Illinois
Environmental
Protection Agency

Bureau of Water
P.O. Box 19276
Springfield, IL
62794-9276
www.epa.illinois.gov

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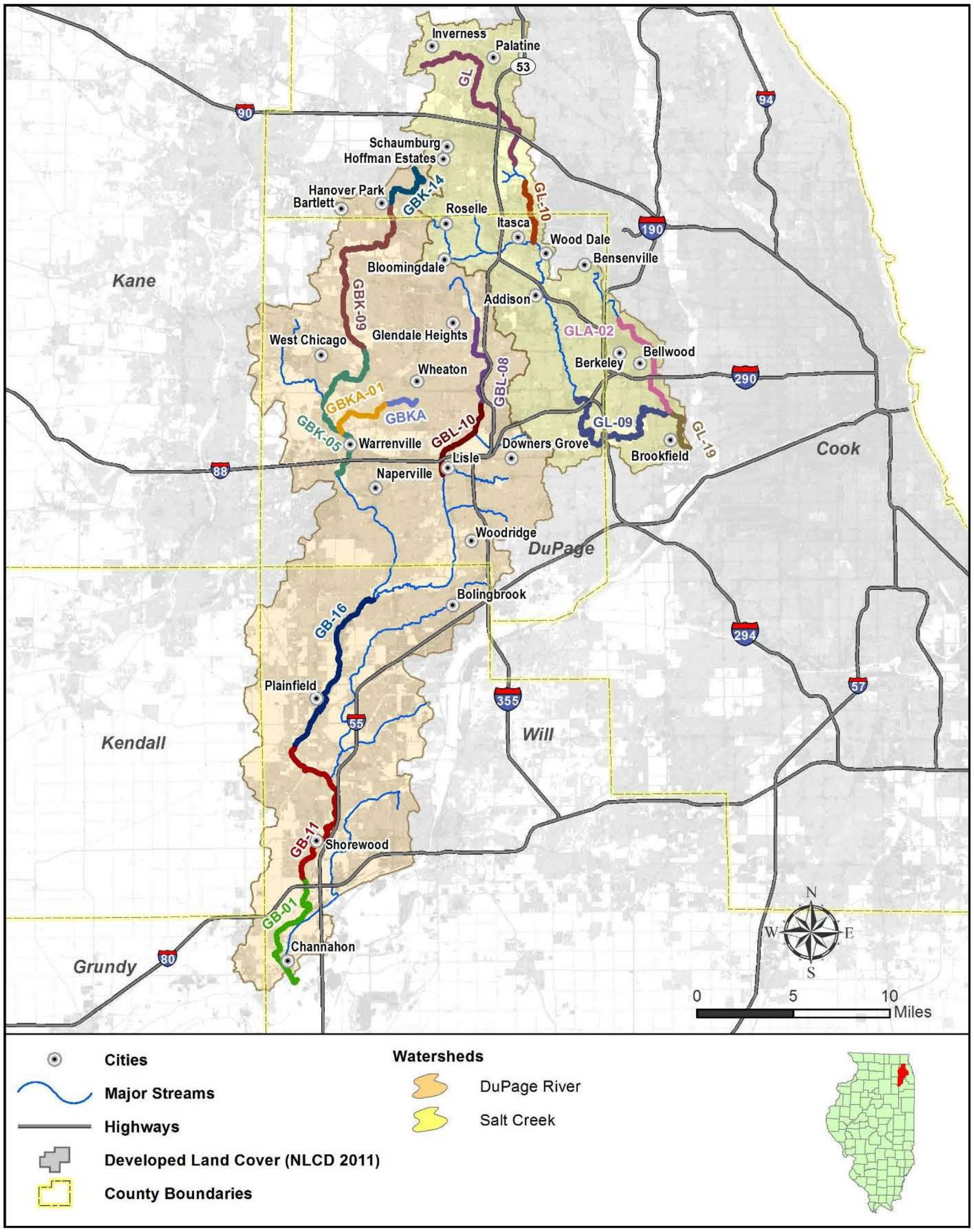
IEPA/BOW/IL-2019-005

DuPage River/Salt Creek Watershed TMDL Report



DuPage River/Salt Creek watershed.

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TMDL Development for the DuPage River/Salt Creek 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:

SEP 0 5 2019

WW-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 conducted a complete review of the final Total Maximum Daily Loads (TMDLs) for fecal coliform, chloride, and dissolved oxygen-demanding substances for the DuPage River and Salt Creek watersheds, including supporting documentation and follow up information. The waterbodies are located in northeastern Illinois. The TMDLs submitted by the Illinois Environmental Protection Agency address the impaired Primary Contact and Aquatic Life Uses for the waterbodies.

The TMDLs meet the requirements of Section 303(d) of the Clean Water Act and EPA's implementing regulations at 40 C.F.R. Part 130. Therefore, EPA hereby approves Illinois's eighteen TMDLs for fecal coliform, chloride, and dissolved oxygen-demanding substances as noted in the enclosed decision document. The statutory and regulatory requirements, and EPA's review of Illinois's compliance with each requirement, are described in the enclosed decision document.

We wish to acknowledge Illinois's effort in submitting these TMDLs and look forward to future TMDL submissions by the State of Illinois. If you have any questions, please contact Ms. Candice Bauer, Acting Chief of the Watersheds and Wetlands Branch, at 312-353-2106.

Sincerely,

Linda Holst

for Joan M. Tanaka
Acting Director, Water Division

Enclosure

cc: Abel Haile, IEPA

TMDL: DuPage River and Salt Creek Watersheds 2, Illinois
Date: SEP 0 5 2019

DECISION DOCUMENT FOR THE APPROVAL OF THE DUPAGE RIVER AND SALT CREEK 2, IL TMDL

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

The TMDL submittal should identify the waterbody as it appears on the State's/Tribe's 303(d) list. The waterbody 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 waterbody 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 waterbody. 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 waterbody 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: The Illinois Environmental Protection Agency (IEPA) developed TMDLs for fecal coliform, chloride, and dissolved oxygen (DO) demanding substances for impaired waters in the DuPage River and Salt Creek (DRSC) watersheds in north-eastern Illinois (Table 1 of this Decision Document). The DRSC watersheds are located in Cook, DuPage, and Will Counties. Table 1 of this Decision Document lists the waterbodies addressed by this TMDL.

Table 1. TMDLs in the DRSC watershed

Segment ID	Segment Name	Designated use	Pollutant Addressed
IL_GB-11	DuPage River	Aquatic Life	Chloride
		Primary Contact	Fecal Coliform
IL_GB-16	DuPage River	Aquatic Life	DO Demanding Substances (TP*, CBOD**, Ammonia)
		Primary Contact	Fecal Coliform
IL_GBK-05	West Branch DuPage River	Primary Contact	Fecal Coliform
IL_GBK-09	West Branch DuPage River	Primary Contact	Fecal Coliform
IL_GBK-14	West Branch DuPage River	Aquatic Life	DO Demanding Substances
		Primary Contact	Fecal Coliform
IL_GBKA	Spring Brook	Aquatic Life	DO Demanding Substances
		Primary Contact	Fecal Coliform
IL-GBKA-01	Spring Brook	Primary Contact	Fecal Coliform
IL_GBL-10	East Branch DuPage River	Primary Contact	Fecal Coliform
IL_GL-09	Salt Creek	Primary Contact	Fecal Coliform
IL_GL-10	Salt Creek	Primary Contact	Fecal Coliform
IL_GL-19	Salt Creek	Primary Contact	Fecal Coliform
IL_GLA-02	Addison Creek	Primary Contact	Fecal Coliform

* - TP = Total Phosphorus
**- CBOD = Carbonaceous Biochemical Oxygen Demand, the measurement of oxygen demand due to organic material in water

The DRSC watershed is approximately 335,000 acres in size. The two main waterbodies (DuPage River and Salt Creek) are separate watersheds. The DuPage River begins as the East Branch and West Branch of the DuPage River, which merge to form the mainstem DuPage River. The DuPage River flows south into the Des Plaines River near Channahon, Illinois (Figure 1 of the TMDL). Salt Creek begins in Cook County, flows south into the Des Plaines River upstream of the DuPage River. The Des Plaines joins with the Kankakee River a few miles south of Channahon to form the Illinois River.

Significant alteration of the drainage in the watersheds has occurred over the last 100 years. Numerous dams have been built in the watersheds, both altering flows and preventing fish migration (Section 3.6 of the TMDL). Some of the dams have been removed or modified. The United States Geological Survey (USGS) operates several gages in the watersheds, as noted on Figure 9 of the TMDL. Review of the gage data indicates that the river systems are effluent-dominated in mid-range to low flows.

IEPA identified several approved TMDL projects in the watersheds (Table 2 of the TMDL). In 2004, TMDLs were developed for the East Branch DuPage River (chloride, ammonia, CBOD), West Branch DuPage River (chloride), and Salt Creek (chloride, ammonia, CBOD, volatile suspended solids). The TMDLs addressed in this Decision Document followed up on watershed monitoring performed as part of the implementation of the 2004 TMDLs.

Distribution of land use: The land use for the DuPage River watershed is mainly urbanized in nature, with a small portion as agricultural (Table 2 of this Decision Document). The Salt Creek watershed is almost completely urbanized. Tables 3 and 4 and Figure 4 of the TMDL contain additional details on the land use in the watersheds. Both watersheds are highly populated; over 4.8 million people live in the two watersheds (Section 3.4 of the TMDL).

Table 2: Land use in the DRSC Watersheds

Land Use	DuPage River		Salt Creek	
	%	acres	%	acres
Agriculture	14	32,218	<1	234
Developed	75	183,058	93	87,488
Forest	4	10,268	3	2,689
Other	7	15,457	<4	4,431
Total	100	241,001	100	94, 842

Problem Identification:
The pollutants of concern are fecal coliform, low DO (DO-demanding substances), and chloride (Table 1 of this Decision Document).

