, Nitrate (NO3) as N	Total	Water	0.607	mg/l	
DGPC-01	9/25/2007	13:40	Nitrogen, Nitrate (NO3) as N	Total	Water	0.272	mg/l	
DGLC-01	9/26/2007	12:10	Nitrogen, Nitrate (NO3) as N	Total	Water	0.239	mg/l	
DGPC-01	8/20/2007	11:00	Nitrogen, Nitrate (NO3) as N	Total	Water	0.214	mg/l	
DGLC-BU-C2	9/5/2007	11:45	Nitrogen, Nitrate (NO3) as N	Total	Water	0.204	mg/l	
DGP-01	8/20/2007	11:40	Nitrogen, Nitrate (NO3) as N	Total	Water	0.154	mg/l	
DGP-01	9/25/2007	12:20	Nitrogen, Nitrate (NO3) as N	Total	Water	0.038	mg/l	
DGO-01	8/20/2007	12:20	Nitrogen, Nitrate (NO3) as N	Total	Water	0.011	mg/l	
DGLC-01	6/18/2007	14:15	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	9.78	mg/l	
DGPC-01	6/12/2007	9:00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	7.11	mg/l	
DGP-01	7/9/2007	11:20	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	6.88	mg/l	
DGO-01	7/3/2007	12:00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	6.87	mg/l	
DGP-01	7/16/2007	11:00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	3.91	mg/l	
DGP-01	7/18/2007	10:45	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	3.75	mg/l	
DGLC-01	7/16/2007	9:45	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	3.44	mg/l	
RLE-1	4/14/2009	11:28	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	2.75	mg/l	18 ft
RLE-1	4/14/2009	11:18	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	2.66	mg/l	9 ft
RLE-1	4/14/2009	11:08	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	2.6	mg/l	1 ft
RLE-1	6/3/2009	11:30	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	2.32	mg/l	1 ft
RLE-1	6/3/2009	12:05	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	2.31	mg/l	9 ft
DGLC-BU-E1	9/5/2007	11:10	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	1.71	mg/l	
RLE-1	6/3/2009	11:40	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	1.22	mg/l	17 ft
RLE-1	06/04/2003	10:48	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.742	mg/l	1 ft
RLE-1	06/04/2003	10:48	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.729	mg/l	11 ft
RLE-2	06/04/2003	11:37	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.722	mg/l	1 ft
RLE-3	06/04/2003	12:03	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.711	mg/l	1 ft
RLE-1	7/22/2009	11:10	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.692	mg/l	9 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	7/22/2009	10:51	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.68	mg/l	1 ft
DGLC-BU-C1	9/5/2007	10:00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.607	mg/l	
DGPC-01	9/25/2007	13:40	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.317	mg/l	
DGPC-01	8/20/2007	11:00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.303	mg/l	
DGP-01	9/17/2007	10:45	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.249	mg/l	
DGLC-01	9/26/2007	12:10	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.239	mg/l	
RLE-1	04/15/2003	10:30	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.209	mg/l	1 ft
DGLC-BU-C2	9/5/2007	11:45	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.204	mg/l	
RLE-1	04/15/2003	10:30	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.203	mg/l	7 ft
RLE-2	04/15/2003	11:06	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.198	mg/l	1 ft
RLE-1	04/15/2003	10:30	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.195	mg/l	11 ft
RLE-3	10/15/2003	12:00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.168	mg/l	1 ft
RLE-1	10/15/2003	11:10	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.166	mg/l	14 ft
RLE-1	10/15/2003	11:10	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.159	mg/l	1 ft
RLE-1	10/15/2003	11:10	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.158	mg/l	7 ft
RLE-2	10/15/2003	11:45	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.158	mg/l	1 ft
DGP-01	8/20/2007	11:40	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.154	mg/l	
RLE-1	8/11/2009	11:10	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.081	mg/l	9 ft
RLE-1	10/14/2009	11:20	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.068	mg/l	17 ft
DGP-01	9/25/2007	10:45	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.063	mg/l	
RLE-1	8/11/2009	11:00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.059	mg/l	1 ft
RLE-1	10/14/2009	11:10	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.058	mg/l	9 ft
RLE-1	10/14/2009	11:00	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.056	mg/l	1 ft
RLE-1	06/04/2003	10:48	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.052	mg/l	18 ft
RLE-1	07/23/2003	10:36	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.044	mg/l	9 ft
RLE-1	07/23/2003	10:36	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.039	mg/l	1 ft
RLE-1	7/22/2009	10:59	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.038	mg/l	18 ft
DGP-01	9/25/2007	12:20	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.038	mg/l	
RLE-1	8/11/2009	11:25	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.024	mg/l	16 ft
RLE-1	08/07/2003	10:41	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.022	mg/l	1 ft
RLE-1	08/07/2003	10:41	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.015	mg/l	7 ft
RLE-3	08/07/2003	11:38	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.015	mg/l	1 ft
RLE-1	08/07/2003	10:41	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.013	mg/l	11 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-2	08/07/2003	11:21	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.011	mg/l	1 ft
DGO-01	8/20/2007	12:20	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	Total	Water	0.011	mg/l	
DGLC-01	6/10/2002	9:00	NITROGEN, NITRITE (NO2) + NITRATE (NO3),Total mg/l	Total	Water	13	mg/l	
DGP-01	6/11/2002	9:00	NITROGEN, NITRITE (NO2) + NITRATE (NO3),Total mg/l	Total	Water	10	mg/l	
DGO-01	6/11/2002	10:45	NITROGEN, NITRITE (NO2) + NITRATE (NO3),Total mg/l	Total	Water	4.8	mg/l	
DGP-01	9/11/2002	13:00	NITROGEN, NITRITE (NO2) + NITRATE (NO3),Total mg/l	Total	Water	1.53	mg/l	
DGLC-01	9/11/2002	14:30	NITROGEN, NITRITE (NO2) + NITRATE (NO3),Total mg/l	Total	Water	0.94	mg/l	
DGP-01	8/8/2002	12:45	NITROGEN, NITRITE (NO2) + NITRATE (NO3),Total mg/l	Total	Water	0.46	mg/l	
DGLC-01	8/12/2002	15:30	NITROGEN, NITRITE (NO2) + NITRATE (NO3),Total mg/l	Total	Water	0.01	mg/l	
DGLC-01	6/18/2007	14:15	Nitrogen, Nitrite (NO2) as N	Total	Water	0.207	mg/l	
DGPC-01	8/20/2007	11:00	Nitrogen, Nitrite (NO2) as N	Total	Water	0.088	mg/l	
DGPC-01	6/12/2007	9:00	Nitrogen, Nitrite (NO2) as N	Total	Water	0.063	mg/l	
DGPC-01	9/25/2007	13:40	Nitrogen, Nitrite (NO2) as N	Total	Water	0.046	mg/l	
DGP-01	7/18/2007	10:45	Nitrogen, Nitrite (NO2) as N	Total	Water	0.042	mg/l	
DGO-01	7/3/2007	12:00	Nitrogen, Nitrite (NO2) as N	Total	Water	0.011	mg/l	
DGLC-01	7/10/2012	8:29	Organic carbon	Total	Water	11.1	mg/l	
DGLC-01	9/18/2012	10:14	Organic carbon	Total	Water	8.05	mg/l	
DGP-01	9/17/2012	10:59	Organic carbon	Total	Water	6.65	mg/l	
DGP-01	5/15/2012	11:29	Organic carbon	Total	Water	2	mg/l	
DGO-01	5/15/2012	10:45	Organic carbon	Total	Water	1.58	mg/l	
DGLC-01	5/14/2012	9:30	Organic carbon	Total	Water	1.55	mg/l	
RLE-1	6/11/2012	10:53	Pentachlorophenol	Total	Water	0.021	ug/l	9 ft
RLE-1	08/07/2003	10:41	pH		Water	9.21	s.u.	1 ft
RLE-2	08/07/2003	11:21	pH		Water	9.21	s.u.	1 ft
RLE-3	08/07/2003	11:38	pH		Water	9.15	s.u.	1 ft
RLE-3	07/23/2003	11:48	pH		Water	8.57	s.u.	1 ft
RLE-2	07/23/2003	11:28	pH		Water	8.56	s.u.	1 ft
DGLC-01	7/10/2012	8:30	pH		Water	8.55	s.u.	
DGLC-BU-C2	9/5/2007	11:45	pH		Water	8.47	s.u.	
DGLC-01	6/18/2007	14:15	pH		Water	8.34	s.u.	
DGO-01	5/15/2012	10:45	pH		Water	8.3	s.u.	
RLE-2	04/15/2003	11:06	pH		Water	8.23	s.u.	1 ft
RLE-1	07/23/2003	10:36	pH		Water	8.22	s.u.	1 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	04/15/2003	10:30	pH		Water	8.2	s.u.	1 ft
RLE-3	04/15/2003	11:20	pH		Water	8.16	s.u.	1 ft
RLE-1	04/15/2003	10:30	pH		Water	8.14	s.u.	7 ft
DGLC-01	9/18/2012	10:15	pH		Water	8.1	s.u.	
DGLC-BU-C1	9/5/2007	10:00	pH		Water	8.03	s.u.	
DGP-01	5/15/2012	11:30	pH		Water	8	s.u.	
DGLC-01	8/22/2007	9:45	pH		Water	7.96	s.u.	
DGP-01	9/17/2012	11:00	pH		Water	7.9	s.u.	
RLE-1	06/04/2003	10:48	pH		Water	7.83	s.u.	1 ft
RLE-2	06/04/2003	11:37	pH		Water	7.83	s.u.	1 ft
RLE-3	06/04/2003	12:03	pH		Water	7.81	s.u.	1 ft
DGO-01	7/3/2007	12:00	pH		Water	7.79	s.u.	
DGLC-01	9/26/2007	12:10	pH		Water	7.77	s.u.	
DGPC-01	6/12/2007	9:00	pH		Water	7.77	s.u.	
DGLC-BU-E1	9/5/2007	11:10	pH		Water	7.72	s.u.	
DGO-01	8/20/2007	12:20	pH		Water	7.72	s.u.	
DGLC-01	7/16/2007	9:45	pH		Water	7.71	s.u.	
RLE-1	04/15/2003	10:30	pH		Water	7.66	s.u.	11 ft
DGPC-01	8/20/2007	11:00	pH		Water	7.65	s.u.	
RLE-1	08/07/2003	10:41	pH		Water	7.63	s.u.	7 ft
DGP-01	7/18/2007	10:45	pH		Water	7.63	s.u.	
DGP-01	8/20/2007	11:40	pH		Water	7.63	s.u.	
DGP-01	9/25/2007	12:20	pH		Water	7.63	s.u.	
DGPC-01	9/25/2007	13:40	pH		Water	7.61	s.u.	
RLE-1	06/04/2003	10:48	pH		Water	7.52	s.u.	11 ft
RLE-3	10/15/2003	12:00	pH		Water	7.51	s.u.	1 ft
RLE-2	10/15/2003	11:45	pH		Water	7.5	s.u.	1 ft
DGLC-01	5/14/2012	9:30	pH		Water	7.5	s.u.	
RLE-1	10/15/2003	11:10	pH		Water	7.45	s.u.	1 ft
RLE-1	10/15/2003	11:10	pH		Water	7.41	s.u.	7 ft
RLE-1	10/15/2003	11:10	pH		Water	7.25	s.u.	14 ft
RLE-1	08/07/2003	10:41	pH		Water	7.07	s.u.	11 ft
RLE-1	07/23/2003	10:36	pH		Water	7.06	s.u.	9 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	06/04/2003	10:48	pH		Water	6.97	s.u.	18 ft
RLE-1	07/23/2003	10:36	pH		Water	6.55	s.u.	17 ft
DGLC-01	9/11/2002	14:30	PH		Water	8.4	s.u.	
DGLC-01	8/12/2002	15:30	PH		Water	7.9	s.u.	
DGP-01	9/11/2002	13:00	PH		Water	7.86	s.u.	
DGP-01	6/11/2002	9:00	PH		Water	7.8	s.u.	
DGP-01	8/8/2002	12:45	PH		Water	7.7	s.u.	
DGO-01	6/11/2002	10:45	PH		Water	7.42	s.u.	
DGLC-01	6/10/2002	9:00	PH		Water	7.4	s.u.	
DGP-01	8/20/2007	11:40	Phenols	Total	Water	74	ug/l	
DGLC-01	9/26/2007	12:10	Phenols	Total	Water	74	ug/l	
DGPC-01	6/12/2007	9:00	Phenols	Total	Water	46	ug/l	
DGPC-01	8/20/2007	11:00	Phenols	Total	Water	46	ug/l	
DGLC-01	8/22/2007	9:45	Phenols	Total	Water	40	ug/l	
DGP-01	7/18/2007	10:45	Phenols	Total	Water	35	ug/l	
DGO-01	5/15/2012	10:45	Phenols	Total	Water	6.46	ug/l	
RLE-1	10/14/2009	11:10	Phenols	Total	Water	5.84	ug/l	9 ft
DGP-01	5/15/2012	11:29	Phenols	Total	Water	5.05	ug/l	
RLE-1	6/3/2009	12:05	Phenols	Total	Water	3.45	ug/l	9 ft
RLE-1	4/17/2012	10:33	Phenols	Total	Water	2.83	ug/l	9 ft
DGLC-01	5/14/2012	9:30	Phenols	Total	Water	2.83	ug/l	
DGLC-01	9/18/2012	10:14	Phenols	Total	Water	2.69	ug/l	
DGP-01	9/17/2012	10:59	Phenols	Total	Water	1.83	ug/l	
DGO-01	6/11/2002	10:45	PHENOLS		Water	38	ug/l	
DGLC-01	6/10/2002	9:00	PHENOLS		Water	10	ug/l	
DGP-01	6/11/2002	9:00	PHENOLS		Water	10	ug/l	
DGLC-01	5/14/2012	9:30	Pheophytin a	Total	Water	1.73	ug/l	1 ft
RLE-1	4/17/2012	10:32	Pheophytin a	Total	Water	0.53	ug/l	3 ft
DGP-01	7/16/2007	11:00	Pheophytin-a	Total	Water	14	ug/l	
DGLC-01	8/22/2007	9:45	Pheophytin-a	Total	Water	12.5	ug/l	
RLE-1	7/22/2009	10:51	Pheophytin-a	Total	Water	6.68	ug/l	4 ft
DGLC-01	9/26/2007	12:10	Pheophytin-a	Total	Water	5.07	ug/l	
DGPC-01	8/20/2007	11:00	Pheophytin-a	Total	Water	3.51	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGO-01	8/20/2007	12:20	Pheophytin-a	Total	Water	1.39	ug/l	
DGPC-01	9/25/2007	13:40	Pheophytin-a	Total	Water	1.1	ug/l	
DGLC-01	9/11/2002	14:30	PHEOPHYTIN-A		Water	2.39	ug/l	
DGLC-01	8/12/2002	15:30	PHEOPHYTIN-A		Water	1.99	ug/l	
DGP-01	8/8/2002	12:45	PHEOPHYTIN-A		Water	1	ug/l	
DGLC-01	6/10/2002	9:00	PHEOPHYTIN-A		Water	1	ug/l	
DGP-01	6/11/2002	9:00	PHEOPHYTIN-A		Water	1	ug/l	
DGO-01	6/11/2002	10:45	PHEOPHYTIN-A		Water	1	ug/l	
DGP-01	9/11/2002	13:00	PHEOPHYTIN-A		Water	1	ug/l	
DGLC-01	7/16/2012	11:35	Phosphorus	Total	Water	1.78	mg/l	
DGLC-01	7/10/2012	8:29	Phosphorus	Total	Water	1.51	mg/l	
DGLC-01	7/10/2012	8:29	Phosphorus	Dissolved	Water	0.858	mg/l	
DGLC-01	9/18/2012	10:14	Phosphorus	Total	Water	0.662	mg/l	
DGLC-01	9/18/2012	8:39	Phosphorus	Total	Water	0.607	mg/l	
DGLC-01	9/18/2012	10:14	Phosphorus	Dissolved	Water	0.447	mg/l	
RLE-1	4/17/2012	10:32	Phosphorus	Total	Water	0.282	mg/l	1 ft
DGO-01	7/17/2012	7:00	Phosphorus	Total	Water	0.142	mg/l	
DGLC-01	5/14/2012	9:30	Phosphorus	Total	Water	0.13	mg/l	
DGP-01	5/15/2012	11:29	Phosphorus	Total	Water	0.13	mg/l	
RLE-1	7/18/2012	10:07	Phosphorus	Total	Water	0.115	mg/l	15 ft
DGP-01	9/18/2012	12:44	Phosphorus	Total	Water	0.104	mg/l	
DGP-01	9/17/2012	10:59	Phosphorus	Total	Water	0.097	mg/l	
DGLC-01	5/14/2012	9:30	Phosphorus	Dissolved	Water	0.095	mg/l	
RLE-1	8/22/2012	10:24	Phosphorus	Total	Water	0.091	mg/l	1 ft
RLE-1	8/22/2012	10:27	Phosphorus	Total	Water	0.091	mg/l	14 ft
RLE-1	6/11/2012	11:00	Phosphorus	Total	Water	0.089	mg/l	16 ft
RLE-1	7/18/2012	10:06	Phosphorus	Total	Water	0.083	mg/l	9 ft
RLE-1	8/22/2012	10:26	Phosphorus	Total	Water	0.081	mg/l	9 ft
RLE-1	4/17/2012	10:35	Phosphorus	Total	Water	0.08	mg/l	15 ft
RLE-1	7/18/2012	10:06	Phosphorus	Total	Water	0.076	mg/l	1 ft
DGP-01	7/17/2012	8:06	Phosphorus	Total	Water	0.076	mg/l	
DGP-01	5/15/2012	11:29	Phosphorus	Dissolved	Water	0.075	mg/l	
RLE-1	4/17/2012	10:32	Phosphorus	Dissolved	Water	0.072	mg/l	1 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	6/11/2012	10:53	Phosphorus	Total	Water	0.065	mg/l	9 ft
RLE-1	4/17/2012	10:33	Phosphorus	Dissolved	Water	0.063	mg/l	9 ft
RLE-1	4/17/2012	10:33	Phosphorus	Total	Water	0.062	mg/l	9 ft
RLE-1	6/11/2012	10:49	Phosphorus	Total	Water	0.057	mg/l	1 ft
DGO-01	5/15/2012	10:45	Phosphorus	Total	Water	0.054	mg/l	
DGP-01	9/17/2012	10:59	Phosphorus	Dissolved	Water	0.053	mg/l	
DGO-01	5/15/2012	10:45	Phosphorus	Dissolved	Water	0.043	mg/l	
RLE-1	7/18/2012	10:06	Phosphorus	Dissolved	Water	0.038	mg/l	9 ft
RLE-1	8/22/2012	10:26	Phosphorus	Dissolved	Water	0.028	mg/l	9 ft
RLE-1	8/22/2012	10:27	Phosphorus	Dissolved	Water	0.028	mg/l	14 ft
RLE-1	8/22/2012	10:24	Phosphorus	Dissolved	Water	0.027	mg/l	1 ft
RLE-1	4/17/2012	10:35	Phosphorus	Dissolved	Water	0.026	mg/l	15 ft
RLE-1	7/18/2012	10:07	Phosphorus	Dissolved	Water	0.024	mg/l	15 ft
RLE-1	7/18/2012	10:06	Phosphorus	Dissolved	Water	0.012	mg/l	1 ft
RLE-1	6/11/2012	10:49	Phosphorus	Dissolved	Water	0.011	mg/l	1 ft
RLE-1	6/11/2012	11:00	Phosphorus	Dissolved	Water	0.011	mg/l	16 ft
RLE-1	6/11/2012	10:53	Phosphorus	Dissolved	Water	0.01	mg/l	9 ft
RLE-1	07/23/2003	10:36	Phosphorus as P	Total	Sediment	1570	mg/kg	19 ft
RLE-1	7/22/2009	10:51	Phosphorus as P	Total	Sediment	846	mg/kg	20 ft
RLE-3	07/23/2003	11:48	Phosphorus as P	Total	Sediment	810	mg/kg	15 ft
RLE-1	7/22/2009	10:59	Phosphorus as P	Total	Water	1.5	mg/l	18 ft
DGLC-BU-E1	9/5/2007	11:10	Phosphorus as P	Total	Water	1.35	mg/l	
DGLC-01	8/22/2007	9:45	Phosphorus as P	Total	Water	1.34	mg/l	
RLE-1	8/11/2009	11:25	Phosphorus as P	Total	Water	1.27	mg/l	16 ft
DGLC-BU-C1	9/5/2007	10:00	Phosphorus as P	Total	Water	1.14	mg/l	
DGLC-01	8/22/2007	9:45	Phosphorus as P	Dissolved	Water	0.797	mg/l	
DGLC-BU-C2	9/5/2007	11:45	Phosphorus as P	Total	Water	0.773	mg/l	
RLE-1	07/23/2003	10:36	Phosphorus as P	Total	Water	0.557	mg/l	17 ft
RLE-1	07/23/2003	10:36	Phosphorus as P	Dissolved	Water	0.452	mg/l	17 ft
DGLC-01	7/16/2007	9:45	Phosphorus as P	Total	Water	0.338	mg/l	
RLE-1	06/04/2003	10:48	Phosphorus as P	Total	Water	0.309	mg/l	18 ft
RLE-1	6/3/2009	11:40	Phosphorus as P	Total	Water	0.307	mg/l	17 ft
DGP-01	7/18/2007	10:45	Phosphorus as P	Total	Water	0.272	mg/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGO-01	8/20/2007	12:20	Phosphorus as P	Total	Water	0.256	mg/l	
DGLC-01	7/16/2007	9:45	Phosphorus as P	Dissolved	Water	0.24	mg/l	
DGPC-01	8/20/2007	11:00	Phosphorus as P	Total	Water	0.229	mg/l	
DGO-01	7/3/2007	12:00	Phosphorus as P	Total	Water	0.207	mg/l	
RLE-1	4/14/2009	11:28	Phosphorus as P	Total	Water	0.197	mg/l	18 ft
DGO-01	7/3/2007	12:00	Phosphorus as P	Dissolved	Water	0.191	mg/l	
RLE-1	6/3/2009	12:05	Phosphorus as P	Total	Water	0.178	mg/l	9 ft
RLE-1	4/14/2009	11:18	Phosphorus as P	Total	Water	0.166	mg/l	9 ft
DGO-01	8/20/2007	12:20	Phosphorus as P	Dissolved	Water	0.166	mg/l	
RLE-1	4/14/2009	11:08	Phosphorus as P	Total	Water	0.158	mg/l	1 ft
RLE-1	6/3/2009	11:30	Phosphorus as P	Dissolved	Water	0.15	mg/l	1 ft
DGLC-01	6/18/2007	14:15	Phosphorus as P	Total	Water	0.145	mg/l	
DGP-01	7/9/2007	11:20	Phosphorus as P	Total	Water	0.141	mg/l	
RLE-1	7/22/2009	10:51	Phosphorus as P	Total	Water	0.139	mg/l	1 ft
RLE-1	6/3/2009	11:30	Phosphorus as P	Total	Water	0.129	mg/l	1 ft
DGLC-01	6/18/2007	14:15	Phosphorus as P	Dissolved	Water	0.126	mg/l	
DGP-01	9/25/2007	10:45	Phosphorus as P	Total	Water	0.126	mg/l	
DGPC-01	8/20/2007	11:00	Phosphorus as P	Dissolved	Water	0.123	mg/l	
DGP-01	8/20/2007	11:40	Phosphorus as P	Total	Water	0.123	mg/l	
RLE-1	8/11/2009	11:25	Phosphorus as P	Dissolved	Water	0.121	mg/l	16 ft
DGP-01	7/18/2007	10:45	Phosphorus as P	Dissolved	Water	0.115	mg/l	
DGP-01	9/17/2007	10:45	Phosphorus as P	Total	Water	0.115	mg/l	
RLE-1	7/22/2009	11:10	Phosphorus as P	Total	Water	0.108	mg/l	9 ft
DGP-01	7/16/2007	11:00	Phosphorus as P	Total	Water	0.097	mg/l	
DGPC-01	6/12/2007	9:00	Phosphorus as P	Total	Water	0.0874	mg/l	
RLE-1	6/3/2009	12:05	Phosphorus as P	Dissolved	Water	0.087	mg/l	9 ft
RLE-1	8/11/2009	11:10	Phosphorus as P	Total	Water	0.086	mg/l	9 ft
RLE-1	08/07/2003	10:41	Phosphorus as P	Total	Water	0.082	mg/l	7 ft
RLE-1	4/14/2009	11:18	Phosphorus as P	Dissolved	Water	0.079	mg/l	9 ft
RLE-1	4/14/2009	11:08	Phosphorus as P	Dissolved	Water	0.078	mg/l	1 ft
RLE-1	4/14/2009	11:28	Phosphorus as P	Dissolved	Water	0.078	mg/l	18 ft
RLE-1	08/07/2003	10:41	Phosphorus as P	Total	Water	0.077	mg/l	11 ft
RLE-1	06/04/2003	10:48	Phosphorus as P	Dissolved	Water	0.077	mg/l	18 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGPC-01	6/12/2007	9:00	Phosphorus as P	Dissolved	Water	0.0758	mg/l	
RLE-3	10/15/2003	12:00	Phosphorus as P	Total	Water	0.073	mg/l	1 ft
RLE-1	7/22/2009	10:59	Phosphorus as P	Dissolved	Water	0.068	mg/l	18 ft
RLE-1	6/3/2009	11:40	Phosphorus as P	Dissolved	Water	0.065	mg/l	17 ft
RLE-1	10/14/2009	11:20	Phosphorus as P	Total	Water	0.064	mg/l	17 ft
RLE-1	07/23/2003	10:36	Phosphorus as P	Total	Water	0.062	mg/l	9 ft
RLE-2	10/15/2003	11:45	Phosphorus as P	Total	Water	0.062	mg/l	1 ft
RLE-2	07/23/2003	11:28	Phosphorus as P	Total	Water	0.062	mg/l	1 ft
RLE-3	07/23/2003	11:48	Phosphorus as P	Total	Water	0.062	mg/l	1 ft
RLE-1	10/14/2009	11:00	Phosphorus as P	Total	Water	0.061	mg/l	1 ft
DGP-01	8/20/2007	11:40	Phosphorus as P	Dissolved	Water	0.061	mg/l	
DGPC-01	9/25/2007	13:40	Phosphorus as P	Total	Water	0.0584	mg/l	
RLE-2	06/04/2003	11:37	Phosphorus as P	Total	Water	0.057	mg/l	1 ft
RLE-1	07/23/2003	10:36	Phosphorus as P	Total	Water	0.056	mg/l	1 ft
RLE-1	10/14/2009	11:10	Phosphorus as P	Total	Water	0.055	mg/l	9 ft
RLE-1	10/15/2003	11:10	Phosphorus as P	Total	Water	0.053	mg/l	1 ft
RLE-1	06/04/2003	10:48	Phosphorus as P	Total	Water	0.053	mg/l	1 ft
RLE-1	10/15/2003	11:10	Phosphorus as P	Total	Water	0.053	mg/l	7 ft
RLE-3	06/04/2003	12:03	Phosphorus as P	Total	Water	0.053	mg/l	1 ft
RLE-1	06/04/2003	10:48	Phosphorus as P	Total	Water	0.051	mg/l	11 ft
RLE-1	10/15/2003	11:10	Phosphorus as P	Total	Water	0.051	mg/l	14 ft
DGP-01	9/25/2007	12:20	Phosphorus as P	Total	Water	0.05	mg/l	
DGPC-01	9/25/2007	13:40	Phosphorus as P	Dissolved	Water	0.0487	mg/l	
RLE-3	08/07/2003	11:38	Phosphorus as P	Total	Water	0.041	mg/l	1 ft
RLE-1	10/14/2009	11:00	Phosphorus as P	Dissolved	Water	0.04	mg/l	1 ft
RLE-1	08/07/2003	10:41	Phosphorus as P	Total	Water	0.039	mg/l	1 ft
RLE-1	8/11/2009	11:00	Phosphorus as P	Total	Water	0.039	mg/l	1 ft
RLE-2	08/07/2003	11:21	Phosphorus as P	Total	Water	0.038	mg/l	1 ft
DGP-01	9/25/2007	12:20	Phosphorus as P	Dissolved	Water	0.0273	mg/l	
RLE-1	7/22/2009	11:10	Phosphorus as P	Dissolved	Water	0.021	mg/l	9 ft
RLE-1	7/22/2009	10:51	Phosphorus as P	Dissolved	Water	0.019	mg/l	1 ft
RLE-1	10/14/2009	11:20	Phosphorus as P	Dissolved	Water	0.019	mg/l	17 ft
RLE-1	8/11/2009	11:10	Phosphorus as P	Dissolved	Water	0.018	mg/l	9 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	10/14/2009	11:10	Phosphorus as P	Dissolved	Water	0.016	mg/l	9 ft
RLE-1	8/11/2009	11:00	Phosphorus as P	Dissolved	Water	0.013	mg/l	1 ft
RLE-1	06/04/2003	10:48	Phosphorus as P	Dissolved	Water	0.011	mg/l	1 ft
RLE-1	06/04/2003	10:48	Phosphorus as P	Dissolved	Water	0.011	mg/l	11 ft
RLE-3	06/04/2003	12:03	Phosphorus as P	Dissolved	Water	0.011	mg/l	1 ft
RLE-1	10/15/2003	11:10	Phosphorus as P	Dissolved	Water	0.01	mg/l	14 ft
RLE-1	07/23/2003	10:36	Phosphorus as P	Dissolved	Water	0.01	mg/l	9 ft
RLE-2	07/23/2003	11:28	Phosphorus as P	Dissolved	Water	0.01	mg/l	1 ft
RLE-2	06/04/2003	11:37	Phosphorus as P	Dissolved	Water	0.01	mg/l	1 ft
RLE-1	07/23/2003	10:36	Phosphorus as P	Dissolved	Water	0.008	mg/l	1 ft
RLE-1	10/15/2003	11:10	Phosphorus as P	Dissolved	Water	0.007	mg/l	7 ft
RLE-3	10/15/2003	12:00	Phosphorus as P	Dissolved	Water	0.007	mg/l	1 ft
RLE-3	07/23/2003	11:48	Phosphorus as P	Dissolved	Water	0.007	mg/l	1 ft
RLE-1	10/15/2003	11:10	Phosphorus as P	Dissolved	Water	0.006	mg/l	1 ft
RLE-2	10/15/2003	11:45	Phosphorus as P	Dissolved	Water	0.006	mg/l	1 ft
RLE-1	08/07/2003	10:41	Phosphorus as P	Dissolved	Water	0.005	mg/l	1 ft
RLE-2	08/07/2003	11:21	Phosphorus as P	Dissolved	Water	0.004	mg/l	1 ft
RLE-1	08/07/2003	10:41	Phosphorus as P	Dissolved	Water	0.003	mg/l	11 ft
RLE-3	08/07/2003	11:38	Phosphorus as P	Dissolved	Water	0.003	mg/l	1 ft
DGLC-01	8/12/2002	15:30	PHOSPHORUS AS P,Dissolved mg/l	Dissolved	Water	0.42	mg/l	
DGO-01	6/11/2002	10:45	PHOSPHORUS AS P,Dissolved mg/l	Dissolved	Water	0.22	mg/l	
DGLC-01	9/11/2002	14:30	PHOSPHORUS AS P,Dissolved mg/l	Dissolved	Water	0.13	mg/l	
DGP-01	6/11/2002	9:00	PHOSPHORUS AS P,Dissolved mg/l	Dissolved	Water	0.08	mg/l	
DGP-01	8/8/2002	12:45	PHOSPHORUS AS P,Dissolved mg/l	Dissolved	Water	0.06	mg/l	
DGLC-01	6/10/2002	9:00	PHOSPHORUS AS P,Dissolved mg/l	Dissolved	Water	0.05	mg/l	
DGP-01	9/11/2002	13:00	PHOSPHORUS AS P,Dissolved mg/l	Dissolved	Water	0.04	mg/l	
DGO-01	6/11/2002	10:45	PHOSPHORUS AS P,Total mg/l	Total	Water	1.76	mg/l	
DGLC-01	8/12/2002	15:30	PHOSPHORUS AS P,Total mg/l	Total	Water	0.65	mg/l	
DGP-01	6/11/2002	9:00	PHOSPHORUS AS P,Total mg/l	Total	Water	0.25	mg/l	
DGLC-01	9/11/2002	14:30	PHOSPHORUS AS P,Total mg/l	Total	Water	0.23	mg/l	
DGLC-01	6/10/2002	9:00	PHOSPHORUS AS P,Total mg/l	Total	Water	0.13	mg/l	
DGP-01	8/8/2002	12:45	PHOSPHORUS AS P,Total mg/l	Total	Water	0.12	mg/l	
DGP-01	9/11/2002	13:00	PHOSPHORUS AS P,Total mg/l	Total	Water	0.08	mg/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	7/18/2012	10:06	Picloram	Total	Water	0.23	ug/l	9 ft
RLE-1	6/11/2012	10:53	Picloram	Total	Water	0.16	ug/l	9 ft
RLE-1	8/22/2012	10:26	Picloram	Total	Water	0.062	ug/l	9 ft
RLE-1	4/17/2012	10:33	Picloram	Total	Water	0.061	ug/l	9 ft
RLE-1	7/22/2009	11:10	Picloram	Total	Water	0.059	ug/l	9 ft
RLE-1	8/11/2009	11:10	Picloram	Total	Water	0.048	ug/l	9 ft
DGLC-BU-E1	9/5/2007	11:10	Potassium	Total	Water	46000	ug/l	
DGLC-BU-C1	9/5/2007	10:00	Potassium	Total	Water	40000	ug/l	
DGLC-BU-C2	9/5/2007	11:45	Potassium	Total	Water	37000	ug/l	
DGLC-01	9/26/2007	12:10	Potassium	Total	Water	29700	ug/l	
DGLC-01	9/26/2007	12:10	Potassium	Dissolved	Water	27800	ug/l	
DGLC-01	9/18/2012	10:14	Potassium	Total	Water	25100	ug/l	
DGLC-01	9/18/2012	10:14	Potassium	Dissolved	Water	24000	ug/l	
DGLC-01	8/22/2007	9:45	Potassium	Total	Water	24000	ug/l	
DGLC-01	8/22/2007	9:45	Potassium	Dissolved	Water	23000	ug/l	
DGLC-01	7/10/2012	8:29	Potassium	Total	Water	13200	ug/l	
DGLC-01	7/10/2012	8:29	Potassium	Dissolved	Water	12400	ug/l	
DGP-01	9/25/2007	12:20	Potassium	Total	Water	7400	ug/l	
DGPC-01	9/25/2007	13:40	Potassium	Total	Water	7100	ug/l	
DGP-01	9/25/2007	12:20	Potassium	Dissolved	Water	7000	ug/l	
DGPC-01	8/20/2007	11:00	Potassium	Total	Water	5900	ug/l	
DGPC-01	9/25/2007	13:40	Potassium	Dissolved	Water	5700	ug/l	
DGPC-01	8/20/2007	11:00	Potassium	Dissolved	Water	5600	ug/l	
DGP-01	8/20/2007	11:40	Potassium	Total	Water	4600	ug/l	
DGP-01	8/20/2007	11:40	Potassium	Dissolved	Water	4400	ug/l	
RLE-1	8/22/2012	10:26	Potassium	Total	Water	4360	ug/l	9 ft
RLE-1	4/14/2009	11:18	Potassium	Total	Water	4330	ug/l	9 ft
DGO-01	8/20/2007	12:20	Potassium	Total	Water	4300	ug/l	
RLE-1	10/14/2009	11:10	Potassium	Total	Water	4180	ug/l	9 ft
DGO-01	8/20/2007	12:20	Potassium	Dissolved	Water	4000	ug/l	
RLE-1	7/18/2012	10:06	Potassium	Total	Water	3940	ug/l	9 ft
RLE-1	6/3/2009	12:05	Potassium	Total	Water	3620	ug/l	9 ft
RLE-1	4/17/2012	10:33	Potassium	Total	Water	3530	ug/l	9 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGP-01	7/18/2007	10:45	Potassium	Total	Water	3400	ug/l	
RLE-1	6/11/2012	10:53	Potassium	Total	Water	3350	ug/l	9 ft
RLE-1	7/22/2009	11:10	Potassium	Total	Water	3210	ug/l	9 ft
RLE-1	8/11/2009	11:10	Potassium	Total	Water	3110	ug/l	9 ft
DGP-01	9/17/2012	10:59	Potassium	Total	Water	2970	ug/l	
DGP-01	9/17/2012	10:59	Potassium	Dissolved	Water	2900	ug/l	
DGLC-01	7/16/2007	9:45	Potassium	Total	Water	2800	ug/l	
RLE-1	7/22/2009	10:51	Potassium	Total	Sediment	2420	mg/kg	20 ft
RLE-1	07/23/2003	10:36	Potassium		Sediment	1800	mg/kg	19 ft
DGP-01	5/15/2012	11:29	Potassium	Total	Water	1700	ug/l	
RLE-3	07/23/2003	11:48	Potassium		Sediment	1500	mg/kg	15 ft
DGP-01	5/15/2012	11:29	Potassium	Dissolved	Water	1390	ug/l	
DGLC-01	5/14/2012	9:30	Potassium	Total	Water	1320	ug/l	
DGLC-01	5/14/2012	9:30	Potassium	Dissolved	Water	899	ug/l	
DGO-01	5/15/2012	10:45	Potassium	Total	Water	803	ug/l	
DGO-01	5/15/2012	10:45	Potassium	Dissolved	Water	686	ug/l	
RLE-1	04/15/2003	10:30	Potassium	Total	Water	4.6	mg/l	7 ft
RLE-1	10/15/2003	11:10	Potassium	Total	Water	4.4	mg/l	7 ft
RLE-1	06/04/2003	10:48	Potassium	Total	Water	4.3	mg/l	11 ft
RLE-1	08/07/2003	10:41	Potassium	Total	Water	3.9	mg/l	7 ft
RLE-1	07/23/2003	10:36	Potassium	Total	Water	3.9	mg/l	9 ft
DGLC-01	6/10/2002	9:00	POTASSIUM,Dissolved mg/l	Dissolved	Water	8.7	mg/l	
DGO-01	6/11/2002	10:45	POTASSIUM,Dissolved mg/l	Dissolved	Water	5.5	mg/l	
DGP-01	8/8/2002	12:45	POTASSIUM,Dissolved mg/l	Dissolved	Water	4.9	mg/l	
DGLC-01	8/12/2002	15:30	POTASSIUM,Dissolved mg/l	Dissolved	Water	3.3	mg/l	
DGLC-01	9/11/2002	14:30	POTASSIUM,Dissolved mg/l	Dissolved	Water	2.6	mg/l	
DGP-01	9/11/2002	13:00	POTASSIUM,Dissolved mg/l	Dissolved	Water	2.5	mg/l	
DGP-01	6/11/2002	9:00	POTASSIUM,Dissolved mg/l	Dissolved	Water	1.8	mg/l	
DGO-01	6/11/2002	10:45	POTASSIUM,Total mg/l	Total	Water	9	mg/l	
DGP-01	8/8/2002	12:45	POTASSIUM,Total mg/l	Total	Water	4.8	mg/l	
DGLC-01	8/12/2002	15:30	POTASSIUM,Total mg/l	Total	Water	3	mg/l	
DGLC-01	9/11/2002	14:30	POTASSIUM,Total mg/l	Total	Water	3	mg/l	
DGP-01	9/11/2002	13:00	POTASSIUM,Total mg/l	Total	Water	2.7	mg/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGP-01	6/11/2002	9:00	POTASSIUM,Total mg/l	Total	Water	1.7	mg/l	
DGLC-01	6/10/2002	9:00	POTASSIUM,Total mg/l	Total	Water	1.4	mg/l	
DGLC-01	9/26/2007	12:10	Silver	Total	Water	5530	ug/l	
DGLC-01	9/26/2007	12:10	Silver	Dissolved	Water	3650	ug/l	
RLE-1	06/04/2003	10:48	Silver	Total	Water	4	ug/l	11 ft
RLE-1	8/11/2009	11:10	Silver	Total	Water	1.08	ug/l	9 ft
DGLC-01	9/18/2012	10:14	Silver	Total	Water	0.89	ug/l	
DGLC-01	9/18/2012	10:14	Silver	Dissolved	Water	0.64	ug/l	
DGLC-01	8/12/2002	15:30	SILVER,Dissolved ug/l	Dissolved	Water	3	ug/l	
DGP-01	8/8/2002	12:45	SILVER,Dissolved ug/l	Dissolved	Water	3	ug/l	
DGLC-01	6/10/2002	9:00	SILVER,Dissolved ug/l	Dissolved	Water	3	ug/l	
DGP-01	6/11/2002	9:00	SILVER,Dissolved ug/l	Dissolved	Water	3	ug/l	
DGO-01	6/11/2002	10:45	SILVER,Dissolved ug/l	Dissolved	Water	3	ug/l	
DGP-01	9/11/2002	13:00	SILVER,Dissolved ug/l	Dissolved	Water	3	ug/l	
DGLC-01	9/11/2002	14:30	SILVER,Dissolved ug/l	Dissolved	Water	3	ug/l	
DGLC-01	8/12/2002	15:30	SILVER,Total ug/l	Total	Water	3	ug/l	
DGP-01	8/8/2002	12:45	SILVER,Total ug/l	Total	Water	3	ug/l	
DGLC-01	6/10/2002	9:00	SILVER,Total ug/l	Total	Water	3	ug/l	
DGP-01	6/11/2002	9:00	SILVER,Total ug/l	Total	Water	3	ug/l	
DGO-01	6/11/2002	10:45	SILVER,Total ug/l	Total	Water	3	ug/l	
DGP-01	9/11/2002	13:00	SILVER,Total ug/l	Total	Water	3	ug/l	
DGLC-01	9/11/2002	14:30	SILVER,Total ug/l	Total	Water	3	ug/l	
DGLC-BU-E1	9/5/2007	11:10	Sodium	Total	Water	1200000	ug/l	
DGLC-BU-C1	9/5/2007	10:00	Sodium	Total	Water	900000	ug/l	
DGLC-BU-C2	9/5/2007	11:45	Sodium	Total	Water	870000	ug/l	
DGLC-01	9/26/2007	12:10	Sodium	Total	Water	732000	ug/l	
DGLC-01	9/18/2012	10:14	Sodium	Total	Water	728000	ug/l	
DGLC-01	9/18/2012	10:14	Sodium	Dissolved	Water	707000	ug/l	
DGLC-01	9/26/2007	12:10	Sodium	Dissolved	Water	693000	ug/l	
DGLC-01	8/22/2007	9:45	Sodium	Total	Water	640000	ug/l	
DGLC-01	8/22/2007	9:45	Sodium	Dissolved	Water	620000	ug/l	
DGLC-01	7/10/2012	8:29	Sodium	Total	Water	161000	ug/l	
DGLC-01	7/10/2012	8:29	Sodium	Dissolved	Water	158000	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGLC-01	7/16/2007	9:45	Sodium	Total	Water	62000	ug/l	
DGLC-01	6/18/2007	14:15	Sodium	Dissolved	Water	28000	ug/l	
DGLC-01	6/18/2007	14:15	Sodium	Total	Water	26000	ug/l	
DGPC-01	9/25/2007	13:40	Sodium	Dissolved	Water	23000	ug/l	
DGPC-01	8/20/2007	11:00	Sodium	Total	Water	21000	ug/l	
DGPC-01	8/20/2007	11:00	Sodium	Dissolved	Water	20000	ug/l	
DGPC-01	9/25/2007	13:40	Sodium	Total	Water	19000	ug/l	
RLE-1	8/22/2012	10:26	Sodium	Total	Water	15700	ug/l	9 ft
DGLC-01	5/14/2012	9:30	Sodium	Total	Water	14300	ug/l	
RLE-1	7/18/2012	10:06	Sodium	Total	Water	14100	ug/l	9 ft
DGO-01	5/15/2012	10:45	Sodium	Total	Water	13100	ug/l	
DGLC-01	5/14/2012	9:30	Sodium	Dissolved	Water	12800	ug/l	
RLE-1	6/11/2012	10:53	Sodium	Total	Water	12600	ug/l	9 ft
RLE-1	10/14/2009	11:10	Sodium	Total	Water	12500	ug/l	9 ft
DGO-01	5/15/2012	10:45	Sodium	Dissolved	Water	12200	ug/l	
DGO-01	7/3/2007	12:00	Sodium	Total	Water	12000	ug/l	
RLE-1	4/14/2009	11:18	Sodium	Total	Water	11900	ug/l	9 ft
RLE-1	4/17/2012	10:33	Sodium	Total	Water	11800	ug/l	9 ft
DGO-01	7/3/2007	12:00	Sodium	Dissolved	Water	11000	ug/l	
DGP-01	8/20/2007	11:40	Sodium	Dissolved	Water	11000	ug/l	
DGP-01	9/25/2007	12:20	Sodium	Dissolved	Water	11000	ug/l	
DGPC-01	6/12/2007	9:00	Sodium	Total	Water	11000	ug/l	
DGO-01	8/20/2007	12:20	Sodium	Total	Water	11000	ug/l	
DGP-01	8/20/2007	11:40	Sodium	Total	Water	11000	ug/l	
RLE-1	8/11/2009	11:10	Sodium	Total	Water	10800	ug/l	9 ft
DGP-01	9/17/2012	10:59	Sodium	Total	Water	10800	ug/l	
DGP-01	9/17/2012	10:59	Sodium	Dissolved	Water	10700	ug/l	
RLE-1	7/22/2009	11:10	Sodium	Total	Water	10500	ug/l	9 ft
DGPC-01	6/12/2007	9:00	Sodium	Dissolved	Water	10000	ug/l	
DGO-01	8/20/2007	12:20	Sodium	Dissolved	Water	10000	ug/l	
DGP-01	9/25/2007	12:20	Sodium	Total	Water	10000	ug/l	
RLE-1	6/3/2009	12:05	Sodium	Total	Water	8970	ug/l	9 ft
DGP-01	5/15/2012	11:29	Sodium	Total	Water	8880	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGP-01	7/18/2007	10:45	Sodium	Total	Water	8600	ug/l	
DGP-01	5/15/2012	11:29	Sodium	Dissolved	Water	8580	ug/l	
RLE-1	06/04/2003	10:48	Sodium	Total	Water	13	mg/l	11 ft
RLE-1	04/15/2003	10:30	Sodium	Total	Water	12	mg/l	7 ft
RLE-1	10/15/2003	11:10	Sodium	Total	Water	12	mg/l	7 ft
RLE-1	08/07/2003	10:41	Sodium	Total	Water	12	mg/l	7 ft
RLE-1	07/23/2003	10:36	Sodium	Total	Water	11	mg/l	9 ft
DGLC-01	8/12/2002	15:30	SODIUM,Dissolved mg/l	Dissolved	Water	74	mg/l	
DGLC-01	9/11/2002	14:30	SODIUM,Dissolved mg/l	Dissolved	Water	56	mg/l	
DGLC-01	6/10/2002	9:00	SODIUM,Dissolved mg/l	Dissolved	Water	18	mg/l	
DGP-01	8/8/2002	12:45	SODIUM,Dissolved mg/l	Dissolved	Water	11	mg/l	
DGP-01	9/11/2002	13:00	SODIUM,Dissolved mg/l	Dissolved	Water	9.5	mg/l	
DGP-01	6/11/2002	9:00	SODIUM,Dissolved mg/l	Dissolved	Water	8.1	mg/l	
DGO-01	6/11/2002	10:45	SODIUM,Dissolved mg/l	Dissolved	Water	4.7	mg/l	
DGLC-01	8/12/2002	15:30	SODIUM,Total mg/l	Total	Water	78	mg/l	
DGLC-01	9/11/2002	14:30	SODIUM,Total mg/l	Total	Water	57	mg/l	
DGP-01	8/8/2002	12:45	SODIUM,Total mg/l	Total	Water	12	mg/l	
DGLC-01	6/10/2002	9:00	SODIUM,Total mg/l	Total	Water	11	mg/l	
DGP-01	9/11/2002	13:00	SODIUM,Total mg/l	Total	Water	9.3	mg/l	
DGP-01	6/11/2002	9:00	SODIUM,Total mg/l	Total	Water	8.1	mg/l	
DGO-01	6/11/2002	10:45	SODIUM,Total mg/l	Total	Water	5.4	mg/l	
RLE-1	4/14/2009	11:08	Solids, Dissolved	Dissolved	Water	216	mg/l	1 ft
RLE-1	4/14/2009	11:18	Solids, Dissolved	Dissolved	Water	200	mg/l	9 ft
RLE-1	7/22/2009	11:10	Solids, Dissolved	Dissolved	Water	188	mg/l	9 ft
RLE-1	6/3/2009	12:05	Solids, Dissolved	Dissolved	Water	182	mg/l	9 ft
RLE-1	4/14/2009	11:28	Solids, Dissolved	Dissolved	Water	182	mg/l	18 ft
RLE-1	10/14/2009	11:10	Solids, Dissolved	Dissolved	Water	178	mg/l	9 ft
RLE-1	8/11/2009	11:10	Solids, Dissolved	Dissolved	Water	148	mg/l	9 ft
RLE-3	07/23/2003	11:48	Solids, Fixed	Non-volatile	Sediment	16.7	%	15 ft
RLE-1	07/23/2003	10:36	Solids, Fixed	Volatile	Sediment	14.5	%	19 ft
RLE-1	07/23/2003	10:36	Solids, Fixed	Non-volatile	Sediment	11.5	%	19 ft
RLE-3	07/23/2003	11:48	Solids, Fixed	Volatile	Sediment	11.3	%	15 ft
DGLC-01	8/12/2002	15:30	SOLIDS, FIXED		Water	503	mg/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGLC-01	9/11/2002	14:30	SOLIDS, FIXED		Water	429	mg/l	
DGP-01	9/11/2002	13:00	SOLIDS, FIXED		Water	344	mg/l	
DGLC-01	6/10/2002	9:00	SOLIDS, FIXED		Water	322	mg/l	
DGP-01	8/8/2002	12:45	SOLIDS, FIXED		Water	315	mg/l	
DGP-01	6/11/2002	9:00	SOLIDS, FIXED		Water	290	mg/l	
DGO-01	6/11/2002	10:45	SOLIDS, FIXED		Water	110	mg/l	
DGO-01	6/11/2002	10:45	SOLIDS, FIXED,Total mg/l	Total	Water	1450	mg/l	
DGP-01	6/11/2002	9:00	SOLIDS, FIXED,Total mg/l	Total	Water	181	mg/l	
DGLC-01	6/10/2002	9:00	SOLIDS, FIXED,Total mg/l	Total	Water	101	mg/l	
DGLC-01	8/12/2002	15:30	SOLIDS, FIXED,Total mg/l	Total	Water	62	mg/l	
DGLC-01	9/11/2002	14:30	SOLIDS, FIXED,Total mg/l	Total	Water	50	mg/l	
DGP-01	8/8/2002	12:45	SOLIDS, FIXED,Total mg/l	Total	Water	18	mg/l	
DGP-01	9/11/2002	13:00	SOLIDS, FIXED,Total mg/l	Total	Water	13	mg/l	
DGO-01	6/11/2002	10:45	SOLIDS, FIXED,Volatile mg/l	Volatile	Water	158	mg/l	
DGP-01	6/11/2002	9:00	SOLIDS, FIXED,Volatile mg/l	Volatile	Water	20	mg/l	
DGLC-01	8/12/2002	15:30	SOLIDS, FIXED,Volatile mg/l	Volatile	Water	12	mg/l	
DGLC-01	9/11/2002	14:30	SOLIDS, FIXED,Volatile mg/l	Volatile	Water	11	mg/l	
DGLC-01	6/10/2002	9:00	SOLIDS, FIXED,Volatile mg/l	Volatile	Water	9	mg/l	
DGP-01	8/8/2002	12:45	SOLIDS, FIXED,Volatile mg/l	Volatile	Water	5	mg/l	
DGP-01	9/11/2002	13:00	SOLIDS, FIXED,Volatile mg/l	Volatile	Water	5	mg/l	
DGLC-01	8/22/2007	9:45	Solids, suspended, volatile		Water	61.5	mg/l	
DGLC-BU-C1	9/5/2007	10:00	Solids, suspended, volatile		Water	43	mg/l	
DGLC-BU-C2	9/5/2007	11:45	Solids, suspended, volatile		Water	42	mg/l	
DGLC-BU-E1	9/5/2007	11:10	Solids, suspended, volatile		Water	29	mg/l	
RLE-1	8/11/2009	11:25	Solids, suspended, volatile		Water	15	mg/l	16 ft
RLE-1	7/22/2009	10:59	Solids, suspended, volatile		Water	13	mg/l	18 ft
RLE-1	7/22/2009	10:51	Solids, suspended, volatile		Water	11	mg/l	1 ft
RLE-1	8/11/2009	11:10	Solids, suspended, volatile		Water	10	mg/l	9 ft
RLE-1	8/11/2009	11:00	Solids, suspended, volatile		Water	9	mg/l	1 ft
RLE-1	4/14/2009	11:28	Solids, suspended, volatile		Water	9	mg/l	18 ft