Fecal coliform: The waterbodies identified in Table 1 of this Decision Document as being addressed for fecal coliform all exceeded the IEPA fecal coliform water quality standard (WQS), both the single-sample maximum and the geometric mean (Table 13 of the TMDL).

DO: Segment GB-16 (West Branch DuPage River) has been monitored for DO for several years, both discrete sampling and continuous monitoring (Section 5.1.2 of the TMDL). Results of the monitoring indicate that the waterbody exceeds the lower range of the DO standard during the later parts of the summer (Figures 22 and 23 of the TMDL). The DuPage River Salt Creek Workgroup (DRSCW) performed monitoring of Segments GBKA and GBK-14 in August of 2016. Monitoring results indicate the DO water quality standard is not being met.

Chloride: IEPA identified one segment (GB-11) as impaired for chloride (Section 5.1.4 of the TMDL). Water quality data indicted five exceedences out of 366 sampling observations between 1977 and 2010 (Table 16 and Figure 27 of the TMDL).

Pollutant:

Fecal coliform: Bacteria exceedances can negatively impact recreational uses (fishing, swimming, wading, boating, etc.) and public health. At elevated levels, bacteria may cause illness within humans who have contact with or ingest bacteria-laden water. Recreation-based contact can lead to ear, nose, and throat infections, and stomach illness.

DO: IEPA identified three segments as demonstrating degraded oxygen concentrations within the water column. Low dissolved oxygen concentrations can negatively impact aquatic life use. The decrease in dissolved oxygen can stress benthic macroinvertebrates and fish. Elevated levels of oxygen-consuming pollutants, such as ammonia, and CBOD, can reduce dissolved oxygen in the water column, and cause large shifts in dissolved oxygen and pH throughout the day. Excessive amounts of nutrients such as phosphorus can stimulate plant and algal growth, which can negatively impact DO levels in a waterbody as well. 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.

Chloride: Chloride is essential for aquatic life to carry out a range of biological functions. However, high concentrations of chloride in the surrounding water can harm cellular osmotic processes in aquatic life. Excessive dissolved chlorides in water may stress aquatic species and prohibit the transport of needed molecules into the cell. Persistent elevated concentrations of chloride in the water may result in aquatic life such as fish, invertebrates and even some plant species becoming stressed and/or dying.

Priority Ranking:

The watershed was given priority for TMDL development due to the impairment impacts on the public value of the impaired water resource, and the timing as part of the Illinois basin monitoring process.

Source Identification (point and nonpoint sources):

Point Source Identification:

Fecal coliform: IEPA identified 39 individual point sources located in the DRSC watersheds (Section 5.3.1 and Table 18 of the TMDL). Of these 39 point sources, 31 are wastewater treatment facilities only (WWTFs). The remaining eight include Combined Sewer Overflow (CSO) systems, which can discharge mixed stormwater and sewage during high-flow events. IEPA also identified stormwater (Municipal Separate Storm Sewer System or MS4) as a potential source of bacteria in the watersheds.

Chloride: IEPA identified four NPDES-permitted facilities in Segment GB-11, which is impaired for chloride. WWTFs can discharge chloride as a result of deicing efforts as well as water softening discharge. IEPA also assigned allocations to the Illinois Department of Transportation (ILDOT) to address highway deicing efforts, as well as to MS4s in the watershed. (Table 27 of the TMDL).

DO substances: IEPA identified three WWTFs that discharge DO-demanding substances in Segment GB-16 (Lower DuPage River). Much of the organic material in wastewater is removed during the treatment process, but some amounts of organic material are discharged. When these substances decay in the stream, oxygen is consumed and the levels of dissolved oxygen drop. IEPA identified three pollutants: total phosphorus, total ammonia, and CBOD that need to be controlled in WWTF discharges. Although CSOs and MS4s can discharge DO-demanding substances, IEPA determined that the critical condition for low DO in the segment is during low-flow periods, when CSOs and MS4s are not significant contributors (Table 34 of the TMDL). The other two segments listed as impaired for low DO do not have any point source discharges.

Nonpoint Source Identification*:* The potential nonpoint sources for the DRSC watershed TMDLs are:

Fecal coliform:
Non-regulated stormwater runoff: Non-regulated urban stormwater runoff can add fecal coliform to the impaired waters. The sources of bacteria in stormwater include animal/pet wastes, and wildlife. IEPA noted that that much of the watersheds are covered by a MS4 permit, and therefore non-regulated stormwater runoff has limited impact in the watersheds.

Agricultural Operations: Runoff from agricultural lands may contain significant amounts of bacteria which may lead to impairments in the DuPage River watershed. There is limited agricultural land in the DuPage River watershed, and virtually none in the Salt Creek watershed.

Failing septic systems: IEPA noted that failing septic systems, where waste material can pond at the surface and eventually flow into surface waters or be washed in during precipitation events, are potential sources of bacteria. IEPA determined that while much of the watersheds are served by sewer systems, portions of the watersheds are not, and the potential for septic failure is possible.

Chloride:
Road salt runoff: IEPA determined that the major source of chloride loading to the DRSC watersheds is run-off from roadways containing road salt (Section 5.3.5 of the TMDL). Runoff from precipitation events as well as snowmelt can transport chloride into the waterbodies.

DO substances:
Agricultural Operations: IEPA noted that agricultural operations can generate DO-demanding substances that can run off farm fields and enter the waterbodies (Section 5. 4 of the TMDL). The use of fertilizers, field debris, and other organic matter can enter the waters, decompose, and use up the dissolved oxygen in the water column.

In-stream processes: Organic material can also enter the waters and settle to the streambed during the year, and then as flows are reduced during the late summer, decompose and scavenge oxygen. This is measured as sediment-oxygen demand (SOD). Nutrients can also stimulate the growth of algae and plants, which can consume oxygen during the night hours, causing significant daily swings in DO levels.

Non-regulated stormwater runoff: Non-regulated stormwater runoff can add DO-demanding substances to the impaired waters. Many of the same causes of bacteria loading also can contribute nutrients and organic material, such as pet wastes and wildlife.

Failing Septic Systems: Failing septics systems can contribute nutrients as well as bacteria to streams.

Population and future growth trends: The population for the watersheds is fairly significant; approximately 4.8 million people live in the two watersheds (Section 3.4 of the TMDL). The population is expected to continue to grow over the foreseeable future, particularly in the mainstem portion of the DuPage River in Will County. IEPA considered a reserve capacity to account for future growth, but determined that the loadings as calculated were sufficient (Section 6.3.3 of the TMDL). Future increases will require re-opening and possible modification of the TMDL. IEPA did determine allocations for two WWTFs based upon ongoing plant expansion, the Naperville-Springbrook WWTF (IL0034061) and the Bolingbrook WWTF (IL0069744) (Table 18 of the TMDL).

EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this first element.

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 waterbody, 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:
Designated Use/Standards: Section 4.2 of the TMDL states that the DRSC watersheds are not meeting the General Use designation. The applicable water quality standards (WQS) for these waterbodies 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 for General Use Water Quality Standards. The portions of the WQS that

apply to the DRSC are General Use, specifically the Aquatic Life Use and Primary Contact Use (Section 4.2 of the TMDL).

Criteria: The applicable criteria are found in Table 3 of this Decision Document.

Table 3: WQSs for the impaired waters in the DRSC watersheds

Pollutant	Units	Criteria
Chloride	mg/L	500
Dissolved Oxygen	mg/L	For most waters (GBK-14 and GBKA): March-July >5.0 minimum and >6.0 as a 7-day mean Aug-Feb >3.5 minimum and >4.0 as a 7-day mean and >5.5 as a 30-day mean For enhanced waters (GB-16): March-July >5.0 minimum and >6.25 as a 7-day mean Aug-Feb >4.0 minimum and >4.5 as a 7-day mean and >6.0 as a 30-day mean
Fecal coliform	Count/100 mL	May through October 200*, 400**

* - geometric mean based upon a minimum of 5 samples in a 30 day period
** - not to be exceed by more than 10% of the samples in a 30 day period

Target: The water quality targets for these TMDLs are in Table 4 of this Decision Document.

Fecal coliform: IEPA used both portions of the WQS to determine loads. Allocations were developed for each bacteria-impaired segment based upon the 200 counts/100mL geometric mean and the 400 counts/100 mL single sample maximum (SSM) (Section 3 of this Decision Document).

Chloride: The IEPA used the numeric WQS for chloride of 500 mg/L as the TMDL target.

DO: IEPA determined that the DO instantaneous minimum portion of the WQS was most likely to be exceeded (Appendices E1-E3 of the TMDL). IEPA reviewed the DO data for the impaired segments, and noted that the waterbodies are meeting the "mean" portions of the DO criteria. Therefore, the modeling effort focused on the "minimum" portion of the WQS. The State determined that attaining the "minimum" portion of the criteria will result in attainment of the entire DO WQS (Appendices E1-E3 of the TMDL). The modeling effort undertaken by the State for Segment GB-16 was developed for early August, the critical time of year with the lowest DO conditions due to low in-stream flows and higher water temperatures. The corresponding DO instantaneous minimum target is >4.0 mg/L (Appendix E1 of the TMDL). For the other two segments, the modeling effort also was developed for early August. However, the State utilized a more conservative target of >5.0 mg/L (Appendices E2 and E3 of the TMDL).

As further discussed in Section 3 of this Decision Document, IEPA modeled the impacts of DO-demanding substances on the levels of DO in the streams. Several scenarios were investigated, and IEPA determined that total phosphorus, total ammonia, and CBOD were the three pollutants that needed to be controlled in Segment GB-16, and a more general pollutant of DO-demanding substances (DO-deficit; see Section 3 of this Decision Document for further explanation) need to be controlled in Segments GBK-14 and GBKA.