RLE-1	6/3/2009	11:40	Solids, suspended, volatile		Water	8	mg/l	17 ft
RLE-1	7/22/2009	11:10	Solids, suspended, volatile		Water	7	mg/l	9 ft
DGLC-01	9/26/2007	12:10	Solids, suspended, volatile		Water	7	mg/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	4/14/2009	11:08	Solids, suspended, volatile		Water	6	mg/l	1 ft
RLE-1	4/14/2009	11:18	Solids, suspended, volatile		Water	6	mg/l	9 ft
RLE-1	10/14/2009	11:20	Solids, suspended, volatile		Water	6	mg/l	17 ft
DGO-01	8/20/2007	12:20	Solids, suspended, volatile		Water	6	mg/l	
DGLC-01	6/18/2007	14:15	Solids, suspended, volatile		Water	5.5	mg/l	
RLE-1	10/14/2009	11:00	Solids, suspended, volatile		Water	5	mg/l	1 ft
RLE-1	10/14/2009	11:10	Solids, suspended, volatile		Water	5	mg/l	9 ft
DGP-01	8/20/2007	11:40	Solids, suspended, volatile		Water	5	mg/l	
DGPC-01	8/20/2007	11:00	Solids, suspended, volatile		Water	4.5	mg/l	
DGP-01	9/25/2007	12:20	Solids, suspended, volatile		Water	4.5	mg/l	
RLE-1	6/3/2009	11:30	Solids, suspended, volatile		Water	4	mg/l	1 ft
RLE-1	6/3/2009	12:05	Solids, suspended, volatile		Water	4	mg/l	9 ft
DGPC-01	9/25/2007	13:40	Solids, suspended, volatile		Water	4	mg/l	
DGP-01	7/16/2007	11:00	Solids, suspended, volatile		Water	4	mg/l	
DGLC-01	7/16/2007	9:45	Solids, suspended, volatile		Water	1.5	mg/l	
DGP-01	7/18/2007	10:45	Solids, suspended, volatile		Water	1	mg/l	
DGLC-01	8/22/2007	9:45	Solids, Total Suspended (TSS)		Water	118	mg/l	
DGLC-BU-C1	9/5/2007	10:00	Solids, Total Suspended (TSS)		Water	65	mg/l	
DGLC-BU-C2	9/5/2007	11:45	Solids, Total Suspended (TSS)		Water	62	mg/l	
RLE-1	06/04/2003	10:48	Solids, Total Suspended (TSS)	Non-filterable	Water	61	mg/l	18 ft
DGLC-BU-C2	9/5/2007	11:45	Solids, Total Suspended (TSS)		Water	54	mg/l	
RLE-1	07/23/2003	10:36	Solids, Total Suspended (TSS)	Non-filterable	Water	52	mg/l	17 ft
RLE-1	8/11/2009	11:25	Solids, Total Suspended (TSS)		Water	52	mg/l	16 ft
DGLC-BU-C1	9/5/2007	10:00	Solids, Total Suspended (TSS)		Water	44	mg/l	
RLE-1	7/22/2009	10:59	Solids, Total Suspended (TSS)		Water	42	mg/l	18 ft
DGLC-BU-E1	9/5/2007	11:10	Solids, Total Suspended (TSS)		Water	36	mg/l	
DGLC-BU-E1	9/5/2007	11:10	Solids, Total Suspended (TSS)		Water	35	mg/l	
RLE-1	6/3/2009	11:40	Solids, Total Suspended (TSS)		Water	24	mg/l	17 ft
DGP-01	7/18/2007	10:45	Solids, Total Suspended (TSS)		Water	23	mg/l	
DGLC-01	9/26/2007	12:10	Solids, Total Suspended (TSS)		Water	23	mg/l	
RLE-1	4/14/2009	11:28	Solids, Total Suspended (TSS)		Water	20	mg/l	18 ft
RLE-2	10/15/2003	11:45	Solids, Total Suspended (TSS)	Non-filterable	Water	19	mg/l	1 ft
RLE-3	10/15/2003	12:00	Solids, Total Suspended (TSS)	Non-filterable	Water	19	mg/l	1 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-3	08/07/2003	11:38	Solids, Total Suspended (TSS)	Non-filterable	Water	19	mg/l	1 ft
RLE-1	08/07/2003	10:41	Solids, Total Suspended (TSS)	Non-filterable	Water	18	mg/l	11 ft
DGPC-01	8/20/2007	11:00	Solids, Total Suspended (TSS)		Water	17.5	mg/l	
RLE-1	08/07/2003	10:41	Solids, Total Suspended (TSS)	Non-filterable	Water	17	mg/l	1 ft
RLE-1	10/14/2009	11:20	Solids, Total Suspended (TSS)		Water	17	mg/l	17 ft
RLE-1	10/15/2003	11:10	Solids, Total Suspended (TSS)	Non-filterable	Water	16	mg/l	7 ft
RLE-1	4/14/2009	11:18	Solids, Total Suspended (TSS)		Water	16	mg/l	9 ft
RLE-3	07/23/2003	11:48	Solids, Total Suspended (TSS)	Non-filterable	Water	16	mg/l	1 ft
RLE-1	10/15/2003	11:10	Solids, Total Suspended (TSS)	Non-filterable	Water	15	mg/l	1 ft
RLE-1	06/04/2003	10:48	Solids, Total Suspended (TSS)	Non-filterable	Water	15	mg/l	11 ft
RLE-1	10/15/2003	11:10	Solids, Total Suspended (TSS)	Non-filterable	Water	15	mg/l	14 ft
RLE-1	7/22/2009	11:10	Solids, Total Suspended (TSS)		Water	15	mg/l	9 ft
RLE-3	06/04/2003	12:03	Solids, Total Suspended (TSS)	Non-filterable	Water	15	mg/l	1 ft
RLE-1	7/22/2009	10:51	Solids, Total Suspended (TSS)		Water	14	mg/l	1 ft
RLE-1	8/11/2009	11:10	Solids, Total Suspended (TSS)		Water	14	mg/l	9 ft
RLE-2	08/07/2003	11:21	Solids, Total Suspended (TSS)	Non-filterable	Water	14	mg/l	1 ft
DGO-01	8/20/2007	12:20	Solids, Total Suspended (TSS)		Water	14	mg/l	
RLE-1	08/07/2003	10:41	Solids, Total Suspended (TSS)	Non-filterable	Water	13	mg/l	7 ft
RLE-1	07/23/2003	10:36	Solids, Total Suspended (TSS)	Non-filterable	Water	13	mg/l	9 ft
RLE-1	4/14/2009	11:08	Solids, Total Suspended (TSS)		Water	13	mg/l	1 ft
RLE-1	6/3/2009	12:05	Solids, Total Suspended (TSS)		Water	13	mg/l	9 ft
DGLC-01	6/18/2007	14:15	Solids, Total Suspended (TSS)		Water	13	mg/l	
RLE-1	06/04/2003	10:48	Solids, Total Suspended (TSS)	Non-filterable	Water	11	mg/l	1 ft
RLE-1	10/14/2009	11:00	Solids, Total Suspended (TSS)		Water	11	mg/l	1 ft
RLE-3	04/15/2003	11:20	Solids, Total Suspended (TSS)	Non-filterable	Water	11	mg/l	1 ft
DGP-01	8/20/2007	11:40	Solids, Total Suspended (TSS)		Water	10.5	mg/l	
RLE-1	10/14/2009	11:10	Solids, Total Suspended (TSS)		Water	10	mg/l	9 ft
RLE-2	07/23/2003	11:28	Solids, Total Suspended (TSS)	Non-filterable	Water	10	mg/l	1 ft
RLE-2	06/04/2003	11:37	Solids, Total Suspended (TSS)	Non-filterable	Water	10	mg/l	1 ft
DGP-01	9/17/2007	10:45	Solids, Total Suspended (TSS)		Water	10	mg/l	
RLE-1	04/15/2003	10:30	Solids, Total Suspended (TSS)	Non-filterable	Water	9	mg/l	11 ft
RLE-1	07/23/2003	10:36	Solids, Total Suspended (TSS)	Non-filterable	Water	8	mg/l	1 ft
RLE-1	6/3/2009	11:30	Solids, Total Suspended (TSS)		Water	8	mg/l	1 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	8/11/2009	11:00	Solids, Total Suspended (TSS)		Water	8	mg/l	1 ft
DGP-01	7/16/2007	11:00	Solids, Total Suspended (TSS)		Water	8	mg/l	
DGPC-01	9/25/2007	13:40	Solids, Total Suspended (TSS)		Water	7	mg/l	
DGP-01	9/25/2007	12:20	Solids, Total Suspended (TSS)		Water	6.5	mg/l	
RLE-1	04/15/2003	10:30	Solids, Total Suspended (TSS)	Non-filterable	Water	6	mg/l	1 ft
RLE-2	04/15/2003	11:06	Solids, Total Suspended (TSS)	Non-filterable	Water	6	mg/l	1 ft
DGO-01	7/3/2007	12:00	Solids, Total Suspended (TSS)		Water	6	mg/l	
DGLC-01	7/16/2007	9:45	Solids, Total Suspended (TSS)		Water	4.5	mg/l	
DGP-01	9/25/2007	10:45	Solids, Total Suspended (TSS)		Water	4.5	mg/l	
RLE-1	04/15/2003	10:30	Solids, Total Suspended (TSS)	Non-filterable	Water	4	mg/l	7 ft
RLE-1	08/07/2003	10:41	Solids, Volatile	Filterable	Water	17	mg/l	1 ft
RLE-3	08/07/2003	11:38	Solids, Volatile	Filterable	Water	14	mg/l	1 ft
RLE-1	07/23/2003	10:36	Solids, Volatile	Filterable	Water	13	mg/l	17 ft
RLE-1	06/04/2003	10:48	Solids, Volatile	Filterable	Water	12	mg/l	18 ft
RLE-2	08/07/2003	11:21	Solids, Volatile	Filterable	Water	10	mg/l	1 ft
RLE-3	07/23/2003	11:48	Solids, Volatile	Filterable	Water	9	mg/l	1 ft
RLE-1	07/23/2003	10:36	Solids, Volatile	Filterable	Water	8	mg/l	9 ft
RLE-2	07/23/2003	11:28	Solids, Volatile	Filterable	Water	8	mg/l	1 ft
RLE-1	07/23/2003	10:36	Solids, Volatile	Filterable	Water	6	mg/l	1 ft
RLE-1	06/04/2003	10:48	Solids, Volatile	Filterable	Water	6	mg/l	1 ft
RLE-1	06/04/2003	10:48	Solids, Volatile	Filterable	Water	6	mg/l	11 ft
RLE-2	10/15/2003	11:45	Solids, Volatile	Filterable	Water	6	mg/l	1 ft
RLE-2	06/04/2003	11:37	Solids, Volatile	Filterable	Water	6	mg/l	1 ft
RLE-3	06/04/2003	12:03	Solids, Volatile	Filterable	Water	6	mg/l	1 ft
RLE-1	10/15/2003	11:10	Solids, Volatile	Filterable	Water	5	mg/l	1 ft
RLE-1	04/15/2003	10:30	Solids, Volatile	Filterable	Water	5	mg/l	11 ft
RLE-1	10/15/2003	11:10	Solids, Volatile	Filterable	Water	5	mg/l	14 ft
RLE-1	10/15/2003	11:10	Solids, Volatile	Filterable	Water	4	mg/l	7 ft
RLE-3	10/15/2003	12:00	Solids, Volatile	Filterable	Water	4	mg/l	1 ft
RLE-3	04/15/2003	11:20	Solids, Volatile	Filterable	Water	4	mg/l	1 ft
RLE-1	04/15/2003	10:30	Solids, Volatile	Filterable	Water	3	mg/l	1 ft
RLE-1	04/15/2003	10:30	Solids, Volatile	Filterable	Water	3	mg/l	7 ft
RLE-1	08/07/2003	10:41	Solids, Volatile	Filterable	Water	2	mg/l	11 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	08/07/2003	10:41	Solids, Volatile	Filterable	Water	2	mg/l	7 ft
RLE-2	04/15/2003	11:06	Solids, Volatile	Filterable	Water	2	mg/l	1 ft
DGLC-BU-E1	9/5/2007	11:10	Specific conductance		Water	5220	umho/cm	
DGLC-BU-C1	9/5/2007	10:00	Specific conductance		Water	4800	umho/cm	
DGLC-BU-C2	9/5/2007	11:45	Specific conductance		Water	4700	umho/cm	
DGLC-01	9/26/2007	12:10	Specific conductance		Water	4440	umho/cm	
DGLC-01	9/18/2012	10:15	Specific conductance		Water	4420	umho/cm	
DGLC-01	8/22/2007	9:45	Specific conductance		Water	3760	umho/cm	
DGLC-01	7/10/2012	8:30	Specific conductance		Water	1456	umho/cm	
DGLC-01	7/16/2007	9:45	Specific conductance		Water	854	umho/cm	
DGPC-01	9/25/2007	13:40	Specific conductance		Water	690	umho/cm	
DGPC-01	8/20/2007	11:00	Specific conductance		Water	677	umho/cm	
DGLC-01	6/18/2007	14:15	Specific conductance		Water	643	umho/cm	
DGP-01	8/20/2007	11:40	Specific conductance		Water	590	umho/cm	
DGO-01	8/20/2007	12:20	Specific conductance		Water	561	umho/cm	
DGPC-01	6/12/2007	9:00	Specific conductance		Water	558	umho/cm	
DGLC-01	5/14/2012	9:30	Specific conductance		Water	549	umho/cm	
DGP-01	9/25/2007	12:20	Specific conductance		Water	529	umho/cm	
DGP-01	5/15/2012	11:30	Specific conductance		Water	515	umho/cm	
DGO-01	7/3/2007	12:00	Specific conductance		Water	499	umho/cm	
DGP-01	7/18/2007	10:45	Specific conductance		Water	496	umho/cm	
DGP-01	9/17/2012	11:00	Specific conductance		Water	480	umho/cm	
DGO-01	5/15/2012	10:45	Specific conductance		Water	424	umho/cm	
RLE-1	07/23/2003	10:36	Specific conductance		Water	383	umho/cm	17 ft
RLE-1	06/04/2003	10:48	Specific conductance		Water	330	umho/cm	18 ft
RLE-1	06/04/2003	10:48	Specific conductance		Water	315	umho/cm	1 ft
RLE-1	06/04/2003	10:48	Specific conductance		Water	314	umho/cm	11 ft
RLE-2	06/04/2003	11:37	Specific conductance		Water	314	umho/cm	1 ft
RLE-1	08/07/2003	10:41	Specific conductance		Water	310	umho/cm	11 ft
RLE-3	06/04/2003	12:03	Specific conductance		Water	310	umho/cm	1 ft
RLE-2	04/15/2003	11:06	Specific conductance		Water	277	umho/cm	1 ft
RLE-1	10/15/2003	11:10	Specific conductance		Water	274	umho/cm	14 ft
RLE-2	10/15/2003	11:45	Specific conductance		Water	273	umho/cm	1 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-3	10/15/2003	12:00	Specific conductance		Water	273	umho/cm	1 ft
RLE-1	10/15/2003	11:10	Specific conductance		Water	272	umho/cm	7 ft
RLE-1	10/15/2003	11:10	Specific conductance		Water	271	umho/cm	1 ft
RLE-1	04/15/2003	10:30	Specific conductance		Water	271	umho/cm	1 ft
RLE-3	04/15/2003	11:20	Specific conductance		Water	270	umho/cm	1 ft
RLE-1	04/15/2003	10:30	Specific conductance		Water	269	umho/cm	11 ft
RLE-1	04/15/2003	10:30	Specific conductance		Water	269	umho/cm	7 ft
RLE-1	07/23/2003	10:36	Specific conductance		Water	255	umho/cm	9 ft
RLE-1	08/07/2003	10:41	Specific conductance		Water	254	umho/cm	7 ft
RLE-1	07/23/2003	10:36	Specific conductance		Water	249	umho/cm	1 ft
RLE-2	07/23/2003	11:28	Specific conductance		Water	245	umho/cm	1 ft
RLE-3	07/23/2003	11:48	Specific conductance		Water	245	umho/cm	1 ft
RLE-3	08/07/2003	11:38	Specific conductance		Water	234	umho/cm	1 ft
RLE-2	08/07/2003	11:21	Specific conductance		Water	231	umho/cm	1 ft
RLE-1	08/07/2003	10:41	Specific conductance		Water	230	umho/cm	1 ft
DGLC-BU-E1	9/5/2007	11:10	Strontium	Total	Water	6100	ug/l	
DGLC-BU-C1	9/5/2007	10:00	Strontium	Total	Water	5400	ug/l	
DGLC-BU-C2	9/5/2007	11:45	Strontium	Total	Water	4900	ug/l	
DGLC-01	9/18/2012	10:14	Strontium	Total	Water	3510	ug/l	
DGLC-01	9/18/2012	10:14	Strontium	Dissolved	Water	3430	ug/l	
DGLC-01	8/22/2007	9:45	Strontium	Total	Water	3200	ug/l	
DGLC-01	8/22/2007	9:45	Strontium	Dissolved	Water	2900	ug/l	
DGLC-01	9/26/2007	12:10	Strontium	Dissolved	Water	1000	ug/l	
DGLC-01	9/26/2007	12:10	Strontium	Total	Water	1000	ug/l	
DGLC-01	7/10/2012	8:29	Strontium	Total	Water	933	ug/l	
DGLC-01	7/10/2012	8:29	Strontium	Dissolved	Water	886	ug/l	
DGLC-01	7/16/2007	9:45	Strontium	Total	Water	460	ug/l	
DGPC-01	9/25/2007	13:40	Strontium	Total	Water	290	ug/l	
DGLC-01	6/18/2007	14:15	Strontium	Dissolved	Water	240	ug/l	
DGPC-01	9/25/2007	13:40	Strontium	Dissolved	Water	240	ug/l	
DGLC-01	6/18/2007	14:15	Strontium	Total	Water	240	ug/l	
DGPC-01	8/20/2007	11:00	Strontium	Dissolved	Water	230	ug/l	
DGPC-01	8/20/2007	11:00	Strontium	Total	Water	220	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGO-01	7/3/2007	12:00	Strontium	Dissolved	Water	200	ug/l	
DGP-01	9/17/2012	10:59	Strontium	Total	Water	193	ug/l	
DGP-01	9/17/2012	10:59	Strontium	Dissolved	Water	192	ug/l	
DGO-01	8/20/2007	12:20	Strontium	Dissolved	Water	190	ug/l	
DGO-01	8/20/2007	12:20	Strontium	Total	Water	190	ug/l	
DGP-01	9/25/2007	12:20	Strontium	Total	Water	190	ug/l	
DGP-01	8/20/2007	11:40	Strontium	Dissolved	Water	180	ug/l	
DGO-01	7/3/2007	12:00	Strontium	Total	Water	170	ug/l	
DGP-01	8/20/2007	11:40	Strontium	Total	Water	170	ug/l	
DGLC-01	5/14/2012	9:30	Strontium	Total	Water	163	ug/l	
DGO-01	5/15/2012	10:45	Strontium	Total	Water	161	ug/l	
DGP-01	9/25/2007	12:20	Strontium	Dissolved	Water	160	ug/l	
DGPC-01	6/12/2007	9:00	Strontium	Total	Water	160	ug/l	
DGO-01	5/15/2012	10:45	Strontium	Dissolved	Water	151	ug/l	
DGPC-01	6/12/2007	9:00	Strontium	Dissolved	Water	150	ug/l	
DGLC-01	5/14/2012	9:30	Strontium	Dissolved	Water	147	ug/l	
DGP-01	5/15/2012	11:29	Strontium	Total	Water	146	ug/l	
DGP-01	5/15/2012	11:29	Strontium	Dissolved	Water	141	ug/l	
DGP-01	7/18/2007	10:45	Strontium	Total	Water	140	ug/l	
RLE-1	8/22/2012	10:26	Strontium	Total	Water	121	ug/l	9 ft
RLE-1	6/11/2012	10:53	Strontium	Total	Water	120	ug/l	9 ft
RLE-1	7/18/2012	10:06	Strontium	Total	Water	112	ug/l	9 ft
RLE-1	06/04/2003	10:48	Strontium	Total	Water	110	ug/l	11 ft
RLE-1	10/14/2009	11:10	Strontium	Total	Water	108	ug/l	9 ft
RLE-1	4/17/2012	10:33	Strontium	Total	Water	107	ug/l	9 ft
RLE-1	8/11/2009	11:10	Strontium	Total	Water	103	ug/l	9 ft
RLE-1	04/15/2003	10:30	Strontium	Total	Water	100	ug/l	7 ft
RLE-1	10/15/2003	11:10	Strontium	Total	Water	100	ug/l	7 ft
RLE-1	7/22/2009	11:10	Strontium	Total	Water	99.6	ug/l	9 ft
RLE-1	4/14/2009	11:18	Strontium	Total	Water	93.6	ug/l	9 ft
RLE-1	08/07/2003	10:41	Strontium	Total	Water	92	ug/l	7 ft
RLE-1	6/3/2009	12:05	Strontium	Total	Water	89	ug/l	9 ft
RLE-1	07/23/2003	10:36	Strontium	Total	Water	82	ug/l	9 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGLC-01	6/10/2002	9:00	STRONTIUM,Dissolved ug/l	Dissolved	Water	4800	ug/l	
DGLC-01	8/12/2002	15:30	STRONTIUM,Dissolved ug/l	Dissolved	Water	190	ug/l	
DGLC-01	9/11/2002	14:30	STRONTIUM,Dissolved ug/l	Dissolved	Water	180	ug/l	
DGP-01	9/11/2002	13:00	STRONTIUM,Dissolved ug/l	Dissolved	Water	160	ug/l	
DGP-01	8/8/2002	12:45	STRONTIUM,Dissolved ug/l	Dissolved	Water	150	ug/l	
DGP-01	6/11/2002	9:00	STRONTIUM,Dissolved ug/l	Dissolved	Water	140	ug/l	
DGO-01	6/11/2002	10:45	STRONTIUM,Dissolved ug/l	Dissolved	Water	65	ug/l	
DGLC-01	8/12/2002	15:30	STRONTIUM,Total ug/l	Total	Water	210	ug/l	
DGLC-01	9/11/2002	14:30	STRONTIUM,Total ug/l	Total	Water	180	ug/l	
DGP-01	8/8/2002	12:45	STRONTIUM,Total ug/l	Total	Water	160	ug/l	
DGLC-01	6/10/2002	9:00	STRONTIUM,Total ug/l	Total	Water	160	ug/l	
DGP-01	9/11/2002	13:00	STRONTIUM,Total ug/l	Total	Water	160	ug/l	
DGP-01	6/11/2002	9:00	STRONTIUM,Total ug/l	Total	Water	140	ug/l	
DGO-01	6/11/2002	10:45	STRONTIUM,Total ug/l	Total	Water	120	ug/l	
DGLC-BU-E1	9/5/2007	11:10	Sulfate	Total	Water	1230	mg/l	
DGLC-BU-C1	9/5/2007	10:00	Sulfate	Total	Water	1140	mg/l	
DGLC-BU-C2	9/5/2007	11:45	Sulfate	Total	Water	1090	mg/l	
DGLC-01	9/26/2007	12:10	Sulfate	Total	Water	1090	mg/l	
DGLC-01	9/18/2012	10:14	Sulfate	Total	Water	902	mg/l	
DGLC-01	8/22/2007	9:45	Sulfate	Total	Water	863	mg/l	
DGLC-01	7/10/2012	8:29	Sulfate	Total	Water	185	mg/l	
DGLC-01	7/16/2007	9:45	Sulfate	Total	Water	97.8	mg/l	
DGLC-01	6/18/2007	14:15	Sulfate	Total	Water	60	mg/l	
DGO-01	7/3/2007	12:00	Sulfate	Total	Water	26.9	mg/l	
DGP-01	7/18/2007	10:45	Sulfate	Total	Water	25.1	mg/l	
RLE-1	4/17/2012	10:33	Sulfate	Total	Water	23.3	mg/l	9 ft
DGPC-01	6/12/2007	9:00	Sulfate	Total	Water	22.1	mg/l	
DGO-01	8/20/2007	12:20	Sulfate	Total	Water	16	mg/l	
RLE-1	4/14/2009	11:18	Sulfate	Total	Water	15.9	mg/l	9 ft
DGP-01	8/20/2007	11:40	Sulfate	Total	Water	15.9	mg/l	
DGLC-01	5/14/2012	9:30	Sulfate	Total	Water	14.4	mg/l	
RLE-1	6/11/2012	10:53	Sulfate	Total	Water	13.3	mg/l	9 ft
DGP-01	9/25/2007	12:20	Sulfate	Total	Water	13.1	mg/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	10/14/2009	11:10	Sulfate	Total	Water	11.8	mg/l	9 ft
RLE-1	7/22/2009	11:10	Sulfate	Total	Water	11.5	mg/l	9 ft
RLE-1	8/22/2012	10:26	Sulfate	Total	Water	11.3	mg/l	9 ft
RLE-1	8/11/2009	11:10	Sulfate	Total	Water	11.3	mg/l	9 ft
RLE-1	6/3/2009	12:05	Sulfate	Total	Water	11	mg/l	9 ft
DGO-01	5/15/2012	10:45	Sulfate	Total	Water	10.5	mg/l	
DGP-01	5/15/2012	11:29	Sulfate	Total	Water	9.58	mg/l	
DGPC-01	8/20/2007	11:00	Sulfate	Total	Water	6.94	mg/l	
DGPC-01	9/25/2007	13:40	Sulfate	Total	Water	5.26	mg/l	
RLE-1	7/18/2012	10:06	Sulfate	Total	Water	5.01	mg/l	9 ft
DGLC-01	8/12/2002	15:30	SULFATE		Water	222	mg/l	
DGLC-01	9/11/2002	14:30	SULFATE		Water	80	mg/l	
DGP-01	8/8/2002	12:45	SULFATE		Water	79.9	mg/l	
DGLC-01	6/10/2002	9:00	SULFATE		Water	16.5	mg/l	
DGP-01	9/11/2002	13:00	SULFATE		Water	13.7	mg/l	
DGP-01	6/11/2002	9:00	SULFATE		Water	10.3	mg/l	
DGO-01	6/11/2002	10:45	SULFATE		Water	10	mg/l	
DGP-01	7/18/2007	10:45	Temperature, air		Water	31	deg C	
DGLC-01	8/22/2007	9:45	Temperature, air		Water	30	deg C	
DGLC-BU-E1	9/5/2007	11:10	Temperature, air		Water	30	deg C	
DGO-01	7/3/2007	12:00	Temperature, air		Water	30	deg C	
DGLC-BU-C1	9/5/2007	10:00	Temperature, air		Water	29	deg C	
DGO-01	5/15/2012	10:45	Temperature, air		Water	28	deg C	
DGP-01	5/15/2012	11:30	Temperature, air		Water	28	deg C	
DGLC-01	6/18/2007	14:15	Temperature, air		Water	28	deg C	
DGLC-01	7/10/2012	8:30	Temperature, air		Water	25	deg C	
DGO-01	8/20/2007	12:20	Temperature, air		Water	24	deg C	
DGP-01	8/20/2007	11:40	Temperature, air		Water	24	deg C	
DGP-01	9/25/2007	12:20	Temperature, air		Water	24	deg C	
DGPC-01	6/12/2007	9:00	Temperature, air		Water	24	deg C	
DGPC-01	8/20/2007	11:00	Temperature, air		Water	24	deg C	
DGLC-01	7/16/2007	9:45	Temperature, air		Water	22	deg C	
DGLC-01	5/14/2012	9:30	Temperature, air		Water	21	deg C	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGLC-01	9/26/2007	12:10	Temperature, air		Water	20	deg C	
DGPC-01	9/25/2007	13:40	Temperature, air		Water	20	deg C	
DGP-01	9/17/2012	11:00	Temperature, air		Water	19	deg C	
DGLC-01	9/18/2012	10:15	Temperature, air		Water	14	deg C	
DGLC-01	8/12/2002	15:30	TEMPERATURE, AIR deg C		Water	31	deg C	
DGP-01	8/8/2002	12:45	TEMPERATURE, AIR deg C		Water	28	deg C	
DGLC-01	6/10/2002	9:00	TEMPERATURE, AIR deg C		Water	25	deg C	
DGP-01	9/11/2002	13:00	TEMPERATURE, AIR deg C		Water	24	deg C	
DGLC-01	9/11/2002	14:30	TEMPERATURE, AIR deg C		Water	24	deg C	
DGP-01	6/11/2002	9:00	TEMPERATURE, AIR deg C		Water	22	deg C	
DGO-01	6/11/2002	10:45	TEMPERATURE, AIR deg C		Water	22	deg C	
RLE-1	08/07/2003	10:41	Temperature, sample		Water	15	deg C	7 ft
RLE-1	10/15/2003	11:10	Temperature, sample		Water	14	deg C	7 ft
RLE-1	06/04/2003	10:48	Temperature, sample		Water	10	deg C	11 ft
RLE-1	08/07/2003	10:41	Temperature, sample		Water	8	deg C	1 ft
RLE-1	07/23/2003	10:36	Temperature, sample		Water	8	deg C	1 ft
RLE-1	08/07/2003	10:41	Temperature, sample		Water	8	deg C	11 ft
RLE-1	07/23/2003	10:36	Temperature, sample		Water	8	deg C	17 ft
RLE-1	08/07/2003	10:41	Temperature, sample		Water	8	deg C	7 ft
RLE-1	07/23/2003	10:36	Temperature, sample		Water	8	deg C	9 ft
RLE-1	07/23/2003	10:36	Temperature, sample		Water	8	deg C	9 ft
RLE-2	08/07/2003	11:21	Temperature, sample		Water	8	deg C	1 ft
RLE-2	07/23/2003	11:28	Temperature, sample		Water	8	deg C	1 ft
RLE-3	08/07/2003	11:38	Temperature, sample		Water	8	deg C	1 ft
RLE-3	07/23/2003	11:48	Temperature, sample		Water	8	deg C	1 ft
RLE-1	04/15/2003	10:30	Temperature, sample		Water	7	deg C	427 ft
RLE-1	8/11/2009	11:00	Temperature, sample		Water	6	deg C	1 ft
RLE-1	8/11/2009	11:10	Temperature, sample		Water	6	deg C	9 ft
RLE-1	8/11/2009	11:25	Temperature, sample		Water	6	deg C	16 ft
DGLC-01	5/14/2012	9:30	Temperature, sample		Water	6	deg C	
DGLC-01	7/10/2012	8:29	Temperature, sample		Water	6	deg C	
DGP-01	7/16/2007	11:00	Temperature, sample		Water	6	deg C	
DGP-01	7/16/2007	11:00	Temperature, sample		Water	6	deg C	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGP-01	7/18/2007	10:45	Temperature, sample		Water	6	deg C	
DGLC-01	7/16/2007	9:45	Temperature, sample		Water	6	deg C	
RLE-1	6/3/2009	11:30	Temperature, sample		Water	5	deg C	1 ft
RLE-1	6/3/2009	12:05	Temperature, sample		Water	5	deg C	9 ft
RLE-1	6/3/2009	11:40	Temperature, sample		Water	5	deg C	17 ft
DGPC-01	6/12/2007	9:00	Temperature, sample		Water	5	deg C	
DGPC-01	6/12/2007	9:00	Temperature, sample		Water	5	deg C	
DGO-01	7/3/2007	12:00	Temperature, sample		Water	5	deg C	
DGO-01	7/3/2007	12:00	Temperature, sample		Water	5	deg C	
DGPC-01	8/20/2007	11:00	Temperature, sample		Water	5	deg C	
DGPC-01	8/20/2007	11:00	Temperature, sample		Water	5	deg C	
DGLC-01	8/22/2007	9:45	Temperature, sample		Water	4.7	deg C	
RLE-1	10/15/2003	11:10	Temperature, sample		Water	4	deg C	1 ft
RLE-1	04/15/2003	10:30	Temperature, sample		Water	4	deg C	1 ft
RLE-1	04/15/2003	10:30	Temperature, sample		Water	4	deg C	11 ft
RLE-1	10/15/2003	11:10	Temperature, sample		Water	4	deg C	14 ft
RLE-1	10/15/2003	11:10	Temperature, sample		Water	4	deg C	7 ft
RLE-1	04/15/2003	10:30	Temperature, sample		Water	4	deg C	7 ft
RLE-1	7/22/2009	10:51	Temperature, sample		Water	4	deg C	1 ft
RLE-1	7/22/2009	11:10	Temperature, sample		Water	4	deg C	9 ft
RLE-1	7/22/2009	10:59	Temperature, sample		Water	4	deg C	18 ft
RLE-2	10/15/2003	11:45	Temperature, sample		Water	4	deg C	1 ft
RLE-2	04/15/2003	11:06	Temperature, sample		Water	4	deg C	1 ft
RLE-3	10/15/2003	12:00	Temperature, sample		Water	4	deg C	1 ft
RLE-3	04/15/2003	11:20	Temperature, sample		Water	4	deg C	1 ft
DGP-01	5/15/2012	11:29	Temperature, sample		Water	4	deg C	
DGO-01	5/15/2012	10:45	Temperature, sample		Water	4	deg C	
DGP-01	9/17/2012	10:59	Temperature, sample		Water	4	deg C	
DGLC-01	6/18/2007	14:15	Temperature, sample		Water	4	deg C	
DGLC-01	6/18/2007	14:15	Temperature, sample		Water	4	deg C	
DGO-01	8/20/2007	12:20	Temperature, sample		Water	4	deg C	
DGO-01	8/20/2007	12:20	Temperature, sample		Water	4	deg C	
DGP-01	8/20/2007	11:40	Temperature, sample		Water	4	deg C	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGP-01	8/20/2007	11:40	Temperature, sample		Water	4	deg C	
DGLC-BU-E1	9/5/2007	11:10	Temperature, sample		Water	4	deg C	
DGLC-BU-C1	9/5/2007	10:00	Temperature, sample		Water	4	deg C	
DGLC-BU-C2	9/5/2007	11:45	Temperature, sample		Water	4	deg C	
DGP-01	9/17/2007	10:45	Temperature, sample		Water	4	deg C	
DGLC-01	9/26/2007	12:10	Temperature, sample		Water	3.6	deg C	
DGPC-01	6/12/2007	9:00	Temperature, sample		Water	3.4	deg C	
RLE-1	4/14/2009	11:08	Temperature, sample		Water	3	deg C	1 ft
RLE-1	10/14/2009	11:00	Temperature, sample		Water	3	deg C	1 ft
RLE-1	4/14/2009	11:18	Temperature, sample		Water	3	deg C	9 ft
RLE-1	10/14/2009	11:10	Temperature, sample		Water	3	deg C	9 ft
RLE-1	10/14/2009	11:20	Temperature, sample		Water	3	deg C	17 ft
RLE-1	4/14/2009	11:28	Temperature, sample		Water	3	deg C	18 ft
DGP-01	7/17/2012	8:06	Temperature, sample		Water	3	deg C	
DGO-01	7/17/2012	7:00	Temperature, sample		Water	3	deg C	
DGLC-01	7/16/2012	11:35	Temperature, sample		Water	3	deg C	
DGP-01	7/9/2007	11:20	Temperature, sample		Water	3	deg C	
DGP-01	9/17/2007	10:45	Temperature, sample		Water	3	deg C	
DGP-01	9/25/2007	10:45	Temperature, sample		Water	3	deg C	
DGP-01	7/18/2007	10:45	Temperature, sample		Water	2.8	deg C	
DGLC-01	7/16/2007	9:45	Temperature, sample		Water	2.8	deg C	
DGLC-BU-C1	9/5/2007	10:00	Temperature, sample		Water	2.5	deg C	
DGLC-BU-E1	9/5/2007	11:10	Temperature, sample		Water	2.5	deg C	
DGLC-BU-C2	9/5/2007	11:45	Temperature, sample		Water	2.5	deg C	
DGP-01	9/25/2007	10:45	Temperature, sample		Water	2.5	deg C	
DGPC-01	8/20/2007	11:00	Temperature, sample		Water	2.1	deg C	
DGO-01	8/20/2007	12:20	Temperature, sample		Water	2.1	deg C	
DGP-01	8/20/2007	11:40	Temperature, sample		Water	2.1	deg C	
RLE-1	06/04/2003	10:48	Temperature, sample		Water	2	deg C	1 ft
RLE-1	06/04/2003	10:48	Temperature, sample		Water	2	deg C	11 ft
RLE-1	06/04/2003	10:48	Temperature, sample		Water	2	deg C	18 ft
RLE-1	4/17/2012	10:32	Temperature, sample		Water	2	deg C	
RLE-1	4/17/2012	10:33	Temperature, sample		Water	2	deg C	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	4/17/2012	10:35	Temperature, sample		Water	2	deg C	
RLE-1	6/11/2012	10:49	Temperature, sample		Water	2	deg C	
RLE-1	6/11/2012	10:53	Temperature, sample		Water	2	deg C	
RLE-1	6/11/2012	11:00	Temperature, sample		Water	2	deg C	
RLE-1	7/18/2012	10:06	Temperature, sample		Water	2	deg C	
RLE-1	7/18/2012	10:07	Temperature, sample		Water	2	deg C	
RLE-1	7/18/2012	10:06	Temperature, sample		Water	2	deg C	
RLE-1	8/22/2012	10:24	Temperature, sample		Water	2	deg C	
RLE-1	8/22/2012	10:26	Temperature, sample		Water	2	deg C	
RLE-1	8/22/2012	10:27	Temperature, sample		Water	2	deg C	
RLE-2	06/04/2003	11:37	Temperature, sample		Water	2	deg C	1 ft
RLE-3	06/04/2003	12:03	Temperature, sample		Water	2	deg C	1 ft
DGP-01	7/16/2007	11:00	Temperature, sample		Water	2	deg C	
DGLC-01	6/18/2007	14:15	Temperature, sample		Water	1.8	deg C	
DGP-01	9/25/2007	12:20	Temperature, sample		Water	1.8	deg C	
DGPC-01	9/25/2007	13:40	Temperature, sample		Water	1.8	deg C	
DGLC-01	9/18/2012	10:14	Temperature, sample		Water	1	deg C	
DGO-01	7/3/2007	12:00	Temperature, sample		Water	0.5	deg C	
RLE-1	4/14/2009	11:08	Temperature, sample		Water	0	deg C	2 ft
RLE-1	6/3/2009	11:30	Temperature, sample		Water	0	deg C	4 ft
RLE-1	7/22/2009	10:51	Temperature, sample		Sediment	0	deg C	20 ft
DGLC-01	9/18/2012	8:39	Temperature, sample		Water	0	deg C	
DGP-01	9/18/2012	12:44	Temperature, sample		Water	0	deg C	
DGP-01	9/11/2002	13:00	TEMPERATURE, SAMPLE deg C		Water	6	deg C	
DGLC-01	6/10/2002	9:00	TEMPERATURE, SAMPLE deg C		Water	5	deg C	
DGP-01	6/11/2002	9:00	TEMPERATURE, SAMPLE deg C		Water	5	deg C	
DGO-01	6/11/2002	10:45	TEMPERATURE, SAMPLE deg C		Water	5	deg C	
DGP-01	8/8/2002	12:45	TEMPERATURE, SAMPLE deg C		Water	4	deg C	
DGLC-01	9/11/2002	14:30	TEMPERATURE, SAMPLE deg C		Water	4	deg C	
DGLC-01	8/12/2002	15:30	TEMPERATURE, SAMPLE deg C		Water	2	deg C	
DGLC-01	8/22/2007	9:45	Temperature, water		Water	27.68	deg C	
DGLC-01	6/18/2007	14:15	Temperature, water		Water	26	deg C	
DGLC-BU-C2	9/5/2007	11:45	Temperature, water		Water	25.85	deg C	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGLC-BU-E1	9/5/2007	11:10	Temperature, water		Water	25.74	deg C	
DGLC-01	7/10/2012	8:30	Temperature, water		Water	24.87	deg C	
DGP-01	8/20/2007	11:40	Temperature, water		Water	23.96	deg C	
DGPC-01	8/20/2007	11:00	Temperature, water		Water	23.8	deg C	
DGO-01	8/20/2007	12:20	Temperature, water		Water	23.73	deg C	
DGP-01	7/18/2007	10:45	Temperature, water		Water	23.25	deg C	
DGLC-01	7/16/2007	9:45	Temperature, water		Water	22.79	deg C	
DGLC-BU-C1	9/5/2007	10:00	Temperature, water		Water	22.68	deg C	
DGP-01	9/25/2007	12:20	Temperature, water		Water	22.39	deg C	
DGLC-01	9/26/2007	12:10	Temperature, water		Water	22.36	deg C	
DGPC-01	9/25/2007	13:40	Temperature, water		Water	20.71	deg C	
DGO-01	7/3/2007	12:00	Temperature, water		Water	20.39	deg C	
DGPC-01	6/12/2007	9:00	Temperature, water		Water	20.32	deg C	
DGP-01	9/17/2012	11:00	Temperature, water		Water	17.3	deg C	
DGP-01	5/15/2012	11:30	Temperature, water		Water	16.9	deg C	
DGLC-01	9/18/2012	10:15	Temperature, water		Water	15.9	deg C	
DGO-01	5/15/2012	10:45	Temperature, water		Water	15.9	deg C	
DGLC-01	5/14/2012	9:30	Temperature, water		Water	14	deg C	
DGLC-01	8/12/2002	15:30	TEMPERATURE, WATER deg C		Water	30.5	deg C	
DGLC-01	9/11/2002	14:30	TEMPERATURE, WATER deg C		Water	26.1	deg C	
DGP-01	8/8/2002	12:45	TEMPERATURE, WATER deg C		Water	22.4	deg C	
DGP-01	6/11/2002	9:00	TEMPERATURE, WATER deg C		Water	21.4	deg C	
DGP-01	9/11/2002	13:00	TEMPERATURE, WATER deg C		Water	21.1	deg C	
DGO-01	6/11/2002	10:45	TEMPERATURE, WATER deg C		Water	19.8	deg C	
DGLC-01	6/10/2002	9:00	TEMPERATURE, WATER deg C		Water	18.7	deg C	
RLE-1	6/11/2012	10:53	Total dissolved solids		Water	202	mg/l	9 ft
RLE-1	7/18/2012	10:06	Total dissolved solids		Water	188	mg/l	9 ft
RLE-1	4/17/2012	10:33	Total dissolved solids		Water	116	mg/l	9 ft
RLE-1	8/22/2012	10:26	Total dissolved solids		Water	80	mg/l	9 ft
RLE-1	7/22/2009	10:51	Total fixed solids		Sediment	89.2	%	20 ft
RLE-1	7/22/2009	10:51	Total solids		Sediment	33.3	%	20 ft
RLE-1	6/11/2012	10:53	Total suspended solids		Water	161	mg/l	9 ft
DGLC-01	7/16/2012	11:35	Total suspended solids		Water	86	mg/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	4/17/2012	10:35	Total suspended solids		Water	45	mg/l	15 ft
DGLC-01	7/10/2012	8:29	Total suspended solids		Water	45	mg/l	
DGLC-01	9/18/2012	10:14	Total suspended solids		Water	44	mg/l	
RLE-1	8/22/2012	10:27	Total suspended solids		Water	36	mg/l	14 ft
RLE-1	6/11/2012	11:00	Total suspended solids		Water	33	mg/l	16 ft
DGLC-01	5/14/2012	9:30	Total suspended solids		Water	32	mg/l	
DGP-01	5/15/2012	11:29	Total suspended solids		Water	32	mg/l	
RLE-1	7/18/2012	10:07	Total suspended solids		Water	31	mg/l	15 ft
RLE-1	8/22/2012	10:24	Total suspended solids		Water	26	mg/l	1 ft
RLE-1	7/18/2012	10:06	Total suspended solids		Water	26	mg/l	9 ft
RLE-1	8/22/2012	10:26	Total suspended solids		Water	26	mg/l	9 ft
DGLC-01	9/18/2012	8:39	Total suspended solids		Water	26	mg/l	
RLE-1	7/18/2012	10:06	Total suspended solids		Water	23	mg/l	1 ft
RLE-1	4/17/2012	10:32	Total suspended solids		Water	19	mg/l	1 ft
RLE-1	6/11/2012	10:49	Total suspended solids		Water	18	mg/l	1 ft
RLE-1	4/17/2012	10:33	Total suspended solids		Water	16	mg/l	9 ft
DGP-01	9/17/2012	10:59	Total suspended solids		Water	15	mg/l	
DGO-01	7/17/2012	7:00	Total suspended solids		Water	11	mg/l	
DGP-01	9/18/2012	12:44	Total suspended solids		Water	11	mg/l	
DGP-01	7/17/2012	8:06	Total suspended solids		Water	8	mg/l	
RLE-1	7/22/2009	10:51	Total volatile solids		Sediment	10.8	%	20 ft
DGLC-01	8/22/2007	9:45	Turbidity		Water	74	NTU	
DGLC-01	9/18/2012	10:15	Turbidity		Water	45	NTU	
DGLC-01	7/10/2012	8:30	Turbidity		Water	33	NTU	
DGLC-01	5/14/2012	9:30	Turbidity		Water	28	NTU	
DGP-01	7/18/2007	10:45	Turbidity		Water	27	NTU	
DGP-01	5/15/2012	11:30	Turbidity		Water	26	NTU	
DGLC-01	9/26/2007	12:10	Turbidity		Water	23	NTU	
DGP-01	8/20/2007	11:40	Turbidity		Water	15.8	NTU	
DGPC-01	8/20/2007	11:00	Turbidity		Water	14.5	NTU	
DGO-01	8/20/2007	12:20	Turbidity		Water	12.7	NTU	
DGPC-01	9/25/2007	13:40	Turbidity		Water	11	NTU	
DGP-01	9/17/2012	11:00	Turbidity		Water	10.5	NTU	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGLC-01	6/18/2007	14:15	Turbidity		Water	9.9	NTU	
DGO-01	5/15/2012	10:45	Turbidity		Water	7.5	NTU	
DGP-01	9/25/2007	12:20	Turbidity		Water	7.2	NTU	
DGO-01	7/3/2007	12:00	Turbidity		Water	6.8	NTU	
DGPC-01	6/12/2007	9:00	Turbidity		Water	6.3	NTU	
DGLC-01	7/16/2007	9:45	Turbidity		Water	5	NTU	
DGO-01	6/11/2002	10:45	TURBIDITY NTU		Water	835	NTU	
DGP-01	6/11/2002	9:00	TURBIDITY NTU		Water	90	NTU	
DGLC-01	8/12/2002	15:30	TURBIDITY NTU		Water	51.1	NTU	
DGLC-01	9/11/2002	14:30	TURBIDITY NTU		Water	44	NTU	
DGLC-01	6/10/2002	9:00	TURBIDITY NTU		Water	34	NTU	
DGP-01	8/8/2002	12:45	TURBIDITY NTU		Water	15	NTU	
DGP-01	9/11/2002	13:00	TURBIDITY NTU		Water	8.2	NTU	
DGLC-01	8/22/2007	9:45	Vanadium	Total	Water	10	ug/l	
DGLC-BU-C2	9/5/2007	11:45	Vanadium	Total	Water	8	ug/l	
DGLC-01	8/22/2007	9:45	Vanadium	Dissolved	Water	7.4	ug/l	
DGLC-01	9/18/2012	10:14	Vanadium	Total	Water	6.06	ug/l	
RLE-1	6/3/2009	12:05	Vanadium	Total	Water	4.79	ug/l	9 ft
DGLC-01	7/16/2007	9:45	Vanadium	Total	Water	4.5	ug/l	
DGPC-01	8/20/2007	11:00	Vanadium	Total	Water	3.8	ug/l	
DGO-01	7/3/2007	12:00	Vanadium	Total	Water	3.1	ug/l	
DGLC-01	9/18/2012	10:14	Vanadium	Dissolved	Water	2.93	ug/l	
RLE-1	7/22/2009	11:10	Vanadium	Total	Water	2.62	ug/l	9 ft
RLE-1	8/22/2012	10:26	Vanadium	Total	Water	1.96	ug/l	9 ft
RLE-1	6/11/2012	10:53	Vanadium	Total	Water	1.36	ug/l	9 ft
RLE-1	10/14/2009	11:10	Vanadium	Total	Water	1.15	ug/l	9 ft
DGP-01	9/17/2012	10:59	Vanadium	Total	Water	0.98	ug/l	
RLE-1	8/11/2009	11:10	Vanadium	Total	Water	0.77	ug/l	9 ft
DGP-01	9/17/2012	10:59	Vanadium	Dissolved	Water	0.31	ug/l	
DGLC-01	8/12/2002	15:30	VANADIUM,Dissolved ug/l	Dissolved	Water	7	ug/l	
DGP-01	8/8/2002	12:45	VANADIUM,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGLC-01	6/10/2002	9:00	VANADIUM,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGP-01	6/11/2002	9:00	VANADIUM,Dissolved ug/l	Dissolved	Water	5	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
DGO-01	6/11/2002	10:45	VANADIUM,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGP-01	9/11/2002	13:00	VANADIUM,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGLC-01	9/11/2002	14:30	VANADIUM,Dissolved ug/l	Dissolved	Water	5	ug/l	
DGO-01	6/11/2002	10:45	VANADIUM,Total ug/l	Total	Water	57	ug/l	
DGLC-01	8/12/2002	15:30	VANADIUM,Total ug/l	Total	Water	7	ug/l	
DGP-01	8/8/2002	12:45	VANADIUM,Total ug/l	Total	Water	5	ug/l	
DGLC-01	6/10/2002	9:00	VANADIUM,Total ug/l	Total	Water	5	ug/l	
DGP-01	6/11/2002	9:00	VANADIUM,Total ug/l	Total	Water	5	ug/l	
DGP-01	9/11/2002	13:00	VANADIUM,Total ug/l	Total	Water	5	ug/l	
DGLC-01	9/11/2002	14:30	VANADIUM,Total ug/l	Total	Water	5	ug/l	
DGLC-01	7/16/2012	11:35	Volatile suspended solids		Water	47	mg/l	
RLE-1	6/11/2012	10:53	Volatile suspended solids		Water	29	mg/l	9 ft
DGLC-01	7/10/2012	8:29	Volatile suspended solids		Water	28	mg/l	
RLE-1	6/11/2012	11:00	Volatile suspended solids		Water	16	mg/l	16 ft
DGLC-01	9/18/2012	10:14	Volatile suspended solids		Water	15	mg/l	
RLE-1	6/11/2012	10:49	Volatile suspended solids		Water	13	mg/l	1 ft
DGLC-01	9/18/2012	8:39	Volatile suspended solids		Water	12	mg/l	
RLE-1	7/18/2012	10:06	Volatile suspended solids		Water	11	mg/l	1 ft
RLE-1	4/17/2012	10:35	Volatile suspended solids		Water	10	mg/l	15 ft
RLE-1	7/18/2012	10:07	Volatile suspended solids		Water	9	mg/l	15 ft
RLE-1	7/18/2012	10:06	Volatile suspended solids		Water	8	mg/l	9 ft
RLE-1	8/22/2012	10:27	Volatile suspended solids		Water	8	mg/l	14 ft
DGLC-01	5/14/2012	9:30	Volatile suspended solids		Water	8	mg/l	
RLE-1	8/22/2012	10:24	Volatile suspended solids		Water	7	mg/l	1 ft
RLE-1	4/17/2012	10:33	Volatile suspended solids		Water	7	mg/l	9 ft
DGP-01	9/17/2012	10:59	Volatile suspended solids		Water	7	mg/l	
DGP-01	9/18/2012	12:44	Volatile suspended solids		Water	7	mg/l	
RLE-1	4/17/2012	10:32	Volatile suspended solids		Water	6	mg/l	1 ft
RLE-1	8/22/2012	10:26	Volatile suspended solids		Water	6	mg/l	9 ft
DGP-01	5/15/2012	11:29	Volatile suspended solids		Water	6	mg/l	
DGO-01	7/17/2012	7:00	Volatile suspended solids		Water	6	mg/l	
DGP-01	7/17/2012	8:06	Volatile suspended solids		Water	5	mg/l	
RLE-1	7/22/2009	11:10	Zinc	Total	Water	285	ug/l	9 ft