Table 4: TMDL targets for the DRSC Watersheds

Pollutant	Target
Chloride	500 mg/L
DO*	>4.0 for GB-16 >5.0 for GBK-14 and GBKA
Fecal coliform	200/400 counts/100 mL

* - Pollutants identified to address DO are total phosphorus, total ammonia, and CBOD for Segment GB-16 and DO-deficit for Segments GBK-14 and GBKA

EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this second element.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

A TMDL must identify the loading capacity of a waterbody 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 stream 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:

The approach utilized by the IEPA to calculate the loading capacity for the fecal coliform and chloride TMDLs is described in Section 6.1 of the TMDL. The TMDL summaries for fecal coliform and chloride are presented in Tables 5-29 of this Decision Document. For DO-demanding substances, the approach utilized by IEPA is described in Section 6.2 and

Appendices E1-E3 of the TMDL. The TMDL summaries for DO-demanding substances are presented in Tables 30-32 of this Decision Document.

Fecal coliform and chloride: For the bacteria TMDLs both the geometric mean of 200 counts/100 ml fecal coliform for five samples equally spaced over a 30-day period, and the SSM of 400 counts/100mL exceeded in no more than 10% of the samples per 30 days, were used to calculate the loading capacity of the TMDLs.

Typically loading capacities are expressed as a mass per time (e.g. pounds per day). However, for bacteria loading capacity calculations, mass is not always an appropriate measure because bacteria is expressed in terms of organism counts. This approach is consistent with the EPA's regulations which define "load" as "an amount of matter that is introduced into a receiving water" (40 CFR §130.2). To establish the loading capacities for the DRSC bacteria TMDLs, IEPA used Illinois's water quality standards for fecal coliform (200 cfu/100 mL). By calculating loads based upon both portions of the fecal coliform WQS, IEPA determined that the WQS will be met under either portion. A loading capacity is, "the greatest amount of loading that a water can receive without violating water quality standards." (40 CFR §130.2). Therefore, a loading capacity set at the WQS will assure that the water does not violate WQS. IEPA's fecal coliform TMDL approach is based upon the premise that all discharges (point and nonpoint) must meet the WQS when entering the water body. If all sources meet the WQS at discharge, then the water body should meet the WQS and the designated use.

For the chloride TMDL, the water quality target from Table 4 of this Decision Document (500 mg/L) was used to calculate the loading capacities.

Flow data from several USGS gages in the two watersheds were used to develop the Load Duration Curves (LDCs). Flow data was available for a number of years (Section 3.6 and Figure 9 of the TMDL). Daily stream flows are necessary to implement the LDC approach.

The LDCs were created by multiplying individual flow values by the WQS and then multiplying that value by a conversion factor. The resulting points are plotted onto a load duration curve graph. The LDC graphs for impaired waterbodies have flow duration interval (percentage of time flow exceeded) on the X-axis and pollutant loads (number of bacteria or pollutant mass per unit time) on the Y-axis. The fecal coliform LDC used fecal coliform measurements in millions of bacteria per day, while the chloride LDC used pounds per day. The curved line on a LDC graph represents the TMDL for the respective flow conditions observed at that location.

Pollutant values from the monitoring sites were 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 LDC (Section 7 of the TMDL).

The LDC plot was subdivided into five flow regimes; very high flows (exceeded 0–10% of the time), high conditions (exceeded 10–40% of the time), mid-range flows (exceeded 40–60% of the time), low conditions (exceeded 60–90% of the time), and very low flows (exceeded 90–100% of the time). LDC plots can be organized to display individual sampling loads and the calculated LDC. Watershed managers can interpret these plots (individual sampling points plotted with 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 LDC 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 pollutant loads based on flow magnitudes. Different sources will contribute pollutant 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 pollutant loading into surface waters. This allows for a more efficient implementation effort.

The TMDLs for the DRSC were calculated as appropriate. The regulated permittees discharging fecal coliform and chloride have allocations determined for them (Table 5-29 of this Decision Document). The load allocations were calculated after the determination of the Margin of Safety. Other load allocations (ex. non-regulated stormwater runoff, wildlife inputs, etc.) were not divided amongst individual nonpoint contributors. Instead, load allocations were combined into a generalized loading.

The LDC for fecal coliform shows exceedences under all flow conditions, and in similar magnitudes, indicating a variety of sources are contributing to the impairment. The LDC for chloride has only four exceedences. These exceedences occurred under mid- to lower-flow conditions.

Tables 5-29 of this Decision Document calculates five points (the midpoints of the designated flow regime) on the loading capacity curves. 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 load duration curve method can be used to display collected pollutant monitoring data and allows for the estimation of load reductions necessary for attainment of the appropriate water quality standards. 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 TMDLs 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 these TMDLs.

DO-demanding substances (Segment GB-16): To develop the TMDL for low DO for Segment GB-16, IEPA used the QUAL2K model (Section 6.2 and Appendices E1-E3 of the TMDL). QUAL2K is a steady state, one-dimensional model that can simulate DO concentrations on an hourly time step (Section 1 of Appendix E1 of the TMDL). Typically, daily data are simulated during critical conditions (e.g., low flow and warm temperatures) and iterated over multiple repeated days to achieve convergence. QUAL2K represents streams as a series of segments, each of which has approximately constant characteristics (e.g., slope, shading, bottom width). Each segment is further divided into a series of equally spaced model computational elements, which are assumed fully mixed. Factors that affect in-stream temperature and DO concentrations are represented in QUAL2K, including solar inputs, stream shading, air temperature, oxidation of suspended and dissolved organic matter. The relative magnitude of these factors can be determined through model application, and scenarios can be developed to evaluate if management actions can improve in-stream conditions.

The results of the QUAL2K modeling show that several factors are contributing to the DO impairment. Segment GB-16 receives flow from three WWTFs, which contribute various substances that consume oxygen. In-stream processes also were found to negatively impact DO levels in the segment. The QUAL2K model was used to investigate several scenarios to meet the WQS (Section 4.2 of Appendix E1 of the TMDL). Two scenarios were determined to attain the DO standard in Segment GB-16:

Table 33: DO-substance Scenarios for Segment GB-16

Scenario 2	Scenario 3
• SOD reduced to 2.04 $g/m^2/d$ • Point source minimum DO increased to 6.5 mg/L • Bolingbrook and Plainfield WWTPs CBOD decreased to 10 mg/L • Headwater total phosphorus decreased to 1 mg/L • *Naperville WWTF CBOD reduced to 7.5 mg/L* • *SOD coverage reduced to 7.5%*	• SOD reduced to 2.04 $g/m^2/d$ • Point source minimum DO increased to 6.5 mg/L • Bolingbrook and Plainfield WWTPs CBOD decreased to 10 mg/L • Headwater total phosphorus decreased to 1 mg/L • *Naperville WWTF CBOD remains the same* • *SOD coverage reduced to 5.0%*

SOD = Sediment Oxygen Demand

The difference between the two scenarios are noted in italics in Table 33. Results of the modeling determined that SOD was a significant component of low DO in the segment. To reduce SOD in the system, IEPA determined that the total phosphorus coming from upstream sources need to be reduced, as well as reducing pollutants from the three WWTFs (Section 4.2 of Appendix E1 of the TMDL). Controlling these various loads will reduce the intensity of SOD as well as the areal extent of the stream with elevated levels of SOD. Table 30 of this Decision Document summarizes the two sets of allocations for Segment GB-16. For the purposes of this TMDL approval, EPA is approving the allocations for Scenario 2, which are more conservative regarding allocations. However, the EPA notes that IEPA will pursue implementing Scenario 3 through the NPDES permit process. EPA has determined it is reasonable to expect either scenario to attain WQS if implemented appropriately.

DO-demanding substances (GBK-14 and GBKA): Similar to the process for Segment GB-16, IEPA used QUAL2K to develop the TMDLs for Segments GBK-14 and GBKA (Appendices E2 and E3 of the TMDL). However, the cause of the low DO differs for these two segments. These segments are small headwater streams with no WWTF inputs; IEPA determined the critical condition for low DO was summer very low flow, with no stormwater inputs (Section 6.2 of the TDML). Analysis of the data and modeling results by IEPA showed that the source of the low DO is a more diffuse set of DO-demanding substances than for Segment GB-16. The analysis showed that DO decreases are due to high SOD levels in the streambed, low reaeration rates, and low flow. Typically, low reaeration rates and low flow are not pollutants under the Clean Water Act, and therefore would not require a TMDL. SOD can be a pollutant, but IEPA determined that just controlling SOD alone was not sufficient to attain the WQS.

To address the DO impairment, IEPA used QUAL2K to determine the DO deficit, the measure of the difference between the DO saturation and the DO criterion. By using the QUAL2K model, IEPA was able to calculate the overall DO impacts of various pollutants (i.e., total phosphorus, nitrogen, SOD, CBOD, etc.) as well as stream characteristics (i.e., flow, depth, reaeration rate, etc.) and calculate the overall DO-demanding substances affecting the streams (Appendices E2 and E3 of the TMDL).

Tables 31 and 32 of this Decision Document summarize the TMDLs addressing low DO for these two segments. IEPA noted that in addition to reducing pollutant loads into the waterbodies, changes to the waterbody characteristics (increasing reaeration and flow) in the waterbodies will be needed to attain WQS.

EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this third element.

4. Load Allocations (LAs)

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:
Fecal coliform: The LAs for fecal coliform are found in Tables 5-28 of this Decision Document. IEPA identified several nonpoint sources of bacteria in the watersheds, such as agricultural runoff, failing septics, and wildlife. IEPA did not further quantify the LA for bacteria.

Chloride: The LAs for chloride are found in Table 29 of this Decision Document. IEPA identified winter de-icing activities as the likely source of chloride. IEPA did not further quantify the LA for chloride.

DO-demanding substances: The LAs for DO-demanding substances are found in Tables 30-32 of this Decision Document. Several nonpoint sources of DO-demanding substances were identified by IEPA, including SOD and agricultural runoff. IEPA did not further quantify the LAs, but did note several implementation targets that are needed to address nonpoint source reductions of DO-demanding substances in the TMDL.

EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this fourth element.

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:
Fecal coliform: IEPA determined loads for fecal coliform for the dischargers in the DRSC watersheds (Table 34 of this Decision Document; Appendix F of the TMDL). The WLAs are based upon two flow conditions; IEPA used the design average flow (DAF) of the facilities for the lower streamflow regimes (10%-100%) and the design maximum flow (DMF) of the facilities for the high streamflow regime (0%-10%). The appropriate flow was multiplied by the WQS of 200 cfu/100 mL geometric mean and the 400 SSM for the facilities noted in Table 34 of this Decision Document (Section 6.3.1 of the TMDL)

IEPA identified several CSO dischargers in the watershed. For the fecal coliform TMDLs, IEPA reviewed the discharge records from 2013-2015 for CSO events for each of the CSO systems. IEPA determined the maximum discharge event for that time period, and multiplied that flow by the WQS (the 200 counts/100 mL geometric mean and the 400 counts/100 mL SSM) (Section 6.3.1 of the TMDL). Several CSO systems are part of the Metropolitan Water Reclamation District (MWRD) of Greater Chicago Tunnel and Reservoir Plan (TARP). These systems convey stormwater into a series of tunnels and reservoirs for storage before pumping the water out, treating it, and discharging to a waterbody. IEPA reviewed the data submitted by MWRD to determine the estimated maximum volume for discharge, and multiplied the flow by the appropriate WQS (Section 6.3.1 and Appendix F of the TMDL).

For MS4s, IEPA determined the land area within each segment watershed that was considered "developed" and assigned that portion of the runoff load to MS4s (Section 6.3.1 of the TMDL). Loads were determined as an aggregate load; loads were not determined for each individual MS4 permittee. Appendix J of the TMDL contains a list of all MS4 permittees in the two watersheds.

For several of the impaired waterbodies, the DAF exceeded the monitored instream flow. For these flow regimes, IEPA noted that the WLAs and LAs are a formula as noted in the TMDL tables in this Decision Document. The WLAs and LAs are expressed as the facility flow times the appropriate WQS (i.e., 500 mg/L for chloride). This applies to both fecal coliform and chloride.

Chloride: IEPA identified four individually permitted dischargers of chloride (Table 35 of this Decision Document) in Segment GB-11. Similar to the bacteria TMDLs, IEPA utilized the DMF for the high flow regime and the DAF for the remaining flow regimes (Section 6.3.1 of the TMDL). The DMF or the DAF was multiplied by the chloride WQS of 500 mg/L to determine the WLA for each facility. For MS4s, a similar process as described above for bacteria was used, where the developed land proportion was multiplied by the WQS (Table 35 of the TMDL). However, IEPA did separate out a WLA for ILDOT, based upon the road mileage in the subwatershed and multiplying that value by the chloride WQS.

DO-demanding substances: IEPA identified three individual point sources discharging DO-demanding substances in Segment GB-16 (Section 7.2.2 of the TMDL). As discussed in Section 3 of this Decision Document, a significant modeling effort was performed to determine the causes and impacts of various DO-demanding substances on the DO levels in the waterbody segment. IEPA determined that two scenarios could result in attaining the DO WQS. Table 30 of this Decision Document (Table 34 of the TMDL) contains the WLAs for the three facilities. WLAs were determined for CBOD, total phosphorus, and total ammonia.

The EPA is approving the WLAs in Scenario 2 (discussed above in Section 3 of the Decision Document) at this time, but notes that the allocations in Scenario 3 are consistent with the TMDL loading capacity, assuming that the additional NPDES permit conditions and implementation targets are met. The EPA is clarifying that it is not approving effluent limits as noted in Table 30 of this Decision Document (Table 34 of the TMDL), or permit conditions as contained in Appendix G of the TMDL. Permit conditions and issues will need to be pursued through the NPDES permit process. Both scenarios include a WLA = 0 for MS4 discharges. IEPA explained that the modeling effort for all three DO-impaired segments focused on the critical conditions when the DO criteria were exceeded, which are during low-flow high temperature summer conditions. IEPA noted that under higher in-stream flows, MS4 discharge at current levels should have no impact on DO levels in the waterbody (email from Abel Haile, IEPA dated 09/05/2019).

EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this fifth element.

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:
Fecal coliform: The DRSC bacteria TMDLs incorporate an explicit MOS of 10% of the total loading capacity (Section 6.3.2 of the TMDL and Tables 5-28 of this Decision Document). An additional conservative assumption is that IEPA did not use a rate of decay, or die-off rate of pathogen species, in the TMDL calculations or in the creation of the load duration curve for fecal coliform. Bacteria have a limited capability of surviving outside their hosts, and normally a rate of decay would be incorporated. IEPA determined that it was more conservative to use the WQS (200/400 counts/100 mL) and not to apply a rate of decay, which could result in a discharge limit greater than the WQS.

As stated in *EPA's Protocol for Developing Pathogen TMDLs* (EPA 841-R-00-002), many different factors affect the survival of pathogens, including the physical condition of the water. These factors include, but are not limited to sunlight, temperature, salinity, and nutrient deficiencies. These factors vary depending on the environmental condition/circumstances of the water, and therefore it would be difficult to assert that the rate of decay caused by any given combination of these environmental variables was sufficient to meet the WQS of 200 cfu/100 mL. Thus, it is more conservative to apply the State's WQS as the MOS, because this standard must be met at all times under all environmental conditions.

Chloride: The chloride TMDL for Segment GB-11 incorporates an explicit MOS of 10% of the total loading capacity. The MOS reserved 10% of the loading capacity and allocated the remaining loads to point and nonpoint sources (Table 29 of this Decision Document). The use of the LDC approach minimized variability associated with the development of the chloride TMDL 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 and assumptions made during the TMDL development process.

DO-demanding substances: The TMDLs addressing the DO impairments in the DRSC watersheds incorporate an implicit MOS regarding the loading capacity. IEPA used a DO target that is 10% higher than the applicable criterion. For Segment GB-16, the WQS is a minimum of 5.0 mg/L. In the QUAL2K model, IEPA developed the TMDL to meet a target of 5.5 mg/L. For Segments GBK-14 and GBKA, the WQS is the minimum of >4.0 mg/L. The target for both

TMDLs is a DO minimum of >4.4 mg/L. The MOS was set to account for uncertainty due to field sampling error and assumptions made during the TMDL development process.

EPA finds that the TMDL document submitted by IEPA has an appropriate MOS satisfying all requirements concerning this sixth element.

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:
The LDC process accounts for seasonal variation by utilizing streamflows over a wide range. The LDC graphs can be used to determine under which conditions exceedences are occurring, and any seasonal component (i.e., spring melt).

Bacterial loads vary by season, typically reaching higher values in the dry summer months when low flows and warm water contribute to increased bacteria abundance, and reaching relatively lower values in colder months when bacterial growth rates attenuate. Bacterial WQS need to be met between May 1st to October 31st, regardless of the flow condition. The development of the LDC utilized flow measurements from local flow gages. These flow measurements were collected over a variety of flow conditions observed during the recreation season. The LDC developed from these flow records represents a range of flow conditions within the impaired watersheds and thereby accounted for seasonal variability over the recreation season.

For chloride, the development of the LDC utilized flow measurements from local flow gages. These flow measurements were collected over a variety of flow conditions observed during the year. The LDC developed from these flow records represents a range of flow conditions within the impaired watersheds and thereby accounted for seasonal variability over the year.

For the DO-demanding substances, analysis of the DO data indicated that DO was a problem during the late summer, when flows and reaeration are the lowest, and the impacts of the pollutants the greatest (Appendices E1-E3 of the TMDL). IEPA focused the modeling effort in this time period to determine the allocations necessary to attain WQS under the most conservative conditions.

EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this seventh element.

8. Reasonable Assurances

When a TMDL is developed for waters impaired by point sources only, the issuance of a National Pollutant Discharge Elimination System (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:
Section 8 of the TMDL discusses reasonable assurance for the DRSC watershed TMDLs. IEPA provided information on controls of fecal coliform, chloride, and DO-demanding substances that will be targeted in the watershed.

Point Sources:
Reasonable assurance that the WLAs will be implemented are through the NPDES program. IEPA listed numerous WWTPs that discharge the pollutants of concern in the DRSC watershed. WLAs have been determined for all three pollutants, and individual WLAs calculated for each point source discharger. Stormwater was identified as a source of the three pollutants, and IEPA has determined aggregate WLAs for each pollutant by subwatershed. As discussed in Section 5 of this Decision Document, IEPA developed two scenarios to address the low-DO in Segment GB-16. These scenarios will require reductions in pollutant loads for the three WWTF dischargers on the segment.

Appendix G of the TMDL contains the NPDES Permit Special Condition either contained or to be contained in the NPDES permits for the permittees listed in Table 34-35 of this Decision Document. These conditions require the permittee to work with the DRSCW to determine the most effective means to address the chloride and low DO impairments in the DRSC watersheds. The Special Conditions include various projects to address other causes of the DO impairment, such as dam removal, waterbody restoration, and additional modeling efforts. Completion dates are included, and annual progress reports are required. The latest progress report is available at http://www.dupagerivers.org/wp-content/uploads/2018/04/DRSCW-LDRWC_SpecialConditionsReport17-18_03312018.pdf on the DRSCW website.

The Special Conditions also require implementation of a watershed Chloride Reduction Program, and to work with members of the DRSCW to reduce chloride discharge. A Phosphorus Discharge Optimization Plan is also required to be implemented to investigate the potential for further reductions in phosphorus discharge from the facilities. The Permittees are also required to investigate nonpoint source phosphorus reductions through a Nutrient Implementation Plan.