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	7/22/2009	10:51	Zinc	Total	Sediment	104	mg/kg	20 ft
RLE-1	07/23/2003	10:36	Zinc	Total	Sediment	89	mg/kg	19 ft
RLE-3	07/23/2003	11:48	Zinc	Total	Sediment	79	mg/kg	15 ft
RLE-1	10/14/2009	11:10	Zinc	Total	Water	36.8	ug/l	9 ft
DGLC-01	8/22/2007	9:45	Zinc	Total	Water	12	ug/l	
DGLC-BU-E1	9/5/2007	11:10	Zinc	Total	Water	12	ug/l	
RLE-1	6/11/2012	10:53	Zinc	Total	Water	10.7	ug/l	9 ft
DGLC-BU-C1	9/5/2007	10:00	Zinc	Total	Water	9.3	ug/l	
DGLC-BU-C2	9/5/2007	11:45	Zinc	Total	Water	7.9	ug/l	
DGLC-01	9/18/2012	10:14	Zinc	Total	Water	6.22	ug/l	
DGP-01	9/25/2007	12:20	Zinc	Total	Water	6.2	ug/l	
DGPC-01	9/25/2007	13:40	Zinc	Total	Water	6.2	ug/l	
RLE-1	4/17/2012	10:33	Zinc	Total	Water	6.01	ug/l	9 ft
DGLC-01	7/16/2007	9:45	Zinc	Total	Water	5.7	ug/l	
DGP-01	7/18/2007	10:45	Zinc	Total	Water	5.4	ug/l	
DGP-01	8/20/2007	11:40	Zinc	Dissolved	Water	5.2	ug/l	
DGO-01	7/3/2007	12:00	Zinc	Total	Water	5.2	ug/l	
DGO-01	7/3/2007	12:00	Zinc	Dissolved	Water	5.1	ug/l	
RLE-1	6/3/2009	12:05	Zinc	Total	Water	5.06	ug/l	9 ft
DGP-01	8/20/2007	11:40	Zinc	Total	Water	4.8	ug/l	
RLE-1	8/11/2009	11:10	Zinc	Total	Water	4.63	ug/l	9 ft
DGPC-01	9/25/2007	13:40	Zinc	Dissolved	Water	4.4	ug/l	
DGLC-01	9/26/2007	12:10	Zinc	Dissolved	Water	3.96	ug/l	
DGPC-01	6/12/2007	9:00	Zinc	Total	Water	3.9	ug/l	
DGO-01	8/20/2007	12:20	Zinc	Total	Water	3.9	ug/l	
DGPC-01	6/12/2007	9:00	Zinc	Dissolved	Water	3.8	ug/l	
DGPC-01	8/20/2007	11:00	Zinc	Total	Water	3.8	ug/l	
DGLC-01	6/18/2007	14:15	Zinc	Dissolved	Water	3.7	ug/l	
RLE-1	4/14/2009	11:18	Zinc	Total	Water	3.57	ug/l	9 ft
DGLC-01	6/18/2007	14:15	Zinc	Total	Water	3.5	ug/l	
DGLC-01	5/14/2012	9:30	Zinc	Total	Water	3.33	ug/l	
DGLC-01	7/10/2012	8:29	Zinc	Total	Water	3.07	ug/l	
DGP-01	9/25/2007	12:20	Zinc	Dissolved	Water	3	ug/l	