Nonpoint Sources:
Fecal coliform: Section 8.5 of the TMDL discusses various BMPs that, when implemented, will significantly reduce fecal coliform loadings to attain WQS. For most of these BMPs, IEPA provided watershed analysis on the impacts these BMPs may have on fecal coliform loads. IEPA noted that the usual source of bacteria loading (agricultural runoff), is not present in much of the watershed. For the East Branch DuPage River and Salt Creek, nonpoint source actions will focus on sanitary surveys to identify failing septics. The West Branch DuPage River and Lower DuPage River have some agricultural lands, and therefore some controls will be needed for those sources.

Chloride: To control chloride loads into the Lower DuPage River, IEPA will focus on controlling road salt runoff in the watershed (Section 8.5.3 of the TMDL). To control chloride, IEPA will focus on operator training for both municipal salting operations as well as private contractors.

DO-demanding substances: To control DO-demanding substances in the TMDL watersheds, IEPA developed a STEPL model that calculates pollutant runoff from various land uses (Section 8 of the TMDL). Figures 69 and 71 in the TMDL identify the phosphorus and BOD loading rates from subwatersheds in the Segment GB-16 watershed. This modeling effort will help IEPA identify the critical areas for pollutant loading, and therefore target BMPs more efficiently.

Local efforts:
IEPA also identified numerous watershed projects in the TMD watershed that will reduce pollutant loads. The DRSCW is a local group of stakeholders that have been working in the watersheds for many years. Tables 66 and 67 of the TMDL contain a list of BMP projects planned for the East Branch and West Branch DuPage Rivers, including costs. The Lower DuPage River Watershed Coalition (LDRWC) has also been active in the watershed. Both groups have applied for and received funding to develop implementation actions and activities, perform monitoring, and target the removal of dams in the watershed. These projects will directly reduce pollutant loads in the waterbodies, as well as improve fish passages, habitat and biota within the impaired waters.

Additional TMDLs:
IEPA noted that several previously approved TMDLs in different portions of the watershed continue to be implemented (Table 2 of the TMDL and https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Pages/reports.aspx#dupeas). Previous TMDLs in the East Branch DuPage River focused on low DO and elevated chloride. TMDLs in the West Branch DuPage River addressed elevated chloride levels. TMDLs in Salt Creek addressed chloride and low DO. These TMDLs are being implemented, and the actions and activities as part of this implementation effort will very likely help reduce pollutants in the DRSC TMDLs (Section 8 of the TMDL).

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 TMDL contains discussion on future monitoring and milestones (Section 9 and Table 70 of the TMDL). There were several monitoring sites used to gather data for the DRSC TMDLs. IEPA performs intensive basin surveys every 5 years on a rotating basins process. Additional monitoring has been done by the DRSCW and LDRWC who have worked in conjunction with IEPA and NPDES permittees in the watershed to gather a wide variety of data to better document the water quality. Some of the monitoring work is required under the Special Conditions in the NPDES permits (Appendix G of the TMDL).

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:
Numerous implementation options are discussed in Section 8 of the TMDL. Many of the options focus on stormwater controls and stream restoration activities.

The potential BMPs are:

- Ordinance development – local ordinances can have significant impacts on the design and operation of stormwater controls
- Pet waste education – reduction of bacteria and nutrients through implementation of controls on pet waste
- Septic System Inspection – improved septic system regulations and point of sale inspections can reduce the potential for failing systems

- Green infrastructure – the use of permeable paving, rain gardens, etc. to reduce and control stormwater runoff

- Stream restoration – the DRSCW and LDRWC have led efforts to improve streams within the TMDL watersheds
- Dam removal – Several dams have been removed or reduced to provide better stream hydrology and fish passage in the watersheds

IEPA also provided data on the potential removal efficiencies for several BMPs in Table 66 of the TMDL. The table also provides information on potential costs for the BMPs.

Significant efforts have been developed in the watershed to address the reduction of chloride in the watershed. The DRSCW and LDRWC have led efforts to develop and host annual workshops for public and private salt spreaders since 2008. The groups have also developed BMPs regarding salt practices in an effort to reduce salt loads throughout the watershed. A variety of best practices information and training materials are available on the DRSCW website (http://www.drscw.org/wp/chlorides-and-winter-management/).

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

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:
An initial public meeting was held on January 28, 2009, to describe the watershed plan and TMDL process. An additional stakeholder meeting was held on March 31, 2009. The TMDL process, NPDES Special Conditions, and project status in the watersheds were discussed during meetings of the DRSCW. The meetings were held approximately every 2 months. Numerous stakeholders were present at the meetings (http://www.drscw.org/wp/agendas-and-minutes/).

The public comment period for the draft TMDL opened on April 24, 2019 and closed on May 24, 2019. A public meeting was held on April 24, 2019, in Lombard, Illinois. The public notices were published in the local newspaper and interested individuals and organizations received copies of the public notice. A hard copy of the TMDL was made available at the Conservation Foundation, DuPage County Stormwater Management Office, the Village of Lombard, and the Village of Plainfield. The draft TMDL was also made available at the website http://www.epa.illinois.gov/public-notices/index. One public comment was received, from the Metropolitan Water Reclamation District of Greater Chicago (Appendix D of the TMDL). The comments corrected the locations of several monitoring stations operated by the District. IEPA revised the TMDL as appropriate based on the comments.

EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning 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 waterbody, and the pollutant(s) of concern.

Comment:
On August 6, 2019, EPA received the DRSC watershed TMDLs and a submittal letter from Sanjay Sofat, IEPA to Joan Tanaka, EPA. In the submittal letter, IEPA stated it was submitting the TMDL report for EPA's final approval. The submittal letter included the name and location of the waterbodies and the pollutants of concern.

EPA finds that the TMDL document submitted by IEPA satisfies all requirements concerning this twelfth element.

Conclusion
After a full and complete review, EPA finds that the TMDLs for the DuPage River Salt Creek watersheds satisfy all of the elements of an approvable TMDL. This approval is for 18 TMDLs: 12 for fecal coliform, five for low DO (phosphorus, ammonia, CBOD, and DO-demanding substances) and one for chloride, as noted in Table 1 of this Decision Document.

EPA's approval of this TMDL does not extend to those waters that are within Indian Country, as defined in 18 U.S.C. Section 1151. EPA is taking no action to approve or disapprove TMDLs for those waters at this time. EPA, or eligible Indian Tribes, as appropriate, will retain responsibilities under the CWA Section 303(d) for those waters.

Fecal Coliform TMDLs

Table 34 of this Decision Document contains the individual WLAs summarized in Tables 5-28.

Table 5. Fecal coliform TMDL summary (single sample maximum standard; DuPage River at GB-11)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [c]	372	-	-	-	-
	NPDES-permitted facilities	4,825	2,134	2,134	b	b
	MS4 [d]	5,641	1,931	339	b	b
Load Allocation		769	263	46	b	b
MOS		1,290	481	280	183	126
Loading Capacity		**12,897**	**4,809**	**2,799**	**1,830**	**1,260**
Existing Load		34,398	12,109	5,271	1,481	1,764
Load Reduction [a]		63%	60%	47%	0%	29%

a. TMDL reduction is based on the observed 90th percentile load in each flow regime.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.
c. CSO events are assumed to occur no more than 4 times a year
d. the MS4 WLA is categorical, see section 6.3.1 for description

Table 6. Fecal coliform TMDL summary (geomean standard; DuPage River at GB-11)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [c]	186	-	-	-	-
	NPDES-permitted facilities	2,415	1,065	1,065	b	b
	MS4 [d]	2,819	967	172	b	b
Load Allocation		384	132	23	b	b
MOS		645	240	140	92	63
Loading Capacity		**6,449**	**2,404**	**1,400**	**915**	**630**
Existing Load		34,398	12,109	5,271	1,481	1,764
Load Reduction [a]		Not calculated				

a. Insufficient data to calculate reduction based on the geomean standard.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.
c. CSO events are assumed to occur no more than 4 times per year.
d. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 7. Fecal coliform TMDL summary (single sample maximum standard; DuPage River at GB-16)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [c]	372	-	-	-	-
	NPDES-permitted facilities	4,707	2,086	b	b	b
	MS4 [d]	3,547	1,148	b	b	b
Load Allocation		351	113	b	b	b
MOS		998	372	217	142	97
Loading Capacity		**9,975**	**3,719**	**2,165**	**1,415**	**974**
Existing Load		125,380	37,179	2,069	1,399	456
Load Reduction [a]		92%	90%	0%	0%	0%

a. TMDL reduction is based on the observed 90th percentile load in each flow regime.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards..
c. CSO events are assumed to occur no more than 4 times per year.
d. The MS4 WLA is categorical, see section 6.3.1 for description

Table 8. Fecal coliform TMDL summary (geomean standard; DuPage River at GB-16)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [c]	186	-	-	-	-
	NPDES-permitted facilities	2,356	1,041	b	b	b
	MS4 [d]	1,771	576	b	b	b
Load Allocation		175	57	b	b	b
MOS		499	186	108	71	49
Loading Capacity		**4,987**	**1,860**	**1,083**	**708**	**487**
Existing Load		125,380	37,179	2,069	1,399	456
Load Reduction [a]		Not calculated				

a. Insufficient data to calculate reduction based on the geomean standard.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards..
c. CSO events are assumed to occur no more than 4 times per year.
d. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 9. Fecal coliform TMDL summary (single sample maximum standard; West Branch DuPage River at GBK-05