Segment	Date	Time	Analyte	Fraction	Medium	Result	Units	Depth
RLE-1	8/22/2012	10:26	Zinc	Total	Water	2.98	ug/l	9 ft
DGLC-01	8/22/2007	9:45	Zinc	Dissolved	Water	2.8	ug/l	
DGPC-01	8/20/2007	11:00	Zinc	Dissolved	Water	2.7	ug/l	
DGP-01	9/17/2012	10:59	Zinc	Total	Water	2.69	ug/l	
DGO-01	8/20/2007	12:20	Zinc	Dissolved	Water	2.6	ug/l	
RLE-1	7/18/2012	10:06	Zinc	Total	Water	2.25	ug/l	9 ft
DGP-01	5/15/2012	11:29	Zinc	Total	Water	2.02	ug/l	
DGP-01	9/17/2012	10:59	Zinc	Dissolved	Water	1.26	ug/l	
DGLC-01	9/18/2012	10:14	Zinc	Dissolved	Water	1.25	ug/l	
DGLC-01	9/26/2007	12:10	Zinc	Total	Water	0.96	ug/l	
DGLC-01	8/12/2002	15:30	ZINC,Dissolved ug/l	Dissolved	Water	100	ug/l	
DGP-01	8/8/2002	12:45	ZINC,Dissolved ug/l	Dissolved	Water	100	ug/l	
DGLC-01	6/10/2002	9:00	ZINC,Dissolved ug/l	Dissolved	Water	100	ug/l	
DGP-01	6/11/2002	9:00	ZINC,Dissolved ug/l	Dissolved	Water	100	ug/l	
DGO-01	6/11/2002	10:45	ZINC,Dissolved ug/l	Dissolved	Water	100	ug/l	
DGP-01	9/11/2002	13:00	ZINC,Dissolved ug/l	Dissolved	Water	100	ug/l	
DGLC-01	9/11/2002	14:30	ZINC,Dissolved ug/l	Dissolved	Water	100	ug/l	
DGO-01	6/11/2002	10:45	ZINC,Total ug/l	Total	Water	140	ug/l	
DGLC-01	8/12/2002	15:30	ZINC,Total ug/l	Total	Water	100	ug/l	
DGP-01	8/8/2002	12:45	ZINC,Total ug/l	Total	Water	100	ug/l	
DGLC-01	6/10/2002	9:00	ZINC,Total ug/l	Total	Water	100	ug/l	
DGP-01	6/11/2002	9:00	ZINC,Total ug/l	Total	Water	100	ug/l	
DGP-01	9/11/2002	13:00	ZINC,Total ug/l	Total	Water	100	ug/l	
DGLC-01	9/11/2002	14:30	ZINC,Total ug/l	Total	Water	100	ug/l	

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Appendix D

Public Comments and Responsiveness Summary

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Responsiveness Summary

Upper La Moine River Watershed

Total Maximum Daily Load

The responsiveness summary responds to questions and comments received during the public comment period from November 18, 2020 through December 21, 2020.

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. **Upper La Moine River Watershed** TMDL report contains a plan detailing the actions necessary to reduce pollutant loads to the impaired water bodies and ensure compliance with applicable water quality standards. The Illinois EPA implements the TMDL program in accordance with Section 303(d) of the federal Clean Water Act and regulations thereunder.

Background

The watershed targeted for TMDL development is the **Upper La Moine River\Missouri Watershed** located in west central Illinois. The Upper La Moine River watershed is located in west-central Illinois and drains approximately 369,000 acres within the state of Illinois. Approximately 182,300 acres (49.4 percent of the total watershed) lie in McDonough County, 164,200 acres lie in Hancock County (44.5 percent of the total watershed), 12,600 acres lie in Warren County (3.4 percent of the total watershed), and 9,800 acres lie in Henderson County (2.7 percent of the total watershed).

The Clean Water Act and USEPA regulations require that states develop TMDLs for waters on the Section 303(d) List. Illinois EPA has developed TMDLs for pollutants that have numeric water quality standards. Therefore, a Chloride TMDL was developed for Drowning Fork waterbody segment (IL_DGLC-01), an Ammonia (Total) TMDL was developed for South Branch La Moine River (IL_DGZR), and a Phosphorus (Total) TMDL was developed for Carthage Lake (IL_RLE).

These waterbodies are listed as impaired per the 2014 - 2016 Draft Illinois Integrated Water Quality Reports and Section 303(d) List.

Illinois EPA contracted with CDM Smith (a TMDL Consultant) to prepare the TMDL report for the Upper LaMoine River Watershed TMDL project.

Public Meetings

A stage one public meeting was held at Macomb City Hall in Macomb, IL on March 8, 2017. The Illinois EPA provided public notice for the public meeting by placing an ad in the local newspaper in the watershed; the Voice (McDonough County). The notice gave the date, time, location, and purpose of the meeting. 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 City Hall in Macomb, IL and on the Agency's web page at: https://www2.illinois.gov/epa/public-notices/Pages/general-notices.aspx.

After consultation with the Illinois Department of Public Health due to COVID-19 and based on their advice, the draft Stage 3 public meeting was held virtually on Wednesday, November 18, 2020. The virtual public meeting started at 10:00 a.m. (CDT), and concluded at 12:00 pm. (CDT), with the meeting record remaining open until midnight on December 21, 2020. Approximately 20 people participated in the virtual public meeting.

Illinois EPA provided public notice for the meeting by placing a display-ad in the local newspaper in the watershed; the Voice (McDonough County). In addition, a direct mailing was sent to La Moine River Ecosystem Partnership, NPDES Permittees, Soil Water Conservation Districts (SWCDs), and other stakeholders in the watershed. The notice gave the date, time, location, and purpose of the meeting. The notice also provided references on how to obtain additional information about this specific project, the TMDL program, and other related information. The draft TMDL report was available for review in hard copy at Macomb City Hall in Macomb, IL, and electronically on the Agency's webpage: www2.illinois.gov/epa/public-notices/Pages/general-notices.aspx.

Questions & Comments

1. The TMDL report has identified sewage treatment plants for Carthage, Bushnell, Blandinsville, and La Harpe as possible point sources for impairments in the watershed. However, you are ignoring many of the Concentrated Animal Feeding Operations (CAFOs) in the watershed, that produce manure more than the city of Carthage. There are several more hog confinements in the watershed and the information should be available from the Illinois Department of Agriculture. The statement in the 2nd line of text on page 5-28 is factually incorrect.

   Response: Thank you for your comments, Illinois EPA has reviewed the current NPDES permitted data base, and there are no Permitted CAFO facilities in the watershed.

   Through Illinois EPA field investigations, non-NPDES permitted CAFOs have been identified in the watershed (from small to large scale operations). These facilities have not received an NPDES permit as they are designed and constructed to be non-discharging systems. Illinois EPA field staff continues to identify and inventory livestock facilities as the information becomes available.

   However, the TMDL Report has identified Animal Operations in the Watershed based on information available from USDA – National Agricultural Statistics Service (NASS). Please refer to Section 5.4.2 of the TMDL Report for more details. In addition, the TMDL Report includes, Section 9 – Implementation Plan for the Upper La Moine River Watershed to help stakeholders develop Watershed Based Plans to address waterbody impairments in the watershed to meet water quality standards and their designated uses.

   Please also refer to Response #2 below, for guidelines regarding manure and other livestock waste management\handling practices in the watershed.

2. While most of the manure from the CAFOs is injected, they are a source of excessive phosphorus and lead to a lack of dissolved oxygen throughout the watershed. “Manure Management” plans are required to be developed and followed, as the phosphorus concentration build-up test is very high (p - tests as high as 300 parts), and soil tests on the application areas are required. The monitoring plan should include a protocol of what the responsible agency will do when this limit (300 parts) is approached.

Response:

The Illinois EPA and Illinois Department of Agriculture are guided by the Illinois Livestock Management Facilities Act. Illinois EPA has developed and maintains an inventory of permitted CAFOs and unpermitted CAFOs (CAFO Inventory) in the State, including the Upper La Moine River Watershed. Unpermitted CAFOs are not required to apply for and obtain NPDES permit coverage as they are not designed, constructed, operated, or maintained to have a discharge of livestock waste to waters of the United States. On a continuous basis, the Illinois EPA receives and develops information related to CAFOs from various sources which Field Staff personnel reviews and uses to update the existing CAFO Inventory as deemed appropriate. Illinois EPA may conduct inspections of CAFOs identified in the CAFO Inventory to verify compliance with the agricultural stormwater discharge requirements as well as other requirements applicable to CAFOs.

Livestock Management Facilities and Livestock Waste Handling Facilities that are Permitted as a Concentrated Animal Feeding Operations (CAFOs) must develop and implement a Nutrient Management Plan (NMP) in accordance with Special Condition 4 of the CAFO Permit (please see link: https://www2.illinois.gov/epa/Documents/epa.state.il.us/water/permits/cafo/general-npdes-permit.pdf

In addition, please refer to Special Condition 4.c.v., regarding the phosphorus concentration, agronomic phosphorus demand and application rate in relation to the soil conditions were livestock waste is applied.

3. As far as the implementation plan is concerned, it would seem that the Hancock & McDonough Soil & Water Conservation Districts need to take the lead. In the past, these districts shared an employee with primary responsibility for the Conservation Reserve Enhancement Program (CREP). The program was not mentioned in the TMDL report. It appears that these Districts were not represented in the virtual public meeting, and without their involvement, not much we be done.

Response: Please refer to Section 9.12.2.2 which provides details on the Conservation Reserve Program (CRP). CREP is a part of this program.

The implementation plan - Best Management Practices (BMPs) recommended in the TMDL Report can be successfully implemented through the leadership of the La Moine River Ecosystem Partnership in cooperation with the SWCDs and other stakeholders in the watershed. These groups can direct planning efforts for implementing BMPs that are both practical and feasible through programs such as the Agency's Section 319 funding program for developing watershed-based plans, and other programs listed in the TMDL Report. Each SWCD has a Board of Directors, the SWCD Board of Directors will need to determine the role of the SWCD, and their staff, in the execution of the TMDL Implementation Plan

As to the comment about the public meeting participation, the virtual public notice was advertised on the local newspaper (refer to page 2 of the Responsiveness Summary, and Illinois EPA has mailed, “The Public Notice” - (virtual public meeting invitation) to NPDES Permittees, SWCD\NRCS representatives in the watershed, and other non-governmental organizations (NGOs). Those who could not participate in the meeting were encouraged to submit written comments by email or regular mail.

4. Please correct the waterbody name to read as “La Moine River”.

Response: This has been corrected throughout the TMDL report.

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Handwritten comments on Stage 1 Draft Report from Dana Walker, LMREP 4/2/2017

Table 1-1: Was there a major run-off event and discharge from the Bushnell sewage treatment plant (involving a shot of chlorine) in August 2007? This information is currently unknown but further investigation may take place prior to modeling if needed. I speculate that the low dissolved oxygen may be due to enhanced nitrogen and phosphorus (algal growth) from manure application and/or erosion in the watersheds above. Thank you for the information.

Page 2-1: include Henderson County. Text updated

Table 2-1: What about wheat/oats? Appendix A contains more detailed information on landuses throughout the watershed. Agriculture other than corn and soybeans accounts for less than 1% of the watershed area.

Page 2-3: k-factor – what about clay%? This information is unknown. Soil types were searched and it was found that soils containing "clay" in some part of the classification name cover roughly 10% of the watershed area.

Figure 2-3 and 2-4: I wonder about the large amount of "NA" soils The database was rechecked and these data are not available in the soils database.

Table 4-4: Same comment as for Table 1-1.

Page 5-2: Agreed that data is extremely limited and additional data collection is needed. I think you will find that a large % of Hancock Co. cropland is saturated with phosphorus due to excessive manure application. Thank you for the information

Page 5-3: I agree that manganese is probably not a problem.

Page 5-4: I would say that suspended solids and phosphorus tend to go together and wonder if the data collected were during (or after) major run-off (and erosion) events. This information is unknown at this time, however, a load duration curve will be used to calculate reductions needed in stream TP and TSS. This exercise pairs samples with flow data to show if the concentrations occurred under high or low flow conditions.

Page 5-6: Carthage Lake is a ½ mile northwest of Carthage and is fed by a tributary of Long Creek. Text has been updated.

Page 5-7: many of the facilities named do NOT discharge upstream of impaired segments. Table name has been updated.

Page 5-8: table numbers in text are off; also on page 5-9. Numbering updated.

Figure 5-5: should it be micrograms instead of mg? Also figure 5-6. Figures have been corrected

Figure 5-9: puzzling Multiple stations were sampled within the impaired segment during a facility related stream survey in 1988. Text has been added to the report for clarification: *Note that there are multiple water quality stations located in the Drowning Fork segment DGLC-01 and Prairie Creek* *segment DGZN-01; as shown in **Figure 5-1**. The watershed-specific water quality target for TSS in streams is a maximum value of 50.9 mg/L. **Figure 5-8** shows the TSS data collected over time on Drowning Fork Segment DLGC-01 and **Figure 5-9** shows TSS data over time for Prairie Creek segment DGZN-01. Note that when multiple results are shown for a single date, the results are shown from upstream to downstream sites within the segment.*

Figure 5-13: I question the 4/17/12 figure Data were double checked and confirmed.

Figure 5-14: 6/11/12 figure looks funny Data were reviewed and confirmed. However – the high sample was collected at a mid-range depth and text has been added to clarify: *It should be noted that the samples collected above the 50.9 mg/L threshold were collected near the lake bottom in 2003 and 2009 and at a depth of 9 feet in 2009.*

Section 6.4.2: should solids replace sediment? Text updated.

Upper La Moine River Watershed TMDL Stage 1 Draft Report

Review by Eric Moe, President of LaMoine Ecosystem

4/3/2017

1. Page 2-1: Henderson County has some watershed contributing to the overall La Moine watershed. Sentence has been fixed.

2. Drowning Fork impairment – during some of the sample data in 2007, it is possible the only flow contributing to the Drowning Fork would be the City of Bushnell's west WWTP. It is an aerated lagoon with a chlorine exemption. However, the potable water supply is a deep well and R/O system and this is chlorinated. Thank you for this info. We will be using a load duration curve to develop the Stage 3 TMDL which will show if the 2007 samples were collected under extremely low flow. This information will help in the source discussion and implementation plan.

3. FYI. Carthage is currently constructing a deep well and a R/O WTP to replace its source from the Lake. The lake has been unreliable during periods of drought. This information has been added to Section 5.2

4. In table 5-11, the flow for Carthage and for Macomb must be the maximum. Average for Carthage is probably less than 0.5 mgd and Macomb is very low. The Macomb facility is a permitted treated contained overflow facility for periods of wet weather and it has not discharged in years. The table has been updated to include the average and max flows where information was available.

5. Table 5-11. The Macomb IL0029688 facility discharges about 1000 feet upstream from the East fork of the La Moine River in an unnamed tributary. It does not flow into the Kiljordan Creek. According to the permit: The main discharge number is B01. The seven day once in ten year low flow (7Q10) of the receiving stream, Kilijordan Creek is 0 cfs.
http://external.epa.illinois.gov/PublicNoticeService/api/Notices/GetDocument/774

6. Both the City of LaHarpe and the Village of Blandinsville use the LaHarpe Creek as potable water sources. Both have pumping facilities within the stream. Both of the reservoirs to which the water is pumped are also used for recreational purposes – mostly fishing for the Blandinsville reservoir and boating, camping and fishing at LaHarpe. Thank you for the information. LaHarpe Creek, Bladinsville Res and LaHarpe Res are not currently listed for impairment of the public water supply use.

7. Can we recommend additional testing be conducted or is the amount of testing deemed to be adequate? Since Carthage Lake is part of the Ambient Lakes Program, is there a possibility that Spring Lake, Lake Argyle, LaHarpe and Blandinsville reservoirs would have similar characteristics and water quality? Can we have a discussion on this? Additional monitoring is recommended for some of the impaired waterbodies (refer to Section 6). Illinois EPA has also reviewed data availability for the additional lakes mentioned in this comment. Spring Lake has been sampled in the following years: 1999,

2003, 2006, 2009, 2012. Lake Argyle has been sampled in the following years: 1999, 2002, 2005, 2010, 2012. LaHarpe was sampled in 1999. No data were available for Blandinsville. Data are available for review online (EPA STORET: https://www.epa.gov/waterdata/water-quality-data-wqx) or through request from Illinois EPA.

8. Removing LaHarpe Creek from the 303(d) list for manganese is concerning because of the potable water source issues. The recommendation is to delist LaHarpe Creek for impairment of the aquatic life use due to manganese as the standard is not exceeded. According to the 2016 303(d) list – segment DGP was assessed to be fully supporting the public water supply use.

9. Can we show Lake Argyle on the Watershed maps? This is a fair sized impoundment, is a State-owned facility and gets heavy recreational use. Argyle Lake has been added to the figures.

10. On page 5-8 the Crop tillage practices are summarized. Is there a way to include information regarding the percentage of land which utilizes cover crops also? Between 2004 and 2015??? This information would be important to show any progress (or lack thereof) of the implementation of cover crops. This information is currently unknown. We will continue to work with county SWCDs to include as much cropping practice/BMP information as possible in the Stage 3 report.

11. Sampling at typical random field tile outlet locations could be a recommendation to further improve the sampling data. Also, further data in LaHarpe Lake, Lake Argyle and the Blandinsville reservoir would be a valuable enhancement to bolster up the report in order to justify implementation of further water quality policy changes. Thank you for the comment. Future sampling recommendations will be included in the implementation plan. This TMDL does not focus on the reservoirs listed in this comment.

12. The lower basin report mentioned that agricultural practices water quality standards being met are "voluntary". This is significant given the land use is at least 65% corn and soybeans. Can this be mentioned also in this report? Yes, this information will be included in the Stage 3 report/implementation plan.

Thank you!

Eric C Moe

e.moe@mcclureengineering.com

Appendix E

QUAL2K Model Files

QUAL2K FORTRAN

Stream Water Quality Model

Steve Chapra, Hua Tao and Greg Pelletier

Version 2.12b1

System ID:		
River name	**La Harpe Creek**	
Saved file name	**Q2K La Harpe Creek**	
Directory where file saved	**Hard Drive Files\IEPA 2016-18\Upper Lamoine QUAL2K**	
Month	**7**	
Day	**18**	
Year	**2012**	
Local time hours to UTC	**-6**	
Daylight savings time	**Yes**	
Calculation:		
Calculation step	**0.1**	**hours**
Final time	**30**	**day**
Solution method (integration)	**Euler**	
Solution method (pH)	**Brent**	
Time zone	**Central Standard Time**	
Program determined calc step	**0.093750**	**hours**
Time of last calculation	**0.05**	**minutes**
Time of sunrise	**5:32 AM**	
Time of solar noon	**12:59 PM**	
Time of sunset	**8:25 PM**	
Photoperiod	**14.87**	**hours**

QUAL2K
Stream Water Quality Model
La Harpe Creek (7/18/2012)
Headwater Data:

Number of Headwaters	1										
Headwater 0 (Mainstem)											
Headwater label	*Reach No*	*Flow*	*Elevation*	*Weir*				**Rating Curves**			
		Rate		*Weir*	*Height*	*Width*	*adam*	*bdam*	*Velocity*		*Depth*
		(m³/s)	*(m)*	*Type*	*(m)*	*(m)*			*Coefficient*	*Exponent*	*Coefficient*
Mainstem headwater	1	0.02213	222.740				1.2500	0.9000			
Water Quality Constituents	*Units*	*12:00 AM*	*1:00 AM*	*2:00 AM*	*3:00 AM*	*4:00 AM*	*5:00 AM*	*6:00 AM*	*7:00 AM*	*8:00 AM*	*9:00 AM*
Temperature	C	26.89	26.62	26.59	26.49	26.34	26.23	26.09	26.08	26.09	26.33
Conductivity	umhos	866.90	867.70	869.40	869.80	871.00	871.80	872.00	872.00	872.10	872.50
Inorganic Solids	mgD/L	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
Dissolved Oxygen	mg/L	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
CBODslow	mgO2/L										
CBODfast	mgO2/L	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Organic Nitrogen	ugN/L	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00
NH4-Nitrogen	ugN/L	120.00	120.00	120.00	120.00	120.00	120.00	120.00	120.00	120.00	120.00
NO3-Nitrogen	ugN/L	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
Organic Phosphorus	ugP/L	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Inorganic Phosphorus (SRP)	ugP/L	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Phytoplankton	ugA/L	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
Internal Nitrogen (INP)	ugN/L	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84
Internal Phosphorus (IPP)	ugP/L	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
Detritus (POM)	mgD/L	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03
Pathogen	cfu/100 mL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alkalinity	mgCaCO3/L	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00
Constituent i		400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00
Constituent ii											
Constituent iii											
pH	s.u.	8.63	8.61	8.58	8.56	8.53	8.49	8.48	8.49	8.49	8.55

Manning Formula						Prescribed					
	Channel	Manning	Bot Width	Side	Side	Dispersion					
Exponent	Slope	n	m	Slope	Slope	m2/s					
	0.004	0.0400	1.00	1.00	1.00	0.00					
10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM
26.49	27.12	27.42	27.76	28.44	28.71	29.04	29.14	29.12	29.01	28.84	28.59
873.10	871.80	871.80	869.90	866.50	864.90	862.00	858.10	858.10	856.70	857.90	860.60
33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00
120.00	120.00	120.00	120.00	120.00	120.00	120.00	120.00	120.00	120.00	120.00	120.00
800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84
26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00
400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00
8.57	8.67	8.68	8.75	8.82	8.83	8.86	8.86	8.84	8.80	8.76	8.72

10:00 PM	11:00 PM
28.37	28.19
860.70	864.30
33.00	33.00
4.00	4.00
2.00	2.00
1800.00	1800.00
120.00	120.00
800.00	800.00
30.00	30.00
30.00	30.00
26.11	26.11
429.84	429.84
26.11	26.11
10.03	10.03
0.00	0.00
230.00	230.00
400.00	400.00
8.70	8.66

QUAL2K
Stream Water Quality Model
La Harpe Creek (7/18/2012)
Reach Data:

Reach for diel plot	1										
Element for diel plot	1	Reach	Headwater	Reach			Location		Element	Elevation	
Reach	Downstream	Number	Reach	length	Downstream		Upstream	Downstream	Number	Upstream	Downstream
Label	end of reach label			(km)	Latitude	Longitude	(km)	(km)	>=1	(m)	(m)
Mainstem headwater		1	Yes	1.00	42.28	88.23	2.000	1.000	10	222.740	222.740

Downstream					
Latitude			Longitude		
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
42.00	17	1	88.00	14	0.601414

Hydraulic Model (Weir Overrides Manning Formula; Manning Formula Override Rating Curves)														
Weir					Rating Curves				Manning Formula					
Weir	Height	Width	adam	bdam	Velocity		Depth		Channel	Manning	Bot Width	Side	Side	
Type	(m)	(m)			Coefficient	Exponent	Coefficient	Exponent	Slope	n	m	Slope	Slope	
			1.2500	0.9000					0.0020	0.0400	1.00	0.5000	0.5000	

Prescribed	Bottom	Bottom	Prescribed	rescribe	Prescribed	Prescribed	Prescribed
Dispersion	Algae	SOD	SOD	CH4 flux	NH4 flux	Inorg P flux	Evap
m2/s	Coverage	Coverage	gO2/m2/d	)O2/m2/(	mgN/m2/d	mgP/m2/d	mm/d
	100.00%	100.00%	64.00				

QUAL2K
Stream Water Quality Model
La Harpe Creek (7/18/2012)
Air Temperature Data:

Upstream Label	Reach Label	Downstream Label	Reach Number	Upstream Distance km	Downstream Distance km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

Hourly air temperature for each reach (degrees C)

(The input values are applied as point estimates at each time. Linear interpolation is used to estimate values between the hourly inputs

12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM
26.67	26.11	26.67	25.56	25.56	25.00	27.22	29.44	31.67	31.67	32.78

11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
34.44	35.56	36.67	36.67	30.00	31.67	31.67	30.00	28.89	27.78	25.56	26.11	23.89

QUAL2K
Stream Water Quality Model
La Harpe Creek (7/18/2012)
Dew Point Temperature Data:

Upstream Label	Reach Label	Downstream Label	Reach Number	Upstream Distance km	Downstream Distance km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

Hourly dewpoint temperature for each reach (degrees C)
(The input values are applied as point estimates at each time. Linear interpolation is used to estimate values between the hourly inputs.)

12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
14.44	14.44	15.00	15.56	16.67	17.22	18.89	20.00	21.11	21.11	21.67	22.22	23.06

1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
23.89	23.89	22.22	21.67	20.56	20.00	21.67	21.67	21.67	21.67	21.67

QUAL2K

Stream Water Quality Model

La Harpe Creek (7/18/2012)

Wind Speed Data:

Upstream Label	Reach Label	Downstream Label	Reach Number	Upstream Distance km	Downstream Distance km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

Wind speed for each reach 7m above water surface (m/s)

(The input values are applied as point estimates at each time. Linear interpolation is used to estimate values between the hourly inputs.)

12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
4.47	4.47	4.02	3.13	3.13	3.13	3.13	3.58	4.47	3.13	3.13	3.13	3.58

1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
4.02	3.58	4.02	3.58	2.68	0.00	0.00	2.23	0.00	0.00	0.00

QUAL2K
Stream Water Quality Model
La Harpe Creek (7/18/2012)
Cloud Cover Data:

Upstream Label	Reach Label	Downstream Label	Reach Number	Upstream Distance km	Downstream Distance km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

Hourly cloud cover shade for each reach (Percent)

(Percent of sky that is covered by clouds. The input values are applied as point estimates at each time. Linear interpolation is used to estimate values between the hourly inputs

12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
42.0%	42.0%	42.0%	42.0%	42.0%	42.0%	39.4%	36.9%	34.3%	31.7%	29.1%	26.6%	24.0%

1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
26.0%	28.0%	30.0%	32.0%	34.0%	36.0%	36.0%	36.0%	36.0%	36.0%	36.0%

QUAL2K
Stream Water Quality Model
La Harpe Creek (7/18/2012)
Shade Data:

				Upstream	Downstream
Upstream	Reach	Downstream	Reach	Distance	Distance
Label	Label	Label	Number	km	km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	8.6%	7.1%	5.7%	4.3%	2.9%	1.4%	0.0%
12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
Integrated hourly effective shade for each reach (Percent)												
(Percent of solar radiation that is blocked because of shade from topography and vegetation. Hourly values are applied as integrated values for each hour, e.g. the value at 12:00 AM is applied from 12:00 to 1:00 AM)												
10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	8.6%	7.1%	5.7%	4.3%	2.9%	1.4%	0.0%

0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

QUAL2K
Stream Water Quality Model
La Harpe Creek (7/18/2012)
Water Column Rates

Parameter	Value	Units	Symbol
Stoichiometry:			
Carbon	40	gC	gC
Nitrogen	7.2	gN	gN
Phosphorus	1	gP	gP
Dry weight	100	gD	gD
Chlorophyll	1	gA	gA
Inorganic suspended solids:			
Settling velocity	0.1	m/d	v_i
Oxygen:			
Reaeration model	Internal		
User reaeration coefficient α	3.93		α
User reaeration coefficient β	0.5		β
User reaeration coefficient γ	1.5		γ
Temp correction	1.024		θ_a
Reaeration wind effect	None		
O2 for carbon oxidation	2.69	gO_2/gC	r_{oc}
O2 for NH4 nitrification	4.57	gO_2/gN	r_{on}
Oxygen inhib model CBOD oxidation	Exponential		
Oxygen inhib parameter CBOD oxidation	0.60	L/mgO2	K_{socf}
Oxygen inhib model nitrification	Exponential		
Oxygen inhib parameter nitrification	0.60	L/mgO2	K_{sona}
Oxygen enhance model denitrification	Exponential		
Oxygen enhance parameter denitrification	0.60	L/mgO2	K_{sodn}
Oxygen inhib model phyto resp	Exponential		
Oxygen inhib parameter phyto resp	0.60	L/mgO2	K_{sop}
Oxygen enhance model bot alg resp	Exponential		
Oxygen enhance parameter bot alg resp	0.60	L/mgO2	K_{sob}
Slow CBOD:			
Hydrolysis rate	0	/d	k_{hc}
Temp correction	1.07		θ_{hc}
Oxidation rate	0	/d	k_{dcs}
Temp correction	1.047		θ_{dcs}
Fast CBOD:			
Oxidation rate	2	/d	k_{dc}
Temp correction	1.047		θ_{dc}
Organic N:			
Hydrolysis	0.015	/d	k_{hn}
Temp correction	1.07		θ_{hn}
Settling velocity	0.0005	m/d	v_{on}
Ammonium:			

Nitrification	**0.08**	**/d**	k_{na}
Temp correction	**1.07**		θ_{na}
Nitrate:			
Denitrification	**0.1**	**/d**	k_{dn}
Temp correction	**1.07**		θ_{dn}
Sed denitrification transfer coeff	**0.8**	**m/d**	v_{di}
Temp correction	**1.07**		θ_{di}
Organic P:			
Hydrolysis	**0.03**	**/d**	k_{hp}
Temp correction	**1.07**		θ_{hp}
Settling velocity	**0.001**	**m/d**	v_{op}
Inorganic P:			
Settling velocity	**0.8**	**m/d**	v_{ip}
Inorganic P sorption coefficient	**1000**	**L/mgD**	K_{dpi}
Sed P oxygen attenuation half sat constant	**1**	**mgO_2/L**	k_{spi}
Phytoplankton:			
Max Growth rate	**0**	**/d**	k_{gp}
Temp correction	**1.07**		θ_{gp}
Respiration rate	**0.15**	**/d**	k_{rp}
Temp correction	**1.07**		θ_{rp}
Excretion rate	**0.3**	**/d**	k_{ep}
Temp correction	**1.07**		θ_{dp}
Death rate	**0.1**	**/d**	k_{dp}
Temp correction	**1.07**		θ_{dp}
External Nitrogen half sat constant	**100**	**ugN/L**	k_{sPp}
External Phosphorus half sat constant	**10**	**ugP/L**	k_{sNp}
Inorganic carbon half sat constant	**1.30E-05**	**moles/L**	k_{sCp}
Light model	**Half saturation**		
Light constant	**250**	**langleys/d**	K_{Lp}
Ammonia preference	**25**	**ugN/L**	k_{hnxp}
Subsistence quota for nitrogen	**0**	**mgN/mgA**	q_{0Np}
Subsistence quota for phosphorus	**0**	**mgP/mgA**	q_{0Pp}
Maximum uptake rate for nitrogen	**0**	**mgN/mgA/d**	ρ_{mNp}
Maximum uptake rate for phosphorus	**0**	**mgP/mgA/d**	ρ_{mPp}
Internal nitrogen half sat constant	**0**	**mgN/mgA**	K_{qNp}
Internal phosphorus half sat constant	**0**	**mgP/mgA**	K_{qPp}
Settling velocity	**0**	**m/d**	v_a
Bottom Algae:			
Growth model	**Zero-order**		
Max Growth rate	**400**	**$mgA/m^2/d$ or /d**	C_{gb}
Temp correction	**1.07**		θ_{gb}
First-order model carrying capacity	**1000**	**mgA/m^2**	$a_{b,max}$
Respiration rate	**0.4**	**/d**	k_{rb}
Temp correction	**1.07**		θ_{rb}
Excretion rate	**0.12**	**/d**	k_{eb}