TMDL Parameter		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facilities	1,405	642	642	b	b
	MS4 [c]	2,349	594	54	b	b
Load Allocation		177	45	4	b	b
MOS		437	142	78	50	33
Loading Capacity		**4,368**	**1,423**	**778**	**500**	**333**
Existing Load		143,396	70,781	6,387	1,444	1,102
Load Reduction [a]		97%	98%	88%	65%	70%

a. TMDL reduction is based on the observed 90th percentile load in each flow regime.

b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.

c. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 10. Fecal coliform TMDL summary (geomean standard; West Branch DuPage River at GBK-05)

TMDL Parameter		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facilities	704	320	320	b	b
	MS4 [c]	1,174	298	28	b	b
Load Allocation		88	22	2	b	b
MOS		218	71	39	25	17
Loading Capacity		**2,184**	**711**	**389**	**250**	**167**
Existing Load		143,396	70,781	6,387	1,444	1,102
Load Reduction [a]		Not calculated				

a. Insufficient data to calculate reduction based on the geomean standard.

b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.

c. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 11. Fecal coliform TMDL summary (single sample maximum standard; West Branch DuPage River at GBK-09)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facilities	612	293	293	b	b
	MS4 [c]	741	205	0.97	b	b
Load Allocation		23	6	0.03	b	b
MOS		153	56	33	22	15
Loading Capacity		**1,529**	**560**	**327**	**222**	**152**
Existing Load		24,165	13,295	1,030	2,822	416
Load Reduction [a]		94%	96%	68%	92%	64%

a. TMDL reduction is based on the observed 90th percentile load in each flow regime.

b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.

c. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 12. Fecal coliform TMDL summary (geomean standard; West Branch DuPage River at GBK-09)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facilities	307	146	146	b	b
	MS4 [c]	370	103	0.97	b	b
Load Allocation		11	3	0.03	b	b
MOS		77	28	16	11	8
Loading Capacity		**765**	**280**	**163**	**111**	**76**
Existing Load		24,165	13,295	1,030	2,822	416
Load Reduction [a]		Not calculated				

a. Insufficient data to calculate reduction based on the geomean standard.

b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.

c. The MS4 WLA is categorical, see section 6.3.1 for description

Table 13. Fecal coliform TMDL summary (single sample maximum; West Branch DuPage River at GBK-14)

TMDL Parameter	Flow Zones				
	High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
	Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation: MS4 [a]	200	73	42.6	29.7	19.8
Load Allocation	2	1	0.4	0.3	0.2
MOS	23	8	5	3	2
Loading Capacity	**225**	**82**	**48**	**33**	**22**
Existing Load	14,287	2,417	406	5,335	3,477
Load Reduction [b]	98%	97%	88%	99%	99%

a. The MS4 WLA is categorical, see section 6.3.1 for description.

b. TMDL reduction is based on the observed 90th percentile load in each flow regime.

Table 14. Fecal coliform TMDL summary (geomean standard; West Branch DuPage River at GBK-14)

TMDL Parameter	Flow Zones				
	High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
	Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation: MS4 [a]	100	36.6	21.8	13.9	9.9
Load Allocation	1	0.4	0.2	0.1	0.1
MOS	11	4	2	2	1
Loading Capacity	**112**	**41**	**24**	**16**	**11**
Existing Load	14,287	2,417	406	5,335	3,477
Load Reduction [b]	Not calculated				

a. The MS4 WLA is categorical, see section 6.3.1 for description.

b. Insufficient data to calculate reduction based on the geomean standard.

Table 15. Fecal coliform TMDL summary (single sample maximum standard; Spring Brook at GBKA)

TMDL Parameter	Flow Zones				
	High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
	Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation: MS4 [a]	202	93	57	40	29
Load Allocation [a]	0	0	0	0	0
MOS	22	10	6	5	3
Loading Capacity	**224**	**103**	**63**	**45**	**32**
Existing Load	7,380	1,737	809	100	117
Load Reduction [b]	97%	94%	92%	55%	73%

a. The MS4 WLA is categorical and accounts for 100% of the watershed, therefore the LA=0. See section 6.3.1 for description.

b. TMDL reduction is based on the observed 90th percentile load in each flow regime.

Table 16. Fecal coliform TMDL summary (geomean standard; Spring Brook at GBKA)

TMDL Parameter	Flow Zones				
	High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
	Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation: MS4 [a]	101	47	29	21	14
Load Allocation [a]	0	0	0	0	0
MOS	11	5	3	2	2
Loading Capacity	**112**	**52**	**32**	**23**	**16**
Existing Load	7,380	1,737	809	100	117
Load Reduction [b]	Not calculated				

a. The MS4 WLA is categorical and accounts for 100% of the watershed, therefore the LA=0. See section 6.3.1 for description.

b. Insufficient data to calculate reduction based on the geomean standard.

Table 17. Fecal coliform TMDL summary (single sample maximum standard; Spring Brook at GBKA-01)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facility: IL0031739 (Wheaton S.D.) [a]	289 (at DMF)	135 (at DAF)	b	b	b
	MS4 [c]	62	27	b	b	b
Load Allocation		1	1	b	b	b
MOS		39	18	11	8	6
Loading Capacity		**391**	**181**	**110**	**79**	**55**
Existing Load		5,777	1,610	211	103	148
Load Reduction [d]		93%	89%	48%	23%	63%

a. DMF = 19.1 MGD, DAF = 8.9 MGD
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.
c. The MS4 WLA is categorical, see section 6.3.1 for description.
d. TMDL reduction is based on the observed 90th percentile load in each flow regime.

Table 18. Fecal coliform TMDL summary (geomean standard; Spring Brook at GBKA-01)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facility: IL0031739 (Wheaton S.D.) [a]	145 (at DMF)	67 (at DAF)	b	b	b
	MS4 [c]	30	13.7	b	b	b
Load Allocation		1	0.3	b	b	b
MOS		20	9	6	4	3
Loading Capacity		**196**	**90**	**55**	**40**	**28**
Existing Load		5,777	1,610	211	103	148
Load Reduction [d]		Not calculated				

a. DMF = 19.1 MGD, DAF = 8.9 MGD
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.
c. The MS4 WLA is categorical, see section 6.3.1 for description.
d. Insufficient data to calculate reduction based on the geomean standard.

Table 19. Fecal coliform TMDL summary (single sample maximum standard; East Branch DuPage River at GBL-10)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [c]	372	-	-	-	-
	NPDES-permitted facilities	1,347	554	554	b	b
	MS4 [d]	1,086	457	89	b	b
Load Allocation		11	5	1	b	b
MOS		313	113	72	52	39
Loading Capacity		**3,129**	**1,129**	**716**	**521**	**391**
Existing Load		22,930	9,863	9,377	3,411	2,129
Load Reduction [a]		86%	89%	92%	85%	82%

a. TMDL reduction is based on the observed 90th percentile load in each flow regime.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.
c. CSO events are assumed to occur no more than 4 times per year.
d. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 20. Fecal coliform TMDL summary (geomean standard; East Branch DuPage River at GBL-10)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [c]	186	-	-	-	-
	NPDES-permitted facilities	674	276	276	b	b
	MS4 [d]	543	230	45.5	b	b
Load Allocation		5	2	0.5	b	b
MOS		156	56	36	26	20
Loading Capacity		**1,564**	**564**	**358**	**260**	**195**
Existing Load		22,930	9,863	9,377	3,411	2,129
Load Reduction [a]		Not calculated				

a. Insufficient data to calculate reduction based on the geomean standard.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.
c. CSO events are assumed to occur no more than 4 times per year.
d. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 21. Fecal coliform TMDL summary (single sample maximum; Salt Creek at GL-09)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [c]	2,719	-	-	-	-
	NPDES-permitted facilities	1,713	886	886	b	b
	MS4 [d]	1,176	1,007	160	b	b
Load Allocation		12	10	2	b	b
MOS		625	211	116	76	50
Loading Capacity		**6,245**	**2,114**	**1,164**	**756**	**500**
Existing Load		214,979	78,888	4,486	1,896	747
Load Reduction [a]		97%	97%	74%	60%	33%

a. TMDL reduction is based on the observed 90th percentile load in each flow regime.

b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.

c. CSO events are assumed to occur no more than 4 times per year.

d. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 22. Fecal coliform TMDL summary (geomean standard; Salt Creek at GL-09)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [c]	1,359	-	-	-	-
	NPDES-permitted facilities	859	444	444	b	b
	MS4 [d]	586	502	79	b	b
Load Allocation		6	5	1	b	b
MOS		312	106	58	38	25
Loading Capacity		**3,122**	**1,057**	**582**	**378**	**250**
Existing Load		214,979	78,888	4,486	1,896	747
Load Reduction [a]		Not calculated				

a. Insufficient data to calculate reduction based on the geomean standard.

b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.

c. CSO events are assumed to occur no more than 4 times per year.

d. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 23. Fecal coliform load duration curve (single sample maximum standard; Salt Creek at GL-10)

TMDL Parameter		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facility: IL0036340 (MWRDGC EGAN WRP – 001) [a]	757	454	c	c	c
	MS4 [b]	1,424	87	c	c	c
Load Allocation		14	1	c	c	c
MOS		244	60	26	11	3
Loading Capacity		**2,439**	**602**	**264**	**105**	**29**
Existing Load		5,938	3,027	332	342	121
Load Reduction [d]		59%	80%	20%	69%	76%

a. DMF = 50 MGD, DAF = 30 MGD. NPDES-permitted facility with excess flow outfall – excess flows not included in WLA.
b. The MS4 WLA is categorical, see section 6.3.1 for description.
c. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.
d. TMDL reduction is based on the observed 90th percentile load in each flow regime.

Table 24. Fecal coliform load duration curve (geomean standard; Salt Creek at GL-10)

TMDL Parameter		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facility: IL0036340 (MWRDGC EGAN WRP – 001) [a]	379	227	c	c	c
	MS4 [b]	712	43.6	c	c	c
Load Allocation		7	0.4	c	c	c
MOS		122	30	13	5	1
Loading Capacity		**1,220**	**301**	**132**	**52**	**14**
Existing Load		5,938	3,027	332	342	121
Load Reduction [d]		Not calculated				

a. DMF = 50 MGD, DAF = 30 MGD. NPDES-permitted facility with excess flow outfall – excess flows not included in WLA.
b. The MS4 WLA is categorical, see section 6.3.1 for description.
c. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.
d. Insufficient data to calculate reduction based on the geomean standard.

Table 25. Fecal coliform TMDL summary (single sample maximum; Salt Creek at GL-19)

TMDL Parameter		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [a]	b	-	-	-	-
	NPDES-permitted facilities	1,864	957	957	c	c
	MS4 [d]	5,017	1,375	332	c	c
Load Allocation		51	14	3	c	c
MOS		770	261	144	93	62
Loading Capacity		**7,702**	**2,607**	**1,436**	**932**	**617**
Existing Load		267,527	379,297	5,919	4,698	1,321
Load Reduction [e]		97%	99%	76%	80%	53%

a. CSO events are assumed to occur no more than 4 times per year.

b. Permitted CSO loads are estimated to be approximately 11,880 billion cfu/event. Permitted CSO facilities can discharge under high flow conditions if meeting permit conditions and long-term control plans.

c. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.

d. The MS4 WLA is categorical, see section 6.3.1 for description

e. TMDL reduction is based on the observed 90th percentile load in each flow regime.

Table 26. Fecal coliform TMDL summary (geomean standard; Salt Creek at GL-19)

TMDL Parameter		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [a]	b	-	-	-	-
	NPDES-permitted facilities	935	480	480	c	c
	MS4 [d]	2,506	687	164	c	c
Load Allocation		25	7	2	c	c
MOS		385	130	72	47	31
Loading Capacity		**3,851**	**1,304**	**718**	**466**	**309**
Existing Load		267,527	379,297	5,919	4,698	1,321
Load Reduction [e]		Not calculated				

a. CSO events are assumed to occur no more than 4 times per year.

b. Permitted CSO loads are estimated to be approximately 5,940 billion cfu/event. Permitted CSO facilities can discharge under high flow conditions if meeting permit conditions and long-term control plans.

c. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.

d. The MS4 WLA is categorical, see section 6.3.1 for description.

e. Insufficient data to calculate reduction based on the geomean standard.

Table 27. Fecal coliform TMDL summary (single sample maximum standard; Addison Creek at GLA-02)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSO: IL0020853 (MWRDGC STICKNEY WRP CSOS – 150) [a]	b	-	-	-	-
	NPDES-permitted facility: IL0021849 (BENSENVILLE STP – 001) [c]	151	71	71	d	d
	MS4 [e]	702	210	52	d	d
Load Allocation		7	2	0.5	d	d
MOS		96	31	14	8	5
Loading Capacity		**956**	**314**	**138**	**84**	**47**
Existing Load		-	18,705	6,727	2,407	1,377
Load Reduction [f]		-	98%	98%	97%	97%

a. CSO events are assumed to occur no more than 4 times per year.
b. Permitted CSO loads are estimated to be approximately 5,891 billion cfu/event. Permitted CSO facilities can discharge under high flow conditions if meeting permit conditions and long-term control plans.
c. DMF = 10 MGD, DAF = 4.7 MGD. NPDES-permitted facility with excess flow outfall – excess flows not included in WLA.
d. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.
e. The MS4 WLA is categorical, see section 6.3.1 for description.
f. TMDL reduction is based on the observed 90th percentile load in each flow regime.

Table 28. Fecal coliform TMDL summary (geomean standard; Addison Creek at GLA-02)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSO: IL0020853 (MWRDGC STICKNEY WRP CSOS – 150) [a]	b	-	-	-	-
	NPDES-permitted facility: IL0021849 (BENSENVILLE STP – 001) [c]	76	36	36	d	d
	MS4 [e]	350	104	26	d	d
Load Allocation		3	1	0.3	d	d
MOS		48	16	7	4	2
Loading Capacity		**478**	**157**	**69**	**42**	**23**
Existing Load		-	18,705	6,727	2,407	1,377
Load Reduction [f]		Not calculated				

a. CSO events are assumed to occur no more than 4 times per year.

b. Permitted CSO loads are estimated to be approximately 2,945 billion cfu/event. Permitted CSO facilities can discharge under high flow conditions if meeting permit conditions and long-term control plans.

c. DMF = 10 MGD, DAF = 4.7 MGD. NPDES-permitted facility with excess flow outfall – excess flows not included in WLA.

d. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.

e. The MS4 WLA is categorical, see section 6.3.1 for description.

f. Insufficient data to calculate reduction based on the geomean standard.

Chloride TMDL

Table 29. Chloride TMDL summary, DuPage River at GB-11

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Chloride Load (tons/day)				
Boundary Condition: Upstream Approved TMDLs in East and West Branch DuPage Rivers		1,106	412	240	157	108
Wasteload Allocation	NPDES-permitted facilities	200	95	95	b	b
	ILDOT Roads	6	2	0.2	b	b
	Non-ILDOT MS4s [c]	220	67	9	b	b
Load Allocation		67	21	3	b	b
MOS		178	66	39	25	17
Loading Capacity		**1,777**	**663**	**386**	**252**	**174**
Existing Load		1,592	532	727	967	65
Load Reduction [a]		0%	0%	47%	74%	0%

a. TMDL reduction is based on the observed maximum load in each flow regime.

b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (500 mg/L). The allowable concentration is based on the water quality standard.

c. The Non-ILDOT MS4 WLA is categorical, see section 6.3.1 for description.

DO-demanding substances TMDLs

Table 30. $CBOD_5$, total phosphorus, and ammonia TMDLs to address dissolved oxygen summary (GB-16)

TMDL Parameter		Scenario 2				Scenario 3			
		$CBOD_5$ (lbs/day)	Total Phosphorus (lbs/day)	Total Ammonia (lbs/day)	Implementation Targets	$CBOD_5$ (lbs/day)	Total Phosphorus (lbs/day)	Total Ammonia (lbs/day)	Implementation Targets
Wasteload Allocation	CSOs	0 [b]	0 [b]	0 [b]	--	0 [b]	0 [b]	0 [b]	--
	Point Source: IL0034061 (Naperville STP)	1,877	250	350	- Minimum DO increased to 6.5 mg/L in permit - Reduce $CBOD_5$ permit limit to 7.5 mg/L	2,503	250	350	• Minimum DO increased to 6.5 mg/L in permit
	Point Source: IL0069744 (Bolingbrook STP #3)	350	53	53	- Minimum DO increased to 6.5 mg/L in permit - Reduce $CBOD_5$ permit limit to 10 mg/L	350	53	53	- Minimum DO increased to 6.5 mg/L in permit - Reduce $CBOD_5$ permit limit to 10 mg/L
	Point Source: IL0074373 (Plainfield North STP)	626	94	94	- Minimum DO increased to 6.5 mg/L in permit - Reduce $CBOD_5$ permit limit to 10 mg/L	626	63	94	- Minimum DO increased to 6.5 mg/L in permit - Reduce $CBOD_5$ permit limit to 10 mg/L
	MS4	0 [b]	0 [b]	0 [b]	--	0 [b]	0 [b]	0 [b]	--
Load Allocation		512	34	34	- SOD rate reduced to 2.04 $g/m^2/d$ - SOD coverage decreased by half to 7.5% - Headwater TP decreased to 1 mg/L - Headwater at 6 mg/L DO	511	34	34	- SOD rate reduced to 2.04 $g/m^2/d$ - SOD coverage decreased to 5% - Headwater TP decreased to 1 mg/L - Headwater at 6 mg/L DO
MOS [a]		*Implicit*			--	*Implicit*			--
Loading Capacity		**3,366**	**674**	**531**	--	**3,990**	**674**	**531**	--
In-stream losses per QUAL2K model (see Appendix E)		-197	-91	-159	--	-260	-74	-160	--
In-stream load of pollutant at downstream point of segment meeting DO standards		3,169	583	372	--	3,730	600	371	--

a. A 10% MOS was applied to the standard during modeling; see Appendix E.

b. This TMDL is provided for critical conditions occurring during low flow summer months; CSO and stormwater discharges are not anticipated at this time. Illinois EPA indicated that it is not intended to apply under higher flow conditions (9/5/19 email from Abel Haile, IEPA to Dave Werbach, EPA).

c. Conversion units used in WLA calculations: 1.547 (MGD per cfs), 86,400 (seconds per day), 28.317 (liters per 1 cubic ft) and 453,592 (mg per lb)

Table 31. Dissolved oxygen demand TMDL summary (GBK-14)

TMDL Parameter	DOD (kg/day)	DOD (lbs/day)
Wasteload Allocation: MS4 [a]	0 [b]	0 [b]
Load Allocation	11	24
MOS [c]	*implicit*	*implicit*
Loading Capacity (kg/day) [d]	**11**	**24**
Existing Load (kg/day)	19	42
Load Reduction	42%	

a. The MS4 WLA is categorical, see section 6.3.1 for description.
b. This TMDL is provided for critical conditions occurring during low flow summer months; CSO and stormwater discharges are not anticipated at this time.
c. A 10% MOS was applied to the standard during modeling; see Appendix E.
d. TMDL is provided for critical conditions: Flow = 1.33 cfs; Water temperature = 19.4 °C; DO_{sat} = 8.96 mg/l. TMDLs can be determined for any combination of flow and water temperature using the following equation:

$$DOD\left[\frac{kg}{\_\_}\right] = (DO_{sat} - DO)\ [mg/L]\ x\ Q\ [cfs]\ x\ 2.447[conversion\ factor]$$

Table 32. Dissolved oxygen demand TMDL summary (Spring Brook at GBKA)