Temp correction	**1.07**		θ_{db}
Death rate	**0.1**	**/d**	k_{db}
Temp correction	**1.07**		θ_{db}
External nitrogen half sat constant	**300**	**ugN/L**	k_{sPb}
External phosphorus half sat constant	**100**	**ugP/L**	k_{sNb}
Inorganic carbon half sat constant	**1.30E-05**	**moles/L**	k_{sCb}
Light model	**Half saturation**		
Light constant	**100**	**langleys/d**	K_{Lb}
Ammonia preference	**25**	**ugN/L**	k_{hnxb}
Subsistence quota for nitrogen	**0.72**	**mgN/mgA**	q_{0N}
Subsistence quota for phosphorus	**0.1**	**mgP/mgA**	q_{0P}
Maximum uptake rate for nitrogen	**72**	**mgN/mgA/d**	ρ_{mN}
Maximum uptake rate for phosphorus	**5**	**mgP/mgA/d**	ρ_{mP}
Internal nitrogen half sat constant	**0.9**	**mgN/mgA**	K_{qN}
Internal phosphorus half sat constant	**0.13**	**mgP/mgA**	K_{qP}
Detritus (POM):			
Dissolution rate	**0.23**	**/d**	k_{dt}
Temp correction	**1.07**		θ_{dt}
Fraction of dissolution to fast CBOD	**1.00**		F_f
Settling velocity	**0.008**	**m/d**	v_{dt}
Pathogens:			
Decay rate	**0.8**	**/d**	k_{dx}
Temp correction	**1.07**		θ_{dx}
Settling velocity	**1**	**m/d**	v_x
Light efficiency factor	**1.00**		α_{path}
pH:			
Partial pressure of carbon dioxide	**347**	**ppm**	p_{CO2}
Constituent i			
First-order reaction rate	**0**	**/d**	
Temp correction	**1**		θ_{dx}
Settling velocity	**0**	**m/d**	v_{dt}
Constituent ii			
First-order reaction rate	**0**	**/d**	
Temp correction	**1**		θ_{dx}
Settling velocity	**0**	**m/d**	v_{dt}
Constituent iii			
First-order reaction rate	**0**	**/d**	
Temp correction	**1**		θ_{dx}
Settling velocity	**0**	**m/d**	v_{dt}

QUAL2K
Stream Water Quality Model
La Harpe Creek (7/18/2012)
Light Parameters and Surface Heat Transfer Models:

Parameter	*Value*	*Unit*	
Photosynthetically Available Radiation	0.47		
Background light extinction	0.2	/m	k_{eb}
Linear chlorophyll light extinction	0.0088	1/m-(ugA/L)	α_p
Nonlinear chlorophyll light extinction	0.054	1/m-(ugA/L)2/3	α_{pn}
ISS light extinction	0.052	1/m-(mgD/L)	α_i
Detritus light extinction	0.174	1/m-(mgD/L)	α_o
Solar shortwave radiation model			
Atmospheric attenuation model for solar	Bras		
Bras solar parameter (used if Bras solar model is selected)			
atmospheric turbidity coefficient (2=clear, 5=smoggy, defaul	2		n_{fac}
Ryan-Stolzenbach solar parameter (used if Ryan-Stolzenbach solar model is selected)			
atmospheric transmission coefficient (0.70-0.91, default 0.8)	0.8		a_{tc}
Downwelling atmospheric longwave IR radiation			
atmospheric longwave emissivity model	Brunt		
Evaporation and air convection/conduction			
wind speed function for evaporation and air convection/con	Brady-Graves-Geyer		
Sediment heat parameters			
Sediment thermal thickness	15	cm	H_s
Sediment thermal diffusivity	0.0064	cm^2/s	α_s
Sediment density	1.6	g/cm^3	ρ_s
Water density	1	g/cm^3	ρ_w
Sediment heat capacity	0.4	cal/(g °C)	C_{ps}
Water heat capacity	1	cal/(g °C)	C_{pw}
Sediment diagenesis model			
Compute SOD and nutrient fluxes	No		

QUAL2K
Stream Water Quality Model
La Harpe Creek (7/18/2012)
Diffuse Source Data:

	Tributary	Headwater	Location Up	Location Down	Diffuse Abstraction	Diffuse Inflow	Temp	Spec Cond	Inorg SS	Diss Oxygen
agriculture runoff	0	Mainstem headwater	2.00	1.00		0.0001				

CBOD slow	CBOD fast	Organic N	Ammon N	Nitrate N	Organic P	Inorganic P	Phyto plankton	Internal Nitrogen	Internal Phosphorus
				10000.00		7000.00			

Detritus	Pathogen	Alk	Constituent i	Constituent ii	Constituent iii	pH
					100.00	7.00

QUAL2K
Stream Water Quality Model
La Harpe Creek (7/18/2012)
Point Source Data:

				Point		Temperature			Specific Conductance			norganic Suspended Solids		
	Tributary	Headwater	Location	Abstraction	Inflow	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of
Name	No.	Label	km	m3/s	m3/s	°C	°C	max	umhos	umhos	max	mg/L	mg/L	max

Dissolved Oxygen			Slow CBOD			Fast CBOD			Organic N			Ammonia N		
mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of
mg/L	mg/L	max	mgO2/L	mgO2/L	max	mgO2/L	mgO2/L	max	ugN/L	ugN/L	max	ugN/L	ugN/L	max

Nitrate + Nitrite N			Organic P			Inorganic P			Phytoplankton			Internal Nitrogen		
mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of
ugN/L	ugN/L	max	ugP/L	ugP/L	max	ugP/L	ugP/L	max	ugA/L	ugA/L	max	ugN/L	ugN/L	max

Internal Phosphorus			Detritus			athogen Indicator Bacteri			Alkalinity			Constituent i		
mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of
ugP/L	ugP/L	max	mgD/L	mgD/L	max	cfu/100	cfu/100m	max	gCaCO3	gCaCO3/	max			max

Constituent ii			Constituent iii			pH		
mean	range/2	time of	mean	range/2	time of	mean	range/2	time of
		max			max	s.u.	s.u.	max

QUAL2K
Stream Water Quality Model
Prairie Creek (8/22/1988)
Headwater Data:

Number of Headwaters	1										
Headwater 0 (Mainstem)											
Headwater label	*Reach No*	*Flow*	*Elevation*	*Weir*				*Rating Curves*			
		Rate		*Weir*	*Height*	*Width*	*adam*	*bdam*	*Velocity*		*Depth*
		(m^3/s)	*(m)*	*Type*	*(m)*	*(m)*			*Coefficient*	*Exponent*	*Coefficient*
Mainstem headwater	1	0.00028	222.740				1.2500	0.9000			
Water Quality Constituents	*Units*	*12:00 AM*	*1:00 AM*	*2:00 AM*	*3:00 AM*	*4:00 AM*	*5:00 AM*	*6:00 AM*	*7:00 AM*	*8:00 AM*	*9:00 AM*
Temperature	C	26.89	26.62	26.59	26.49	26.34	26.23	26.09	26.08	26.09	26.33
Conductivity	umhos	866.90	867.70	869.40	869.80	871.00	871.80	872.00	872.00	872.10	872.50
Inorganic Solids	mgD/L	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
Dissolved Oxygen	mg/L	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
CBODslow	mgO2/L										
CBODfast	mgO2/L	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Organic Nitrogen	ugN/L	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00
NH4-Nitrogen	ugN/L	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00
NO3-Nitrogen	ugN/L	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
Organic Phosphorus	ugP/L	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00
Inorganic Phosphorus (SRP)	ugP/L	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
Phytoplankton	ugA/L	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
Internal Nitrogen (INP)	ugN/L	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84
Internal Phosphorus (IPP)	ugP/L	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
Detritus (POM)	mgD/L	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03
Pathogen	cfu/100 mL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alkalinity	mgCaCO3/L	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00
Constituent i		400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00
Constituent ii											
Constituent iii											
pH	s.u.	8.63	8.61	8.58	8.56	8.53	8.49	8.48	8.49	8.49	8.55

Manning Formula						Prescribed					
	Channel	Manning	Bot Width	Side	Side	Dispersion					
Exponent	Slope	n	m	Slope	Slope	m2/s					
	0.004	0.0400	1.00	1.00	1.00	0.00					
10:00 AM	*11:00 AM*	*12:00 PM*	*1:00 PM*	*2:00 PM*	*3:00 PM*	*4:00 PM*	*5:00 PM*	*6:00 PM*	*7:00 PM*	*8:00 PM*	*9:00 PM*
26.49	27.12	27.42	27.76	28.44	28.71	29.04	29.14	29.12	29.01	28.84	28.59
873.10	871.80	871.80	869.90	866.50	864.90	862.00	858.10	858.10	856.70	857.90	860.60
33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00
1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00
800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00
800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84
26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00
400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00
8.57	8.67	8.68	8.75	8.82	8.83	8.86	8.86	8.84	8.80	8.76	8.72

10:00 PM	*11:00 PM*
28.37	28.19
860.70	864.30
33.00	33.00
4.20	4.20
5.00	5.00
1800.00	1800.00
1800.00	1800.00
800.00	800.00
200.00	200.00
800.00	800.00
26.11	26.11
429.84	429.84
26.11	26.11
10.03	10.03
0.00	0.00
230.00	230.00
400.00	400.00
8.70	8.66

Headwater 1 (Tributary 1)											
Headwater label	***Reach No***	***Flow***	***Elevation***	***Weir***				**Rating Curves**			
		Rate		***Weir***	***Height***	***Width***	***adam***	***bdam***	***Velocity***		***Depth***
		(m^3/s)	***(m)***	***Type***	***(m)***	***(m)***			***Coefficient***	***Exponent***	***Coefficient***
Water Quality Constituents	***Units***	***12:00 AM***	***1:00 AM***	***2:00 AM***	***3:00 AM***	***4:00 AM***	***5:00 AM***	***6:00 AM***	***7:00 AM***	***8:00 AM***	***9:00 AM***
Temperature	**C**										
Conductivity	**umhos**										
Inorganic Solids	**mgD/L**										
Dissolved Oxygen	**mg/L**										
CBODslow	**mgO2/L**										
CBODfast	**mgO2/L**										
Organic Nitrogen	**ugN/L**										
NH4-Nitrogen	**ugN/L**										
NO3-Nitrogen	**ugN/L**										
Organic Phosphorus	**ugP/L**										
Inorganic Phosphorus (SRP)	**ugP/L**										
Phytoplankton	**ugA/L**										
Internal Nitrogen	**ugN/L**										
Internal Phosphorus	**ugP/L**										
Detritus (POM)	**mgD/L**										
Pathogen	**cfu/100 mL**										
Alkalinity	**mgCaCO3/L**										
Constituent i											
Constituent ii											
Constituent iii											
pH	**s.u.**										

Manning Formula						Prescribed
	Channel	Manning	Bot Width	Side	Side	Dispersion
Exponent	Slope	n	m	Slope	Slope	m2/s

10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM

10:00 PM	11:00 PM

Headwater 2 (Tributary 2)											
Headwater label	***Reach No***	***Flow***	***Elevation***	***Weir***				**Rating Curves**			
		Rate		***Weir***	***Height***	***Width***	***adam***	***bdam***	***Velocity***		***Depth***
		(m^3/s)	***(m)***	***Type***	***(m)***	***(m)***			***Coefficient***	***Exponent***	***Coefficient***
Water Quality Constituents	***Units***	***12:00 AM***	***1:00 AM***	***2:00 AM***	***3:00 AM***	***4:00 AM***	***5:00 AM***	***6:00 AM***	***7:00 AM***	***8:00 AM***	***9:00 AM***
Temperature	**C**										
Conductivity	**umhos**										
Inorganic Solids	**mgD/L**										
Dissolved Oxygen	**mg/L**										
CBODslow	**mgO2/L**										
CBODfast	**mgO2/L**										
Organic Nitrogen	**ugN/L**										
NH4-Nitrogen	**ugN/L**										
NO3-Nitrogen	**ugN/L**										
Organic Phosphorus	**ugP/L**										
Inorganic Phosphorus (SRP)	**ugP/L**										
Phytoplankton	**ugA/L**										
Internal Nitrogen	**ugN/L**										
Internal Phosphorus	**ugP/L**										
Detritus (POM)	**mgD/L**										
Pathogen	**cfu/100 mL**										
Alkalinity	**mgCaCO3/L**										
Constituent i											
Constituent ii											
Constituent iii											
pH	**s.u.**										

Manning Formula						Prescribed					
	Channel	Manning	Bot Width	Side	Side	Dispersion					
Exponent	Slope	n	m	Slope	Slope	m2/s					
10:00 AM	**11:00 AM**	**12:00 PM**	**1:00 PM**	**2:00 PM**	**3:00 PM**	**4:00 PM**	**5:00 PM**	**6:00 PM**	**7:00 PM**	**8:00 PM**	**9:00 PM**

10:00 PM	11:00 PM

Headwater 3 (Tributary 3)												
Headwater label	Reach No	Flow	Elevation	Weir				Rating Curves				
		Rate		Weir	Height	Width	adam	bdam	Velocity		Depth	
		(m^3/s)	(m)	Type	(m)	(m)			Coefficient	Exponent	Coefficient	
Water Quality Constituents	Units	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	
Temperature	C											
Conductivity	umhos											
Inorganic Solids	mgD/L											
Dissolved Oxygen	mg/L											
CBODslow	mgO2/L											
CBODfast	mgO2/L											
Organic Nitrogen	ugN/L											
NH4-Nitrogen	ugN/L											
NO3-Nitrogen	ugN/L											
Organic Phosphorus	ugP/L											
Inorganic Phosphorus (SRP)	ugP/L											
Phytoplankton	ugA/L											
Internal Nitrogen	ugN/L											
Internal Phosphorus	ugP/L											
Detritus (POM)	mgD/L											
Pathogen	cfu/100 mL											
Alkalinity	mgCaCO3/L											
Constituent i												
Constituent ii												
Constituent iii												
pH	s.u.											

QUAL2K
Stream Water Quality Model
Prairie Creek (8/22/1988)
Reach Data:

Reach for diel plot	1											
Element for diel plot	1	Reach	Headwater	Reach			Location		Element	Elevation	
Reach	Downstream	Number	Reach	length	Downstream		Upstream	Downstream	Number	Upstream	Downstream
Label	end of reach label			(km)	Latitude	Longitude	(km)	(km)	>=1	(m)	(m)
Mainstem headwater		1	Yes	1.00	42.28	88.23	2.000	1.000	10	222.740	222.740

Downstream					
Latitude			Longitude		
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
42.00	17	1	88.00	14	0.601414

Hydraulic Model (Weir Overrides Manning Formula; Manning Formula Override Rating Curves)													
Weir					Rating Curves				Manning Formula				
Weir	Height	Width	adam	bdam	Velocity		Depth		Channel	Manning	Bot Width	Side	Side
Type	(m)	(m)			Coefficient	Exponent	Coefficient	Exponent	Slope	n	m	Slope	Slope
			1.2500	0.9000					0.0003	0.0400	1.00	0.5000	0.5000

Prescribed	Bottom	Bottom	Prescribed	Prescribed	Prescribed	Prescribed	Prescribed
Dispersion	Algae	SOD	SOD	CH4 flux	NH4 flux	Inorg P flux	Evap
m2/s	Coverage	Coverage	gO2/m2/d	gO2/m2/d	mgN/m2/d	mgP/m2/d	mm/d
	10.00%	100.00%	#REF!				

QUAL2K
Stream Water Quality Model
Prairie Creek (8/22/1988)
Air Temperature Data:

				Upstream	Downstream
Upstream Label	Reach Label	Downstream Label	Reach Number	Distance km	Distance km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
Hourly air temperature for each reach (degrees C)												
(The input values are applied as point estimates at each time. Linear interpolation is used to estimate values between the hourly inputs.)												
26.67	26.11	26.67	25.56	25.56	25.00	27.22	29.44	31.67	31.67	32.78	34.44	35.56

1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
36.67	36.67	30.00	31.67	31.67	30.00	28.89	27.78	25.56	26.11	23.89

QUAL2K
Stream Water Quality Model
Prairie Creek (8/22/1988)
Dew Point Temperature Data:

Upstream Label	Reach Label	Downstream Label	Reach Number	Upstream Distance km	Downstream Distance km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

Hourly dewpoint temperature for each reach (degrees C)
(The input values are applied as point estimates at each time. Linear interpolation is used to estimate values between the hourly inputs.

12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
14.44	14.44	15.00	15.56	16.67	17.22	18.89	20.00	21.11	21.11	21.67	22.22	23.06

1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
23.89	23.89	22.22	21.67	20.56	20.00	21.67	21.67	21.67	21.67	21.67

QUAL2K
Stream Water Quality Model
Prairie Creek (8/22/1988)
Wind Speed Data:

Upstream Label	Reach Label	Downstream Label	Reach Number	Upstream Distance km	Downstream Distance km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

Wind speed for each reach 7m above water surface (m/s)
(The input values are applied as point estimates at each time. Linear interpolation is used to estimate values between the hourly inputs.)

12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
4.47	4.47	4.02	3.13	3.13	3.13	3.13	3.58	4.47	3.13	3.13	3.13	3.58

1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
4.02	3.58	4.02	3.58	2.68	0.00	0.00	2.23	0.00	0.00	0.00

QUAL2K
Stream Water Quality Model
Prairie Creek (8/22/1988)
Cloud Cover Data:

Upstream Label	Reach Label	Downstream Label	Reach Number	Upstream Distance km	Downstream Distance km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

Hourly cloud cover shade for each reach (Percent)

(Percent of sky that is covered by clouds. The input values are applied as point estimates at each time. Linear interpolation is used to estimate values between the hourly inputs.)

12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
42.0%	42.0%	42.0%	42.0%	42.0%	42.0%	39.4%	36.9%	34.3%	31.7%	29.1%	26.6%	24.0%

1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
26.0%	28.0%	30.0%	32.0%	34.0%	36.0%	36.0%	36.0%	36.0%	36.0%	36.0%

QUAL2K
Stream Water Quality Model
Prairie Creek (8/22/1988)
Shade Data:

				Upstream	Downstream
Upstream	Reach	Downstream	Reach	Distance	Distance
Label	Label	Label	Number	km	km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	8.6%	7.1%	5.7%	4.3%	2.9%	1.4%	0.0%
12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
Integrated hourly effective shade for each reach (Percent)												
(Percent of solar radiation that is blocked because of shade from topography and vegetation. Hourly values are applied as integrated values for each hour, e.g. the value at 12:00 AM is applied from 12:00 to 1:00 AM)												
10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	8.6%	7.1%	5.7%	4.3%	2.9%	1.4%	0.0%

0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

QUAL2K
Stream Water Quality Model
Prairie Creek (8/22/1988)
Water Column Rates

Parameter	Value	Units	Symbol
Stoichiometry:			
Carbon	40	gC	gC
Nitrogen	7.2	gN	gN
Phosphorus	1	gP	gP
Dry weight	100	gD	gD
Chlorophyll	1	gA	gA
Inorganic suspended solids:			
Settling velocity	0.1	m/d	v_i
Oxygen:			
Reaeration model	Internal		
User reaeration coefficient α	3.93		α
User reaeration coefficient β	0.5		β
User reaeration coefficient γ	1.5		γ
Temp correction	1.024		θ_a
Reaeration wind effect	None		
O2 for carbon oxidation	2.69	gO_2/gC	r_{oc}
O2 for NH4 nitrification	4.57	gO_2/gN	r_{on}
Oxygen inhib model CBOD oxidation	Exponential		
Oxygen inhib parameter CBOD oxidation	0.60	L/mgO2	K_{socf}
Oxygen inhib model nitrification	Exponential		
Oxygen inhib parameter nitrification	0.60	L/mgO2	K_{sona}
Oxygen enhance model denitrification	Exponential		
Oxygen enhance parameter denitrification	0.60	L/mgO2	K_{sodn}
Oxygen inhib model phyto resp	Exponential		
Oxygen inhib parameter phyto resp	0.60	L/mgO2	K_{sop}
Oxygen enhance model bot alg resp	Exponential		
Oxygen enhance parameter bot alg resp	0.60	L/mgO2	K_{sob}
Slow CBOD:			
Hydrolysis rate	0	/d	k_{hc}
Temp correction	1.07		θ_{hc}
Oxidation rate	0	/d	k_{dcs}
Temp correction	1.047		θ_{dcs}
Fast CBOD:			
Oxidation rate	2	/d	k_{dc}
Temp correction	1.047		θ_{dc}
Organic N:			
Hydrolysis	0.015	/d	k_{hn}
Temp correction	1.07		θ_{hn}
Settling velocity	0.0005	m/d	v_{on}
Ammonium:			

Nitrification	0.08	/d	k_{na}
Temp correction	1.07		θ_{na}
Nitrate:			
Denitrification	0.1	/d	k_{dn}
Temp correction	1.07		θ_{dn}
Sed denitrification transfer coeff	0.8	m/d	v_{di}
Temp correction	1.07		θ_{di}
Organic P:			
Hydrolysis	0.03	/d	k_{hp}
Temp correction	1.07		θ_{hp}
Settling velocity	0.001	m/d	v_{op}
Inorganic P:			
Settling velocity	0.8	m/d	v_{ip}
Inorganic P sorption coefficient	1000	L/mgD	K_{dpi}
Sed P oxygen attenuation half sat constant	1	mgO_2/L	k_{spi}
Phytoplankton:			
Max Growth rate	0	/d	k_{gp}
Temp correction	1.07		θ_{gp}
Respiration rate	0.15	/d	k_{rp}
Temp correction	1.07		θ_{rp}
Excretion rate	0.3	/d	k_{ep}
Temp correction	1.07		θ_{dp}
Death rate	0.1	/d	k_{dp}
Temp correction	1.07		θ_{dp}
External Nitrogen half sat constant	100	ugN/L	k_{sPp}
External Phosphorus half sat constant	10	ugP/L	k_{sNp}
Inorganic carbon half sat constant	1.30E-05	moles/L	k_{sCp}
Light model	Half saturation		
Light constant	250	langleys/d	K_{Lp}
Ammonia preference	25	ugN/L	k_{hnxp}
Subsistence quota for nitrogen	0	mgN/mgA	q_{0Np}
Subsistence quota for phosphorus	0	mgP/mgA	q_{0Pp}
Maximum uptake rate for nitrogen	0	mgN/mgA/d	ρ_{mNp}
Maximum uptake rate for phosphorus	0	mgP/mgA/d	ρ_{mPp}
Internal nitrogen half sat constant	0	mgN/mgA	K_{qNp}
Internal phosphorus half sat constant	0	mgP/mgA	K_{qPp}
Settling velocity	0	m/d	v_a
Bottom Algae:			
Growth model	Zero-order		
Max Growth rate	400	$mgA/m^2/d$ or /d	C_{gb}
Temp correction	1.07		θ_{gb}
First-order model carrying capacity	1000	mgA/m^2	$a_{b,max}$
Respiration rate	0.4	/d	k_{rb}
Temp correction	1.07		θ_{rb}
Excretion rate	0.12	/d	k_{eb}

Temp correction	1.07		θ_{db}
Death rate	0.1	/d	k_{db}
Temp correction	1.07		θ_{db}
External nitrogen half sat constant	300	ugN/L	k_{sPb}
External phosphorus half sat constant	100	ugP/L	k_{sNb}
Inorganic carbon half sat constant	1.30E-05	moles/L	k_{sCb}
Light model	Half saturation		
Light constant	100	langleys/d	K_{Lb}
Ammonia preference	25	ugN/L	k_{hnxb}
Subsistence quota for nitrogen	0.72	mgN/mgA	q_{0N}
Subsistence quota for phosphorus	0.1	mgP/mgA	q_{0P}
Maximum uptake rate for nitrogen	72	mgN/mgA/d	ρ_{mN}
Maximum uptake rate for phosphorus	5	mgP/mgA/d	ρ_{mP}
Internal nitrogen half sat constant	0.9	mgN/mgA	K_{qN}
Internal phosphorus half sat constant	0.13	mgP/mgA	K_{qP}
Detritus (POM):			
Dissolution rate	0.23	/d	k_{dt}
Temp correction	1.07		θ_{dt}
Fraction of dissolution to fast CBOD	1.00		F_f
Settling velocity	0.008	m/d	v_{dt}
Pathogens:			
Decay rate	0.8	/d	k_{dx}
Temp correction	1.07		θ_{dx}
Settling velocity	1	m/d	v_x
Light efficiency factor	1.00		α_{path}
pH:			
Partial pressure of carbon dioxide	347	ppm	p_{CO2}
Constituent i			
First-order reaction rate	0	/d	
Temp correction	1		θ_{dx}
Settling velocity	0	m/d	v_{dt}
Constituent ii			
First-order reaction rate	0	/d	
Temp correction	1		θ_{dx}
Settling velocity	0	m/d	v_{dt}
Constituent iii			
First-order reaction rate	0	/d	
Temp correction	1		θ_{dx}
Settling velocity	0	m/d	v_{dt}

QUAL2K
Stream Water Quality Model
Prairie Creek (8/22/1988)
Light Parameters and Surface Heat Transfer Models:

Parameter	*Value*	*Unit*	
Photosynthetically Available Radiation	0.47		
Background light extinction	0.2	/m	k_{eb}
Linear chlorophyll light extinction	0.0088	1/m-(ugA/L)	α_p
Nonlinear chlorophyll light extinction	0.054	1/m-(ugA/L)2/3	α_{pn}
ISS light extinction	0.052	1/m-(mgD/L)	α_i
Detritus light extinction	0.174	1/m-(mgD/L)	α_o
Solar shortwave radiation model			
Atmospheric attenuation model for solar	Bras		
Bras solar parameter (used if Bras solar model is selected)			
atmospheric turbidity coefficient (2=clear, 5=smoggy, default	2		n_{fac}
Ryan-Stolzenbach solar parameter (used if Ryan-Stolzenbach solar model is selected)			
atmospheric transmission coefficient (0.70-0.91, default 0.8)	0.8		a_{tc}
Downwelling atmospheric longwave IR radiation			
atmospheric longwave emissivity model	Brunt		
Evaporation and air convection/conduction			
wind speed function for evaporation and air convection/cond	Brady-Graves-Geyer		
Sediment heat parameters			
Sediment thermal thickness	15	cm	H_s
Sediment thermal diffusivity	0.0064	cm^2/s	α_s
Sediment density	1.6	g/cm^3	ρ_s
Water density	1	g/cm^3	ρ_w
Sediment heat capacity	0.4	$cal/(g\ ^oC)$	C_{ps}
Water heat capacity	1	$cal/(g\ ^oC)$	C_{pw}
Sediment diagenesis model			
Compute SOD and nutrient fluxes	No		

QUAL2K
Stream Water Quality Model
Prairie Creek (8/22/1988)
Point Source Data:

				Point		Temperature			Specific Conductance			Inorganic Suspended Solids		
	Tributary	Headwater	Location	Abstraction	Inflow	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of
Name	No.	Label	km	m3/s	m3/s	°C	°C	max	umhos	umhos	max	mg/L	mg/L	max
Carthage STP	0	Mainstem headwater	1.90		0.0220	22.00								

Dissolved Oxygen			Slow CBOD			Fast CBOD			Organic N			Ammonia N		
mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of
mg/L	mg/L	max	mgO2/L	mgO2/L	max	mgO2/L	mgO2/L	max	ugN/L	ugN/L	max	ugN/L	ugN/L	max
6.00	0.00					#REF!			2000.00			8300.00		

Nitrate + Nitrite N			Organic P			Inorganic P			Phytoplankton			Internal Nitrogen		
mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of
ugN/L	ugN/L	max	ugP/L	ugP/L	max	ugP/L	ugP/L	max	ugA/L	ugA/L	max	ugN/L	ugN/L	max
			2000.00			900.00								

Internal Phosphorus			Detritus			athogen Indicator Bacter			Alkalinity			Constituent i		
mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of
ugP/L	ugP/L	max	mgD/L	mgD/L	max	cfu/10(	cfu/100m	max	gCaCO3	gCaCO3/	max			max
									100.00					

Constituent ii			Constituent iii			pH		
mean	range/2	time of	mean	range/2	time of	mean	range/2	time of
		max			max	s.u.	s.u.	max
						7.00		

QUAL2K
Stream Water Quality Model
Rock Creek (9/1/2012)
Headwater Data:

Number of Headwaters	1										
Headwater 0 (Mainstem)											
Headwater label	Reach No	Flow	Elevation	Weir				Rating Curves			
		Rate		Weir	Height	Width	adam	bdam	Velocity		Depth
		(m^3/s)	(m)	Type	(m)	(m)			Coefficient	Exponent	Coefficient
Mainstem headwater	1	0.005	222.740				1.2500	0.9000			
Water Quality Constituents	Units	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM
Temperature	C	26.89	26.62	26.59	26.49	26.34	26.23	26.09	26.08	26.09	26.33
Conductivity	umhos	866.90	867.70	869.40	869.80	871.00	871.80	872.00	872.00	872.10	872.50
Inorganic Solids	mgD/L	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
Dissolved Oxygen	mg/L	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
CBODslow	mgO2/L										
CBODfast	mgO2/L	16.56	16.56	16.56	16.56	16.56	16.56	16.56	16.56	16.56	16.56
Organic Nitrogen	ugN/L	81.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00
NH4-Nitrogen	ugN/L	31.50	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00
NO3-Nitrogen	ugN/L	450.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00
Organic Phosphorus	ugP/L	4.50	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Inorganic Phosphorus (SRP)	ugP/L	4.50	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Phytoplankton	ugA/L	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
Internal Nitrogen (INP)	ugN/L	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84
Internal Phosphorus (IPP)	ugP/L	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
Detritus (POM)	mgD/L	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03
Pathogen	cfu/100 mL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alkalinity	mgCaCO3/L	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00
Constituent i		400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00
Constituent ii											
Constituent iii											
pH	s.u.	8.63	8.61	8.58	8.56	8.53	8.49	8.48	8.49	8.49	8.55

Manning Formula						Prescribed					
	Channel	Manning	Bot Width	Side	Side	Dispersion					
Exponent	Slope	n	m	Slope	Slope	m2/s					
	0.00026	0.0400	1.00	1.00	1.00	0.00					
10:00 AM	*11:00 AM*	*12:00 PM*	*1:00 PM*	*2:00 PM*	*3:00 PM*	*4:00 PM*	*5:00 PM*	*6:00 PM*	*7:00 PM*	*8:00 PM*	*9:00 PM*
26.49	27.12	27.42	27.76	28.44	28.71	29.04	29.14	29.12	29.01	28.84	28.59
873.10	871.80	871.80	869.90	866.50	864.90	862.00	858.10	858.10	856.70	857.90	860.60
33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
16.56	16.56	16.56	16.56	16.56	16.56	16.56	16.56	16.56	16.56	16.56	16.56
36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00
14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00
200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00
2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84
26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00
400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00
8.57	8.67	8.68	8.75	8.82	8.83	8.86	8.86	8.84	8.80	8.76	8.72

10:00 PM	*11:00 PM*
28.37	28.19
860.70	864.30
33.00	33.00
6.00	6.00
16.56	16.56
36.00	36.00
14.00	14.00
200.00	200.00
2.00	2.00
2.00	2.00
26.11	26.11
429.84	429.84
26.11	26.11
10.03	10.03
0.00	0.00
230.00	230.00
400.00	400.00
8.70	8.66

QUAL2K
Stream Water Quality Model
Rock Creek (9/1/2012)
Reach Data:

Reach for diel plot	1											
Element for diel plot	1	Reach	Headwater	Reach			Location		Element	Elevation	
Reach	Downstream	Number	Reach	length	Downstream		Upstream	Downstream	Number	Upstream	Downstream
Label	end of reach label			(km)	Latitude	Longitude	(km)	(km)	>=1	(m)	(m)
Mainstem headwater		1	Yes	1.00	42.28	88.23	2.000	1.000	10	222.740	222.740

Downstream					
Latitude			Longitude		
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
42.00	17	1	88.00	14	0.601414

Hydraulic Model (Weir Overrides Manning Formula; Manning Formula Override Rating Curves)													
Weir					Rating Curves				Manning Formula				
Weir	Height	Width	adam	bdam	Velocity		Depth		Channel	Manning	Bot Width	Side	Side
Type	(m)	(m)			Coefficient	Exponent	Coefficient	Exponent	Slope	n	m	Slope	Slope
			1.2500	0.9000					0.0003	0.0400	1.00	0.5000	0.5000

Prescribed	Bottom	Bottom	Prescribed	Prescribed	Prescribed	Prescribed	Prescribed
Dispersion	Algae	SOD	SOD	CH4 flux	NH4 flux	Inorg P flux	Evap
m2/s	Coverage	Coverage	gO2/m2/d	gO2/m2/d	mgN/m2/d	mgP/m2/d	mm/d
	100.00%	100.00%	18.00				

QUAL2K
Stream Water Quality Model
Rock Creek (9/1/2012)
Air Temperature Data:

				Upstream	Downstream
Upstream Label	Reach Label	Downstream Label	Reach Number	Distance km	Distance km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
Hourly air temperature for each reach (degrees C)												
(The input values are applied as point estimates at each time. Linear interpolation is used to estimate values between the hourly inputs.)												
26.67	26.11	26.67	25.56	25.56	25.00	27.22	29.44	31.67	31.67	32.78	34.44	35.56

1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
36.67	36.67	30.00	31.67	31.67	30.00	28.89	27.78	25.56	26.11	23.89

QUAL2K
Stream Water Quality Model
Rock Creek (9/1/2012)
Dew Point Temperature Data:

Upstream Label	Reach Label	Downstream Label	Reach Number	Upstream Distance km	Downstream Distance km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

Hourly dewpoint temperature for each reach (degrees C)

(The input values are applied as point estimates at each time. Linear interpolation is used to estimate values between the hourly inputs.)

12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
14.44	14.44	15.00	15.56	16.67	17.22	18.89	20.00	21.11	21.11	21.67	22.22	23.06

1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
23.89	23.89	22.22	21.67	20.56	20.00	21.67	21.67	21.67	21.67	21.67

QUAL2K
Stream Water Quality Model
Rock Creek (9/1/2012)
Wind Speed Data:

				Upstream	Downstream
Upstream	*Reach*	*Downstream*	*Reach*	*Distance*	*Distance*
Label	*Label*	*Label*	*Number*	*km*	*km*
Mainstem headwater	Mainstem headwater		1	2.00	1.00

12:00 AM	*1:00 AM*	*2:00 AM*	*3:00 AM*	*4:00 AM*	*5:00 AM*	*6:00 AM*	*7:00 AM*	*8:00 AM*	*9:00 AM*	*10:00 AM*	*11:00 AM*	*12:00 PM*
Wind speed for each reach 7m above water surface (m/s)												
(The input values are applied as point estimates at each time. Linear interpolation is used to estimate values between the hourly inputs.)												
4.47	4.47	4.02	3.13	3.13	3.13	3.13	3.58	4.47	3.13	3.13	3.13	3.58

1:00 PM	*2:00 PM*	*3:00 PM*	*4:00 PM*	*5:00 PM*	*6:00 PM*	*7:00 PM*	*8:00 PM*	*9:00 PM*	*10:00 PM*	*11:00 PM*
4.02	3.58	4.02	3.58	2.68	0.00	0.00	2.23	0.00	0.00	0.00

QUAL2K
Stream Water Quality Model
Rock Creek (9/1/2012)
Cloud Cover Data:

Upstream Label	Reach Label	Downstream Label	Reach Number	Upstream Distance km	Downstream Distance km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
Hourly cloud cover shade for each reach (Percent)												
(Percent of sky that is covered by clouds. The input values are applied as point estimates at each time. Linear interpolation is used to estimate values between the hourly inputs.)												
42.0%	42.0%	42.0%	42.0%	42.0%	42.0%	39.4%	36.9%	34.3%	31.7%	29.1%	26.6%	24.0%

1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
26.0%	28.0%	30.0%	32.0%	34.0%	36.0%	36.0%	36.0%	36.0%	36.0%	36.0%

QUAL2K
Stream Water Quality Model
Rock Creek (9/1/2012)
Shade Data:

Upstream Label	Reach Label	Downstream Label	Reach Number	Upstream Distance km	Downstream Distance km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

Integrated hourly effective shade for each reach (Percent)

(Percent of solar radiation that is blocked because of shade from topography and vegetation. Hourly values are applied as integrated values for each hour, e.g. the value at 12:00 AM is applied from 12:00 to 1:00 AM)

12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	8.6%	7.1%	5.7%	4.3%	2.9%	1.4%	0.0%
10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	8.6%	7.1%	5.7%	4.3%	2.9%	1.4%	0.0%

1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

QUAL2K
Stream Water Quality Model
Rock Creek (9/1/2012)
Water Column Rates

Parameter	Value	Units	Symbol
Stoichiometry:			
Carbon	40	gC	gC
Nitrogen	7.2	gN	gN
Phosphorus	1	gP	gP
Dry weight	100	gD	gD
Chlorophyll	1	gA	gA
Inorganic suspended solids:			
Settling velocity	0.1	m/d	v_i
Oxygen:			
Reaeration model	Internal		
User reaeration coefficient α	3.93		α
User reaeration coefficient β	0.5		β
User reaeration coefficient γ	1.5		γ
Temp correction	1.024		θ_a
Reaeration wind effect	None		
O2 for carbon oxidation	2.69	gO_2/gC	r_{oc}
O2 for NH4 nitrification	4.57	gO_2/gN	r_{on}
Oxygen inhib model CBOD oxidation	Exponential		
Oxygen inhib parameter CBOD oxidation	0.60	L/mgO2	K_{socf}
Oxygen inhib model nitrification	Exponential		
Oxygen inhib parameter nitrification	0.60	L/mgO2	K_{sona}
Oxygen enhance model denitrification	Exponential		
Oxygen enhance parameter denitrification	0.60	L/mgO2	K_{sodn}
Oxygen inhib model phyto resp	Exponential		
Oxygen inhib parameter phyto resp	0.60	L/mgO2	K_{sop}
Oxygen enhance model bot alg resp	Exponential		
Oxygen enhance parameter bot alg resp	0.60	L/mgO2	K_{sob}
Slow CBOD:			
Hydrolysis rate	0	/d	k_{hc}
Temp correction	1.07		θ_{hc}
Oxidation rate	0	/d	k_{dcs}
Temp correction	1.047		θ_{dcs}
Fast CBOD:			
Oxidation rate	0.2	/d	k_{dc}
Temp correction	1.047		θ_{dc}
Organic N:			
Hydrolysis	0.015	/d	k_{hn}
Temp correction	1.07		θ_{hn}
Settling velocity	0.0005	m/d	v_{on}
Ammonium:			

Nitrification	**0.08**	**/d**	k_{na}
Temp correction	**1.07**		θ_{na}
Nitrate:			
Denitrification	**0.1**	**/d**	k_{dn}
Temp correction	**1.07**		θ_{dn}
Sed denitrification transfer coeff	**0.8**	**m/d**	v_{di}
Temp correction	**1.07**		θ_{di}
Organic P:			
Hydrolysis	**0.03**	**/d**	k_{hp}
Temp correction	**1.07**		θ_{hp}
Settling velocity	**0.001**	**m/d**	v_{op}
Inorganic P:			
Settling velocity	**0.8**	**m/d**	v_{ip}
Inorganic P sorption coefficient	**1000**	**L/mgD**	K_{dpi}
Sed P oxygen attenuation half sat constant	**1**	**mgO_2/L**	k_{spi}
Phytoplankton:			
Max Growth rate	**0**	**/d**	k_{gp}
Temp correction	**1.07**		θ_{gp}
Respiration rate	**0.15**	**/d**	k_{rp}
Temp correction	**1.07**		θ_{rp}
Excretion rate	**0.3**	**/d**	k_{ep}
Temp correction	**1.07**		θ_{dp}
Death rate	**0.1**	**/d**	k_{dp}
Temp correction	**1.07**		θ_{dp}
External Nitrogen half sat constant	**100**	**ugN/L**	k_{sPp}
External Phosphorus half sat constant	**10**	**ugP/L**	k_{sNp}
Inorganic carbon half sat constant	**1.30E-05**	**moles/L**	k_{sCp}
Light model	**Half saturation**		
Light constant	**250**	**langleys/d**	K_{Lp}
Ammonia preference	**25**	**ugN/L**	k_{hnxp}
Subsistence quota for nitrogen	**0**	**mgN/mgA**	q_{0Np}
Subsistence quota for phosphorus	**0**	**mgP/mgA**	q_{0Pp}
Maximum uptake rate for nitrogen	**0**	**mgN/mgA/d**	ρ_{mNp}
Maximum uptake rate for phosphorus	**0**	**mgP/mgA/d**	ρ_{mPp}
Internal nitrogen half sat constant	**0**	**mgN/mgA**	K_{qNp}
Internal phosphorus half sat constant	**0**	**mgP/mgA**	K_{qPp}
Settling velocity	**0**	**m/d**	v_a
Bottom Algae:			
Growth model	**Zero-order**		
Max Growth rate	**400**	**$mgA/m^2/d$ or /d**	C_{gb}
Temp correction	**1.07**		θ_{gb}
First-order model carrying capacity	**1000**	**mgA/m^2**	$a_{b,max}$
Respiration rate	**0.4**	**/d**	k_{rb}
Temp correction	**1.07**		θ_{rb}
Excretion rate	**0.12**	**/d**	k_{eb}

Temp correction	1.07		θ_{db}
Death rate	0.1	/d	k_{db}
Temp correction	1.07		θ_{db}
External nitrogen half sat constant	300	ugN/L	k_{sPb}
External phosphorus half sat constant	100	ugP/L	k_{sNb}
Inorganic carbon half sat constant	1.30E-05	moles/L	k_{sCb}
Light model	Half saturation		
Light constant	100	langleys/d	K_{Lb}
Ammonia preference	25	ugN/L	k_{hnxb}
Subsistence quota for nitrogen	0.72	mgN/mgA	q_{0N}
Subsistence quota for phosphorus	0.1	mgP/mgA	q_{0P}
Maximum uptake rate for nitrogen	72	mgN/mgA/d	ρ_{mN}
Maximum uptake rate for phosphorus	5	mgP/mgA/d	ρ_{mP}
Internal nitrogen half sat constant	0.9	mgN/mgA	K_{qN}
Internal phosphorus half sat constant	0.13	mgP/mgA	K_{qP}
Detritus (POM):			
Dissolution rate	0.23	/d	k_{dt}
Temp correction	1.07		θ_{dt}
Fraction of dissolution to fast CBOD	1.00		F_f
Settling velocity	0.008	m/d	v_{dt}
Pathogens:			
Decay rate	0.8	/d	k_{dx}
Temp correction	1.07		θ_{dx}
Settling velocity	1	m/d	v_x
Light efficiency factor	1.00		α_{path}
pH:			
Partial pressure of carbon dioxide	347	ppm	p_{CO2}
Constituent i			
First-order reaction rate	0	/d	
Temp correction	1		θ_{dx}
Settling velocity	0	m/d	v_{dt}
Constituent ii			
First-order reaction rate	0	/d	
Temp correction	1		θ_{dx}
Settling velocity	0	m/d	v_{dt}
Constituent iii			
First-order reaction rate	0	/d	
Temp correction	1		θ_{dx}
Settling velocity	0	m/d	v_{dt}

QUAL2K
Stream Water Quality Model
Rock Creek (9/1/2012)
Light Parameters and Surface Heat Transfer Models:

Parameter	*Value*	*Unit*	
Photosynthetically Available Radiation	0.47		
Background light extinction	0.2	/m	k_{eb}
Linear chlorophyll light extinction	0.0088	1/m-(ugA/L)	α_p
Nonlinear chlorophyll light extinction	0.054	1/m-(ugA/L)2/3	α_{pn}
ISS light extinction	0.052	1/m-(mgD/L)	α_i
Detritus light extinction	0.174	1/m-(mgD/L)	α_o
Solar shortwave radiation model			
Atmospheric attenuation model for solar	Bras		
Bras solar parameter (used if Bras solar model is selected)			
atmospheric turbidity coefficient (2=clear, 5=smoggy, default=2)	2		n_{fac}
Ryan-Stolzenbach solar parameter (used if Ryan-Stolzenbach solar model is selected)			
atmospheric transmission coefficient (0.70-0.91, default 0.8)	0.8		a_{tc}
Downwelling atmospheric longwave IR radiation			
atmospheric longwave emissivity model	Brunt		
Evaporation and air convection/conduction			
wind speed function for evaporation and air convection/conduc	ady-Graves-Geyer		
Sediment heat parameters			
Sediment thermal thickness	15	cm	H_s
Sediment thermal diffusivity	0.0064	cm^2/s	α_s
Sediment density	1.6	g/cm^3	ρ_s
Water density	1	g/cm^3	ρ_w
Sediment heat capacity	0.4	cal/(g ^{o}C)	C_{ps}
Water heat capacity	1	cal/(g ^{o}C)	C_{pw}
Sediment diagenesis model			
Compute SOD and nutrient fluxes	No		

QUAL2K
Stream Water Quality Model
Rock Creek (9/1/2012)
Diffuse Source Data:

	Tributary	Headwater	Location Up	Location Down	Diffuse Abstraction	Diffuse Inflow	Temp	Spec Cond	Inorg SS	Diss Oxygen	CBOD slow	CBOD fast	Organic N
agriculture runoff	0	Mainstem headwater	2.00	1.00		0.0001							

	10000		7000										
Ammon N	Nitrate N	Organic P	Inorganic P	Phyto plankton	Internal Nitrogen	Internal hosphoru	Detritus	Pathogen	Alk	Constituen i	Constituent ii	Constituent iii	pH
	450.00		315.00									100.00	7.00

QUAL2K
Stream Water Quality Model
S. Branch La Moine Creek (8/22/1988)
Headwater Data:

Number of Headwaters	1

Headwater 0 (Mainstem)

Headwater label	Reach No	Flow	Elevation	Weir				Rating Curves			
		Rate		Weir	Height	Width	adam	bdam	Velocity		Depth
		(m^3/s)	(m)	Type	(m)	(m)			Coefficient	Exponent	Coefficient
Mainstem headwater	1	0.00170	222.740				1.2500	0.9000			
Water Quality Constituents	**Units**	**12:00 AM**	**1:00 AM**	**2:00 AM**	**3:00 AM**	**4:00 AM**	**5:00 AM**	**6:00 AM**	**7:00 AM**	**8:00 AM**	**9:00 AM**
Temperature	C	26.89	26.62	26.59	26.49	26.34	26.23	26.09	26.08	26.09	26.33
Conductivity	umhos	866.90	867.70	869.40	869.80	871.00	871.80	872.00	872.00	872.10	872.50
Inorganic Solids	mgD/L	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
Dissolved Oxygen	mg/L	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10
CBODslow	mgO2/L										
CBODfast	mgO2/L	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Organic Nitrogen	ugN/L	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00
NH4-Nitrogen	ugN/L	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00
NO3-Nitrogen	ugN/L	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
Organic Phosphorus	ugP/L	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Inorganic Phosphorus (SRP)	ugP/L	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Phytoplankton	ugA/L	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
Internal Nitrogen (INP)	ugN/L	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84
Internal Phosphorus (IPP)	ugP/L	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
Detritus (POM)	mgD/L	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03
Pathogen	cfu/100 mL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alkalinity	mgCaCO3/L	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00
Constituent i		400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00
Constituent ii											
Constituent iii											
pH	s.u.	8.63	8.61	8.58	8.56	8.53	8.49	8.48	8.49	8.49	8.55

Manning Formula						*Prescribed*							
	Channel	*Manning*	*Bot Width*	*Side*	*Side*	*Dispersion*							
Exponent	*Slope*	*n*	*m*	*Slope*	*Slope*	*m2/s*							
	0.004	0.0400	1.00	1.00	1.00	0.00							
10:00 AM	*11:00 AM*	*12:00 PM*	*1:00 PM*	*2:00 PM*	*3:00 PM*	*4:00 PM*	*5:00 PM*	*6:00 PM*	*7:00 PM*	*8:00 PM*	*9:00 PM*	*10:00 PM*	*11:00 PM*
26.49	27.12	27.42	27.76	28.44	28.71	29.04	29.14	29.12	29.01	28.84	28.59	28.37	28.19
873.10	871.80	871.80	869.90	866.50	864.90	862.00	858.10	858.10	856.70	857.90	860.60	860.70	864.30
33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10	12.10
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00	1800.00
500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00	500.00
800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00	800.00
30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84	429.84
26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11	26.11
10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03	10.03
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00	230.00
400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00
8.57	8.67	8.68	8.75	8.82	8.83	8.86	8.86	8.84	8.80	8.76	8.72	8.70	8.66

QUAL2K
Stream Water Quality Model
S. Branch Lamoine Creek (8/22/1988)
Reach Data:

Reach for diel plot	1										
Element for diel plot	1	Reach	Headwater	Reach			Location		Element	Elevation	
Reach	Downstream	Number	Reach	length	Downstream		Upstream	Downstream	Number	Upstream	Downstream
Label	end of reach label			(km)	Latitude	Longitude	(km)	(km)	>=1	(m)	(m)
Mainstem headwater		1	Yes	1.00	42.28	88.23	2.000	1.000	10	222.740	222.740

Downstream					
Latitude			Longitude		
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
42.00	17	1	88.00	14	0.601414

Hydraulic Model (Weir Overrides Manning Formula; Manning Formula Override Rating Curves)													
Weir					Rating Curves				Manning Formula				
Weir	Height	Width	adam	bdam	Velocity		Depth		Channel	Manning	Bot Width	Side	Side
Type	(m)	(m)			Coefficient	Exponent	Coefficient	Exponent	Slope	n	m	Slope	Slope
			1.2500	0.9000					0.0003	0.0400	1.00	0.5000	0.5000

Prescribed	Bottom	Bottom	Prescribed	rescribe	Prescribed	Prescribed	Prescribed
Dispersion	Algae	SOD	SOD	CH4 flux	NH4 flux	Inorg P flux	Evap
m2/s	Coverage	Coverage	gO2/m2/d	)O2/m2/(	mgN/m2/d	mgP/m2/d	mm/d
	10.00%	100.00%	#REF!				

QUAL2K

Stream Water Quality Model

S. Branch La Moine Creek (8/22/1988)

Air Temperature Data:

Upstream Label	Reach Label	Downstream Label	Reach Number	Upstream Distance km	Downstream Distance km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
Hourly air temperature for each reach (degrees C)												
(The input values are applied as point estimates at each time. Linear interpolation is used to estimate values between the hourly inputs.)												
26.67	26.11	26.67	25.56	25.56	25.00	27.22	29.44	31.67	31.67	32.78	34.44	35.56

1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
36.67	36.67	30.00	31.67	31.67	30.00	28.89	27.78	25.56	26.11	23.89

QUAL2K
Stream Water Quality Model
S. Branch La Moine Creek (8/22/1988)
Dew Point Temperature Data:

Upstream Label	Reach Label	Downstream Label	Reach Number	Upstream Distance km	Downstream Distance km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

Hourly dewpoint temperature for each reach (degrees C)

(The input values are applied as point estimates at each time. Linear interpolation is used to estimate values between the hourly inputs.)

12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
14.44	14.44	15.00	15.56	16.67	17.22	18.89	20.00	21.11	21.11	21.67	22.22	23.06

1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
23.89	23.89	22.22	21.67	20.56	20.00	21.67	21.67	21.67	21.67	21.67

QUAL2K
Stream Water Quality Model
S. Branch La Moine Creek (8/22/1988)
Wind Speed Data:

Upstream Label	Reach Label	Downstream Label	Reach Number	Upstream Distance km	Downstream Distance km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

Wind speed for each reach 7m above water surface (m/s)

(The input values are applied as point estimates at each time. Linear interpolation is used to estimate values between the hourly inputs.)

12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
4.47	4.47	4.02	3.13	3.13	3.13	3.13	3.58	4.47	3.13	3.13	3.13	3.58

1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
4.02	3.58	4.02	3.58	2.68	0.00	0.00	2.23	0.00	0.00	0.00

QUAL2K
Stream Water Quality Model
S. Branch La Moine Creek (8/22/1988)
Cloud Cover Data:

				Upstream	Downstream
Upstream Label	Reach Label	Downstream Label	Reach Number	Distance km	Distance km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
Hourly cloud cover shade for each reach (Percent)												
(Percent of sky that is covered by clouds. The input values are applied as point estimates at each time. Linear interpolation is used to estimate values between the hourly inputs												
42.0%	42.0%	42.0%	42.0%	42.0%	42.0%	39.4%	36.9%	34.3%	31.7%	29.1%	26.6%	24.0%

1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
26.0%	28.0%	30.0%	32.0%	34.0%	36.0%	36.0%	36.0%	36.0%	36.0%	36.0%

QUAL2K
Stream Water Quality Model
S. Branch La Moine Creek (8/22/1988)
Shade Data:

				Upstream	Downstream
Upstream	Reach	Downstream	Reach	Distance	Distance
Label	Label	Label	Number	km	km
Mainstem headwater	Mainstem headwater		1	2.00	1.00

10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	8.6%	7.1%	5.7%	4.3%	2.9%	1.4%	0.0%
12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM
Integrated hourly effective shade for each reach (Percent)												
(Percent of solar radiation that is blocked because of shade from topography and vegetation. Hourly values are applied as integrated values for each hour, e.g. the value at 12:00 AM is applied from 12:00 to 1:00 AM)												
10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	8.6%	7.1%	5.7%	4.3%	2.9%	1.4%	0.0%

0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

QUAL2K
Stream Water Quality Model
S. Branch La Moine Creek (8/22/1988)
Water Column Rates

Parameter	Value	Units	Symbol
Stoichiometry:			
Carbon	40	gC	gC
Nitrogen	7.2	gN	gN
Phosphorus	1	gP	gP
Dry weight	100	gD	gD
Chlorophyll	1	gA	gA
Inorganic suspended solids:			
Settling velocity	0.1	m/d	v_i
Oxygen:			
Reaeration model	Internal		
User reaeration coefficient α	3.93		α
User reaeration coefficient β	0.5		β
User reaeration coefficient γ	1.5		γ
Temp correction	1.024		θ_a
Reaeration wind effect	None		
O2 for carbon oxidation	2.69	gO_2/gC	r_{oc}
O2 for NH4 nitrification	4.57	gO_2/gN	r_{on}
Oxygen inhib model CBOD oxidation	Exponential		
Oxygen inhib parameter CBOD oxidation	0.60	L/mgO2	K_{socf}
Oxygen inhib model nitrification	Exponential		
Oxygen inhib parameter nitrification	0.60	L/mgO2	K_{sona}
Oxygen enhance model denitrification	Exponential		
Oxygen enhance parameter denitrification	0.60	L/mgO2	K_{sodn}
Oxygen inhib model phyto resp	Exponential		
Oxygen inhib parameter phyto resp	0.60	L/mgO2	K_{sop}
Oxygen enhance model bot alg resp	Exponential		
Oxygen enhance parameter bot alg resp	0.60	L/mgO2	K_{sob}
Slow CBOD:			
Hydrolysis rate	0	/d	k_{hc}
Temp correction	1.07		θ_{hc}
Oxidation rate	0	/d	k_{dcs}
Temp correction	1.047		θ_{dcs}
Fast CBOD:			
Oxidation rate	2	/d	k_{dc}
Temp correction	1.047		θ_{dc}
Organic N:			
Hydrolysis	0.015	/d	k_{hn}
Temp correction	1.07		θ_{hn}
Settling velocity	0.0005	m/d	v_{on}
Ammonium:			

Nitrification	**0.08**	**/d**	k_{na}
Temp correction	**1.07**		θ_{na}
Nitrate:			
Denitrification	**0.1**	**/d**	k_{dn}
Temp correction	**1.07**		θ_{dn}
Sed denitrification transfer coeff	**0.8**	**m/d**	v_{di}
Temp correction	**1.07**		θ_{di}
Organic P:			
Hydrolysis	**0.03**	**/d**	k_{hp}
Temp correction	**1.07**		θ_{hp}
Settling velocity	**0.001**	**m/d**	v_{op}
Inorganic P:			
Settling velocity	**0.8**	**m/d**	v_{ip}
Inorganic P sorption coefficient	**1000**	**L/mgD**	K_{dpi}
Sed P oxygen attenuation half sat constant	**1**	**mgO_2/L**	k_{spi}
Phytoplankton:			
Max Growth rate	**0**	**/d**	k_{gp}
Temp correction	**1.07**		θ_{gp}
Respiration rate	**0.15**	**/d**	k_{rp}
Temp correction	**1.07**		θ_{rp}
Excretion rate	**0.3**	**/d**	k_{ep}
Temp correction	**1.07**		θ_{dp}
Death rate	**0.1**	**/d**	k_{dp}
Temp correction	**1.07**		θ_{dp}
External Nitrogen half sat constant	**100**	**ugN/L**	k_{sPp}
External Phosphorus half sat constant	**10**	**ugP/L**	k_{sNp}
Inorganic carbon half sat constant	**1.30E-05**	**moles/L**	k_{sCp}
Light model	**Half saturation**		
Light constant	**250**	**langleys/d**	K_{Lp}
Ammonia preference	**25**	**ugN/L**	k_{hnxp}
Subsistence quota for nitrogen	**0**	**mgN/mgA**	q_{0Np}
Subsistence quota for phosphorus	**0**	**mgP/mgA**	q_{0Pp}
Maximum uptake rate for nitrogen	**0**	**mgN/mgA/d**	ρ_{mNp}
Maximum uptake rate for phosphorus	**0**	**mgP/mgA/d**	ρ_{mPp}
Internal nitrogen half sat constant	**0**	**mgN/mgA**	K_{qNp}
Internal phosphorus half sat constant	**0**	**mgP/mgA**	K_{qPp}
Settling velocity	**0**	**m/d**	v_a
Bottom Algae:			
Growth model	**Zero-order**		
Max Growth rate	**400**	**$mgA/m^2/d$ or /d**	C_{gb}
Temp correction	**1.07**		θ_{gb}
First-order model carrying capacity	**1000**	**mgA/m^2**	$a_{b,max}$
Respiration rate	**0.4**	**/d**	k_{rb}
Temp correction	**1.07**		θ_{rb}
Excretion rate	**0.12**	**/d**	k_{eb}

Temp correction	**1.07**		θ_{db}
Death rate	**0.1**	**/d**	k_{db}
Temp correction	**1.07**		θ_{db}
External nitrogen half sat constant	**300**	**ugN/L**	k_{sPb}
External phosphorus half sat constant	**100**	**ugP/L**	k_{sNb}
Inorganic carbon half sat constant	**1.30E-05**	**moles/L**	k_{sCb}
Light model	**Half saturation**		
Light constant	**100**	**langleys/d**	K_{Lb}
Ammonia preference	**25**	**ugN/L**	k_{hnxb}
Subsistence quota for nitrogen	**0.72**	**mgN/mgA**	q_{0N}
Subsistence quota for phosphorus	**0.1**	**mgP/mgA**	q_{0P}
Maximum uptake rate for nitrogen	**72**	**mgN/mgA/d**	ρ_{mN}
Maximum uptake rate for phosphorus	**5**	**mgP/mgA/d**	ρ_{mP}
Internal nitrogen half sat constant	**0.9**	**mgN/mgA**	K_{qN}
Internal phosphorus half sat constant	**0.13**	**mgP/mgA**	K_{qP}
Detritus (POM):			
Dissolution rate	**0.23**	**/d**	k_{dt}
Temp correction	**1.07**		θ_{dt}
Fraction of dissolution to fast CBOD	**1.00**		F_f
Settling velocity	**0.008**	**m/d**	v_{dt}
Pathogens:			
Decay rate	**0.8**	**/d**	k_{dx}
Temp correction	**1.07**		θ_{dx}
Settling velocity	**1**	**m/d**	v_x
Light efficiency factor	**1.00**		α_{path}
pH:			
Partial pressure of carbon dioxide	**347**	**ppm**	p_{CO2}
Constituent i			
First-order reaction rate	**0**	**/d**	
Temp correction	**1**		θ_{dx}
Settling velocity	**0**	**m/d**	v_{dt}
Constituent ii			
First-order reaction rate	**0**	**/d**	
Temp correction	**1**		θ_{dx}
Settling velocity	**0**	**m/d**	v_{dt}
Constituent iii			
First-order reaction rate	**0**	**/d**	
Temp correction	**1**		θ_{dx}
Settling velocity	**0**	**m/d**	v_{dt}

QUAL2K
Stream Water Quality Model
S. Branch La Moine Creek (8/22/1988)
Light Parameters and Surface Heat Transfer Models:

Parameter	*Value*	*Unit*	
Photosynthetically Available Radiation	0.47		
Background light extinction	0.2	/m	k_{eb}
Linear chlorophyll light extinction	0.0088	1/m-(ugA/L)	α_p
Nonlinear chlorophyll light extinction	0.054	1/m-(ugA/L)2/3	α_{pn}
ISS light extinction	0.052	1/m-(mgD/L)	α_i
Detritus light extinction	0.174	1/m-(mgD/L)	α_o
Solar shortwave radiation model			
Atmospheric attenuation model for solar	Bras		
Bras solar parameter (used if Bras solar model is selected)			
atmospheric turbidity coefficient (2=clear, 5=smoggy, default=2	2		n_{fac}
Ryan-Stolzenbach solar parameter (used if Ryan-Stolzenbach solar model is selected)			
atmospheric transmission coefficient (0.70-0.91, default 0.8)	0.8		a_{tc}
Downwelling atmospheric longwave IR radiation			
atmospheric longwave emissivity model	Brunt		
Evaporation and air convection/conduction			
wind speed function for evaporation and air convection/conduc	dy-Graves-Geyer		
Sediment heat parameters			
Sediment thermal thickness	15	cm	H_s
Sediment thermal diffusivity	0.0064	cm^2/s	α_s
Sediment density	1.6	g/cm^3	ρ_s
Water density	1	g/cm^3	ρ_w
Sediment heat capacity	0.4	$cal/(g\ ^oC)$	C_{ps}
Water heat capacity	1	$cal/(g\ ^oC)$	C_{pw}
Sediment diagenesis model			
Compute SOD and nutrient fluxes	No		

QUAL2K
Stream Water Quality Model
S. Branch La Moine Creek (8/22/1988)
Point Source Data:

				Point		Temperature			Specific Conductance			organic Suspended Solic		
	Tributary	Headwater	Location	Abstraction	Inflow	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of
Name	No.	Label	km	m3/s	m3/s	°C	°C	max	umhos	umhos	max	mg/L	mg/L	max
LaHarp STP	0	Mainstem headwater	1.90		0.0146	22.00								

Dissolved Oxygen			Slow CBOD			Fast CBOD			Organic N			Ammonia N		
mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of
mg/L	mg/L	max	mgO2/L	mgO2/L	max	mgO2/L	mgO2/L	max	ugN/L	ugN/L	max	ugN/L	ugN/L	max
7.40	0.00					#REF!			2000.00			#####		

Nitrate + Nitrite N			Organic P			Inorganic P			Phytoplankton			Internal Nitrogen		
mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of
ugN/L	ugN/L	max	ugP/L	ugP/L	max	ugP/L	ugP/L	max	ugA/L	ugA/L	max	ugN/L	ugN/L	max
			2000.00			900.00								

Internal Phosphorus			Detritus			athogen Indicator Bacteri			Alkalinity			Constituent i		
mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of	mean	range/2	time of
ugP/L	ugP/L	max	mgD/L	mgD/L	max	cfu/10(	cfu/100m	max	gCaCO3	gCaCO3/	max			max
									100.00					

Constituent ii			Constituent iii			pH		
mean	range/2	time of	mean	range/2	time of	mean	range/2	time of
		max			max	s.u.	s.u.	max
						7.00		

Appendix F

Load Duration Curve Calculations

Gage ID	Date	Discharge (CFS)	Gage Discharge (less Surrogate NPDES) (CFS)	Watershed Area Ratio	Calculated flow (CFS)	Rank	Flow Exceedance %	Parameter	Results	Units	Limit/ Standard (mg/L)	Allowable Load (lbs/day)	Actual Load (lbs/day)
5584500	6/10/2002	496	496	0.05	26.5038	5344	20.5341%	TP	24.20	mg/L	500	71435.36	3,457
5584500	6/18/2007	79.4	79.4	0.05	4.2427	15555	59.7695%	TP	40.60	mg/L	500	11435.418	929
5584500	7/16/2007	58.9	58.9	0.05	3.1473	16877	64.8492%	TP	65.80	mg/L	500	8482.94859	1,116
5584500	9/11/2002	38.2	38.2	0.05	2.0412	18702	71.8617%	TP	60.30	mg/L	500	5501.67464	664
5584500	8/12/2002	24.3	24.3	0.05	1.2985	20591	79.1201%	TP	79.60	mg/L	500	3499.75638	557
5584500	8/22/2007	13.5	13.5	0.05	0.7214	22637	86.9817%	TP	493.00	mg/L	500	1944.3091	1,917
5584500	9/5/2007	9.51	9.51	0.05	0.5082	23655	90.8934%	TP	652.00	mg/L	500	1369.65774	1,786
5584500	9/26/2007	6.4	6.4	0.05	0.3420	24542	94.3016%	TP	636.00	mg/L	500	921.746536	1,172

Gage ID	Date	Discharge (CFS)	Gage Discharge (less Surrogate NPDES) (CFS)	Watershed Area Ratio	Calculated flow (CFS)	Rank	Flow Exceedance %	Parameter	Results	Units	Limit/ Standard (mg/L)	Allowable Load (lbs/day)	Actual Load (lbs/day)
5584500	6/18/2007	79.4	79.4	0.05	4.2427	15555	59.7695%	NVSS	7.50	mg/L	39.1	894.250	171.531
5584500	7/16/2007	58.9	58.9	0.05	3.1473	16877	64.8492%	NVSS	3.00	mg/L	39.1	663.367	50.898
5584500	8/22/2007	13.5	13.5	0.05	0.7214	22637	86.9817%	NVSS	56.50	mg/L	39.1	152.045	219.707
5584500	9/5/2007	9.51	9.51	0.05	0.5082	23655	90.8934%	NVSS	22.00	mg/L	39.1	107.107	60.265

Gage ID	Date	Discharge (CFS)	Gage Discharge (less Surrogate NPDES) (CFS)	Watershed Area Ratio	Calculated flow (CFS)	Rank	Flow Exceedance %	Parameter	Results	Units	Limit/ Standard (mg/L)	Allowable Load (lbs/day)	Actual Load (lbs/day)
5584500	6/10/2002	496	496	0.05	26.5038	5344	20.5341%	TP	0.13	mg/L	0.17	24.288	18.573
5584500	5/14/2012	462	462	0.05	24.6870	5663	21.7598%	TP	0.13	mg/L	0.17	22.623	17.300
5584500	6/18/2007	79.4	79.4	0.05	4.2427	15555	59.7695%	TP	0.15	mg/L	0.17	3.888	3.316
5584500	7/16/2007	58.9	58.9	0.05	3.1473	16877	64.8492%	TP	0.34	mg/L	0.17	2.884	5.734
5584500	9/11/2002	38.2	38.2	0.05	2.0412	18702	71.8617%	TP	0.23	mg/L	0.17	1.871	2.531
5584500	8/12/2002	24.3	24.3	0.05	1.2985	20591	79.1201%	TP	0.65	mg/L	0.17	1.190	4.550
5584500	8/22/2007	13.5	13.5	0.05	0.7214	22637	86.9817%	TP	1.34	mg/L	0.17	0.661	5.211
5584500	9/18/2012	12	12	0.05	0.6412	22921	88.0730%	TP	0.66	mg/L	0.17	0.588	2.288
5584500	7/16/2012	10.5	10.5	0.05	0.5611	23406	89.9366%	TP	1.78	mg/L	0.17	0.514	5.384
5584500	9/5/2007	9.51	9.51	0.05	0.5082	23655	90.8934%	TP	1.14	mg/L	0.17	0.466	3.123
5584500	7/10/2012	9.45	9.45	0.05	0.5050	23682	90.9971%	TP	1.51	mg/L	0.17	0.463	4.110
5584500	9/26/2007	6.4	6.4	0.05	0.3420	24542	94.3016%	TP	0.00	mg/L	0.17	0.313	0.001

Gage ID	Date	Discharge (CFS)	Gage Discharge (less Surrogate NPDES) (CFS)	Watershed Area Ratio	Calculated flow (CFS)	Rank	Flow Exceedance %	Parameter	Results	Units (mg or micro_gram	Limit/ Standard (mg/L)	Allowable Load (lbs/day)	Actual Load (lbs/day)
5584500	5/14/2012	462	462	0.05	24.6870	5663	21.7598%	TSS	32.00	mg/L	50.9	6773.6	4258
5584500	6/18/2007	79.4	79.4	0.05	4.2427	15555	59.7695%	TSS	13.00	mg/L	50.9	1164.1	297
5584500	7/16/2007	58.9	58.9	0.05	3.1473	16877	64.8492%	TSS	4.50	mg/L	50.9	863.6	76
5584500	8/22/2007	13.5	13.5	0.05	0.7214	22637	86.9817%	TSS	118.00	mg/L	50.9	197.9	459
5584500	9/18/2012	12	12	0.05	0.6412	22921	88.0730%	TSS	44.00	mg/L	50.9	175.9	152
5584500	7/16/2012	10.5	10.5	0.05	0.5611	23406	89.9366%	TSS	86.00	mg/L	50.9	153.9	260
5584500	9/5/2007	9.51	9.51	0.05	0.5082	23655	90.8934%	TSS	65.00	mg/L	50.9	139.4	178
5584500	7/10/2012	9.45	9.45	0.05	0.5050	23682	90.9971%	TSS	45.00	mg/L	50.9	138.6	122
5584500	9/26/2007	6.4	6.4	0.05	0.3420	24542	94.3016%	TSS	23.00	mg/L	50.9	93.8	42

Gage ID	Date	Discharge (CFS)	Gage Discharge (less Surrogate NPDES) (CFS)	Watershed Area Ratio	Calculated flow (CFS)	Rank	Flow Exceedance %	Parameter	Results	Units	Limit/ Standard (mg/L)	Allowable Load (lbs/day)	Actual Load (lbs/day)
5584500	6/11/2002	1420	1420	0.10	143.0840	1948	7.4851%	Manganese	238.00	mg/L	3268.00	2,520,622.6	183,570
5584500	5/15/2012	365	365	0.10	36.7786	6880	26.4361%	Manganese	257.00	mg/L	3268.00	647,906.5	50,952
5584500	8/8/2002	51.2	51.2	0.10	5.1591	17410	66.8972%	Manganese	265.00	mg/L	3268.00	90,884.4	7,370
5584500	9/11/2002	38.2	38.2	0.10	3.8492	18702	71.8617%	Manganese	288.00	mg/L	3268.00	67,808.3	5,976
5584500	9/17/2012	14.6	14.6	0.10	1.4711	22408	86.1018%	Manganese	226.00	mg/L	3268.00	25,916.3	1,792
5584500	8/20/2007	12.2	12.2	0.10	1.2293	22912	88.0384%	Manganese	260.00	mg/L	3268.00	21,656.1	1,723
5584500	9/25/2007	6.24	6.24	0.10	0.6288	24590	94.4861%	Manganese	240.00	mg/L	3268.00	11,076.5	813

Gage ID	Date	Discharge (CFS)	Gage Discharge (less Surrogate NPDES) (CFS)	Watershed Area Ratio	Calculated flow (CFS)	Rank	Flow Exceedance %	Parameter	Results	Units (mg or micro_gram	Limit/Standard	Allowable Load (lbs/day)	Actual Load (lbs/day)
5584500	6/12/2007	106	106	0.03	3.3985	14100	54.1787%	Manganese	270.00	mg/L	3733.00	68387.5	4946
5584500	8/20/2007	12.2	12.2	0.03	0.3911	22912	88.0384%	Manganese	300.00	mg/L	3733.00	7871.0	633
5584500	9/25/2007	6.24	6.24	0.03	0.2001	24590	94.4861%	Manganese	270.00	mg/L	3733.00	4025.8	291

Gage ID	Date	Discharge (CFS)	Gage Discharge (less Surrogate NPDES) (CFS)	Watershed Area Ratio	Calculated flow (CFS)	Rank	Flow Exceedance %	Parameter	Results	Units (mg or micro_gram	Limit/ Standard (mg/L)	Allowable Load (lbs/day)	Actual Load (lbs/day)
5584500	6/23/1988	8.6	8.6	0.01	0.0919	23903	91.8463%	TP	4.80	mg/L	0.17	0.1	2
5584500	8/22/1988	2.6	2.6	0.01	0.0278	25560	98.2133%	TP	0.98	mg/L	0.17	0.0	0
5584500	10/27/1988	2.1	2.1	0.01	0.0224	25700	98.7512%	TP	6.00	mg/L	0.17	0.0	1

Gage ID	Date	Discharge (CFS)	Gage Discharge (less Surrogate NPDES) (CFS)	Watershed Area Ratio	Calculated flow (CFS)	Rank	Flow Exceedance %	Parameter	Results	Units (mg or micro_gram	Limit/Standard	Allowable Load (lbs/day)	Actual Load (lbs/day)
5584500	6/23/1988	8.6	8.6	0.01	0.0919	23903	91.8463%	TSS	92.00	mg/L	50.9	25.2	46
5584500	8/22/1988	2.6	2.6	0.01	0.0278	25560	98.2133%	TSS	12.00	mg/L	50.9	7.6	2
5584500	10/27/1988	2.1	2.1	0.01	0.0224	25700	98.7512%	TSS	152.00	mg/L	50.9	6.2	18

Gage ID	Date	Discharge (CFS)	Gage Discharge (less Surrogate NPDES) (CFS)	Watershed Area Ratio	Calculated flow (CFS)	Rank	Flow Exceedance %	Parameter	Results	Units	Limit/ Standard (mg/L)	Allowable Load (lbs/day)	Actual Load (lbs/day)
5584500	10/1/1984	12.6	12.6	0.02	0.2885	22882	87.9232%	Ammonia	0.05	mg/L	2.2	3.4	0.1
5584500	10/2/1984	11.1	11.1	0.02	0.2542	23172	89.0375%	Ammonia	6.30	mg/L	2.2	3.0	8.6
5584500	7/6/1988	4.1	4.1	0.02	0.0939	25164	96.6916%	Ammonia	21.00	mg/L	2.1	1.1	10.6
5584500	7/5/1988	4	4	0.02	0.0916	25184	96.7685%	Ammonia	0.53	mg/L	2.1	1.0	0.3
5584500	8/22/1988	2.6	2.6	0.02	0.0595	25560	98.2133%	Ammonia	24.00	mg/L	2.1	0.7	7.7

**Note that low flows were adjusted to include the upstream Design Average Flow for the La Harpe STP

Gage ID	Date	Discharge (CFS)	Gage Discharge (less Surrogate NPDES) (CFS)	Watershed Area Ratio	Calculated flow (CFS)	Rank	Flow Exceedance %	Parameter	Results	Units	Limit/ Standard (mg/L)	Allowable Load (lbs/day)	Actual Load (lbs/day)
5584500	7/5/1988	4	4	0.02	0.0916	25184	96.7685%	Manganese	4347	mg/L	3418.35294	1688.0	2147
5584500	8/22/1988	2.6	2.6	0.02	0.0595	25560	98.2133%	Manganese	616	mg/L	3418.35294	1097.2	198

Gage ID	Date	Discharge (CFS)	Gage Discharge (less Surrogate NPDES) (CFS)	Watershed Area Ratio	Calculated flow (CFS)	Rank	Flow Exceedance %	Parameter	Results	Units	Limit/Standard	Allowable Load (lbs/day)	Actual Load (lbs/day)
5584500	10/1/1984	12.6	12.6	0.02	0.2885	22882	87.9232%	TP	0.13	mg/L	0.17	0.3	0.2
5584500	10/2/1984	11.1	11.1	0.02	0.2542	23172	89.0375%	TP	5.00	mg/L	0.17	0.2	6.9
5584500	7/6/1988	4.1	4.1	0.02	0.0939	25164	96.6916%	TP	3.56	mg/L	0.17	0.1	1.8
5584500	7/5/1988	4	4	0.02	0.0916	25184	96.7685%	TP	0.06	mg/L	0.17	0.1	0.0
5584500	8/22/1988	2.6	2.6	0.02	0.0595	25560	98.2133%	TP	0.37	mg/L	0.17	0.1	0.1

Appendix G

SLAM Model Files

Land Use	**Area (Acres)**	**Percentage (%)**
Open Water	57	2.72
Developed, Open Space	62	3.00
Developed, Low Intensity	137	6.57
Developed, Medium Intensity	75	3.60
Developed, High Intensity	6	0.27
Barren Land	10	0.49
Deciduous Forest	207	9.94
Hay/Pasture	204	9.80
Cultivated Crops	1326	63.61

Lake Hydraulics:

	Prescribed	Calculated
Hydraulics	X	

Length	NA
Width	NA

Segment	Mixing_length (ft)	Interface Width (ft)	Surface_area (acres)	Avg Depth (ft)	Volume (AF)	
RLE-1	1,185	na	24	16	396.2	57%
RLE-2	1,292	402	12	12	152.1	29%
RLE-3	1,041	245	6	10	60.2	14%
			43	12.9	608.5	1.00

Calculating Daily Load

Annual_P_load (lbs/year)	Daily_avg_P_load (lbs/day)
1526	4.18

Number of Days in POR
6576

Fraction of particulate P

Lake fp P	Inflow fp P
0.754430317	0.72

Lake Zone Loading Factors

Zone	% P Load	% N Load
1	100%	1.000

Initial P Concentration (mg/L)
0.080

Catchment Area Calcs

Name	Catchment_area (mi^2)	Ratio
5584500	655.0	1.00
Carthage Lake	3.3	0.005

Conversion

Acres	Mi Square
1	0.0015625

Watershed Information		Total Phosphorus Export Coefficients			Phosphorus Loads			
Land Use	Area (acres)	Low (lb/ac/yr)	Median (lb/ac/yr)	High (lb/ac/yr)	Low (lbs/yr)	Median (lbs/yr)	High (lbs/yr)	Proportion of whole
Barren Land	10	0.16	0.16	0.16	1.6	1.6	1.6	0.001072652
Cultivated Crops	1,326	0.66	0.92	0.94	875.1	1219.8	1246.4	0.816771843
Deciduous Forest	207	0.08	0.105	0.13	16.6	21.8	26.9	0.017657947
Developed, High Intensity	6	0.7	1.96	4.77	3.9	10.9	26.5	0.017379582
Developed, Low Intensity	137	0.04	0.47	1.43	5.5	63.7	195.9	0.128380092
Developed, Medium Intensity	75	0.46	1.38	4.77	34.5	103.4	357.5	0.234276762
Developed, Open Space	62	0.03	0.04	0.16	1.9	2.5	10.0	0.006552503
Emergent Herbaceuous Wetlands	--	0.22	0.22	0.22	--	--	--	--
Evergreen Forest	--	0.08	0.105	0.13	--	--	--	--
Herbaceuous	--	0.5	0.5	0.5	--	--	--	--
Mixed Forest	--	0.08	0.105	0.13	--	--	--	--
Open Water	57	0	0	0	0.0	0.0	0.0	0
Hay/Pasture	204	0.5	0.5	0.5	102.2	102.2	102.2	0.066967864
Shrub/Scrub	--	0.08	0.105	0.13	--	--	--	--
Woody Wetlands	--	0.22	0.22	0.22	--	--	--	--
	2,085				Total:	1526.0		

NPDES Within Carthage Lake Basin NONE IN BASIN

NPDES above USGS Gage 05584500 Not Applicable Due to Scaling

MS4 Areas from GIS

Segment	**Subbasin Area (acres)**	**Municipal MS4 Area (acres)**	***Percent Subbasin as MS4 Area***
RLE	2084.5	0.0	0.0%
Lake Total	2084.5	0.0	0.0%

City of Carthage municipal boundary partially in subbasin, but Carthage does not have an NPDES permit for MS4s

Lake Sedimentation Parameters

Calibration Run

Prescribed - Used as calibration factors for sediment nutrient flux where sediment data not available.
Consititutes Internal loading

Zone 3 RLE-1

Month	P (mg/m2/d)	N (mg/m2/d)
Jan	0	0
Feb	0	0
Mar	0	0
Apr	0	0
May	0	0
Jun	1	0
Jul	4.5	0
Aug	6	0
Sep	2	0
Oct	0	0
Nov	0	0
Dec	0	0

P load (lbs/day)	Days	P load (lbs/month)
0.00	31	0.0
0.00	28	0.0
0.00	31	0.0
0.00	30	0.0
0.00	31	0.0
0.38	30	11.4
1.71	31	53.1
2.28	31	70.7
0.76	30	22.8
0.00	31	0.0
0.00	30	0.0
0.00	31	0.0
Annual TP load (lbs)		**158.0**

Reduce loadings to achieve WQS at 90th percentile of output data

Zone	Actual Load (lbs/yr)			Allowable Load (lbs/yr)			Percent Reduction		
	Internal	Watershed	Point Sources	Internal	Watershed	Point Sources	Internal	Watershed	Point Sources
RLE	158	1,526	0	47	458	-	70%	70%	0%
				-	-	-			
				-	-	-			
Total	**158**	**1,526**	**-**	**47**	**458**	**-**	**70%**	**70%**	**0%**

Segment	Loading Source	LC (lbs/day)	WLA- MS4s (lbs/day)	WLA- Facilities (lbs/day)	LA (lbs/day)	MOS (10% ofLC)	Current Load (lbs/day)	Reduction Needed (Percent)
RLE	Internal	0.12989179	0	0	0.11690261	0.01298918	0.432972637	0.7
	External	1.25421359	0	0	1.12879223	0.12542136	4.18071195	0.7
	Total	1.38410538	0	0	1.24569484	0.13841054	4.613684587	0.7

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