TMDL Parameter	DOD (kg/day)	DOD (lbs/day)
Wasteload Allocation: MS4 [a]	0 [b]	0 [b]
Load Allocation	39	86
MOS [c]	*implicit*	*implicit*
Loading Capacity [d]	**39**	**86**
Existing Load	59	130
Load Reduction	34%	

a. The MS4 WLA is categorical, see section 6.3.1 for description.
b. This TMDL is provided for critical conditions occurring during low flow summer months; stormwater discharges are not anticipated at this time.
c. A 10% MOS was applied to the standard during modeling; see Appendix E.
d. TMDL is provided for critical conditions: Flow = 4.3 cfs; Water temperature = 22.26 °C; DO_{sat} = 8.76 mg/l. TMDLs can be determined for any combination of flow and water temperature using the following equation:

$$DOD\left[\frac{kg}{\_\_}\right] = (DO_{sat} - DO)\ [mg/L]\ x\ Q\ [cfs]\ x\ 2.447[conversion\ factor]\ d$$

Table 34. Fecal Coliform and Chloride Wasteload Allocations (See Table 18 of the TMDL for the waterbody segment locations of the dischargers)

Permit ID	Facility	Design Average Flow (MGD)	Design Maximum Flow (MGD)	Fecal Coliform WLA (billion cfu per day)	
				High Flows – Design Maximum Flow (single sample maximum/ geomean standard)	Moist Conditions to Low Flows – Design Average Flow (single sample maximum/ geomean standard)
IL0020061	WOOD DALE NORTH STP – 001[b]	1.97	3.93	60 / 30	30 / 15
IL0021130	BLOOMINGDALE-REEVES WRF – B01[b]	3.45	8.625	131 / 65	52 / 26
IL0021547	GLENBARD WW AUTH-GLENBARD – 001	16.02	47	712 / 356	243 / 121
IL0021849	BENSENVILLE STP – 001[b]	4.7	10.0	151 / 76	71 / 36
IL0022471	GLENBARD WW AUTH-LOMBARD – 001	0.8[a]		12 / 6	12 / 6
IL0022471	GLENBARD WW AUTH-LOMBARD – 002/003 (CSOs)[c]	24.6 (maximum CSO volume, February 2014)[d]		372 / 186	--
IL0023469	WEST CHICAGO STP – B01[b]	7.64	20.3	307 / 154	116 / 58
IL0026352	CAROL STREAM STP – B01[b]	6.5	13.0	197 / 98	98 / 49
IL0027367	ADDISON SOUTH-A.J. LAROCCA STP – B01[b]	3.2	8.0	121 / 61	48 / 24
IL0027367	ADDISON SOUTH-A.J. LAROCCA STP – 004 (CSO)[c]	17.07 (maximum CSO volume, April 2013)[d]		258 / 129	--
IL0027618	BARTLETT WWTP – B01[b]	3.679	5.151	78 / 39	56 / 28
IL0028380	DOWNERS GROVE SD WTC – B01[b]	11	22.0	333 / 167	167 / 83
IL0028398	DUPAGE COUNTY-NORDIC PARK STP – 001	0.5	1.0	15 / 8	42586
IL0028428	DUPAGE COUNTY-CASCADE STP – 001	0.00585	0.0234	0.4 / 0.2	0.1 / 0.05
IL0028746	ELMHURST WWTP – 001[b]	8	20.0	303 / 151	121 / 61
IL0028967	GLENDALE HEIGHTS STP – B01[b]	5.26	10.52	159 / 80	80 / 40
IL0030813	ROSELLE STP – B01[b]	2	4	61 / 30	30 / 15
IL0030953	SALT CREEK SANITARY DISTRICT – 001/002	3.3	8.0	121 / 61	50 / 25
IL0031739	WHEATON S.D. – 001[b]	8.9	19.1	289 /145	135 / 67
IL0031844	DUPAGE COUNTY-WOODRIDGE STP – 001[b]	12	28.6	433 / 217	182 / 91
IL0032689	BOLINGBROOK STP #1 – B01[b]	2.04	4.51	68 / 34	31 / 15
IL0032735	BOLINGBROOK WRF #2 – 001	3	7.5	114 / 57	45 / 23

IL0033618	VILLA PARK WET WEATHER STP – 001/002/003/004 (CSOs)[b,c]	38.5 (maximum CSO volume, based on annual average discharge and 4 events per year)[d]		583 / 291	--
IL0033812	ADDISON NORTH STP – B01[b]	5.3	7.6	115 / 58	80 / 40
				Fecal Coliform WLA (billion cfu per day)	
Permit ID	**Facility**	**Design Average Flow (MGD)**	**Design Maximum Flow (MGD)**	**High Flows – Design Maximum Flow (single sample maximum/ geomean standard)**	**Moist Conditions to Low Flows – Design Average Flow (single sample maximum/ geomean standard)**
IL0034061	NAPERVILLE SPRINGBROOK WRC – 001	26.25 current, 30 future	55.13 current, 63 future	954 / 477	454 / 227
IL0034274	WOOD DALE SOUTH STP – 001[b]	1.13	2.33	35 / 18	17 / 9
IL0034479	HANOVER PARK STP #1 – B01[b]	2.42	8.68	131 / 66	37 / 18
IL0036137	MWRDGC HANOVER PARK STP – 007	12	22	333 / 167	182 / 91
IL0036340	MWRDGC EGAN WRP – 001[b]	30	50	757 / 379	454 / 227
IL0045039	VILLAGE OF WESTERN SPRINGS CSOS – 004[c]	No reported CSO volume		0 / 0	--
IL0048721	ROSELLE-BOTTERMAN WWTF – 001	1.22	4.60	70 / 35	18 / 9
IL0052817	STONEWALL UTILITY COMPANY - STP	0.01	0.07	1.1 / 0.5	0.2 / 0.1
IL0069744	BOLINGBROOK WRF #3 – 001	2.8 current, 4.2 future	7.0 current, 10.5 future	159 / 79	64 / 32
IL0074373	PLAINFIELD NORTH STP – 001	7.5	15.0	227 /114	114 / 57
IL0076414	JOLIET AUX SABLE WWTP – 001	3.2	7.8	118 / 59	48 / 24
IL0079073	ITASCA STP – 001	3.2	8.2	124 / 62	48 / 24
IL0028053[e]	MWRDGC STICKNEY WRP CSOS – 150[c] (Westchester Pump Station)	389 (maximum CSO volume, October 2014)[d]		1,878 / 939 – discharges to GL-09 11,039 / 5,520 – discharges to GL-19 5,891 / 2,945 discharges to GLA-02	--
ILM580008[e]	LAGRANGE PARK CSOS – 001/002/003/004/005/006[c]	124 (maximum CSO volume, April 2013)[d]			
ILM580009[e]	VILLAGE OF LAGRANGE CSOS – 001/002/003[c]	No reported CSO volume			
ILM580032[e]	BROOKFIELD CSOS – 001/002/003/005/006/007[c]	341 (maximum CSO volume, April 2013)[d]			

a. 2013-2015 average DMR flows.

b. NPDES-permitted facility with excess flow outfall – excess flows not included in WLAs.

c. CSOs are only allowed to discharge 4 times per year at this level.

d. Maximum CSO volumes from 2013-2015 DMRs.

e. MWRD-permitted facilities are combined into one categorical WLA.

Table 35. Chloride WLAs for Individual Permits in GB-11

Permit ID	Facility Name	Design Average Flow (MGD)	Design Maximum Flow (MGD)	Chloride WLA (tons/day)	
				High Flows – Design Maximum Flow	Moist Conditions to Low Flows – Design Average Flow
IL0034061	NAPERVILLE SPRING-BROOK WRC – 001	30 (future conditions)	63 (future conditions)	131	63
IL0069744	BOLINGBROOK WRF #3 – 001	4.2 (future conditions)	10.5 (future conditions)	22	9
IL0074373	PLAINFIELD NORTH STP – 001	7.5	15.0	31	16
IL0076414	JOLIET AUX SABLE WWTP – 001	3.2	7.8	16	7
			Total	**200**	**95**

Table 36. Chloride WLAs for MS4 in GB-11

MS4	Chloride WLA (tons/day)		
	High Flows	Moist Conditions	Mid-Range Flows
ILDOT Roads	6	2	0.2
Non-ILDOT MS4s [a]	220	67	9
Total	**226**	**69**	**9..2**

a. The Non-ILDOT MS4 WLA is categorical, see section 6.3.1 for description and Appendix J for a list of MS4s.

DuPage River/Salt Creek Watershed TMDL Report

Final Report

1021 North Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276

Report prepared by:

With assistance from:

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Appendices

Acknowledgements

AECOM Environment developed portions of Sections 1-6 while under contract with Illinois EPA between 2008 and 2012 (see Appendix A).

The DuPage River Salt Creek Work Group and staff from the Conservation Foundation were integral in developing Section 8 to reflect local priorities in addition to providing support throughout the remainder of the project including gathering additional monitoring data (dissolved oxygen, pH, and other parameters) on selected streams to support the TMDL development process.

Executive Summary

The Clean Water Act and U.S. Environmental Protection Agency (EPA) regulations require that Total Maximum Daily Loads (TMDLs) be developed for waters that do not support their designated uses. In simple terms, a TMDL is a plan to attain and maintain water quality standards in waters that are not currently meeting them. The State of Illinois uses a three-stage approach to develop TMDLs for a watershed:

- **Stage 1** – Watershed characterization, historical dataset evaluation, data analysis, methodology selection, data gap identification
- **Stage 2** – Data collection to fill in data gaps, if necessary
- **Stage 3** – Model calibration, TMDL scenarios, and implementation plan

This TMDL study addresses the approximately 520 square mile DuPage River and Salt Creek watersheds located in northeastern Illinois. Fifteen stream segments within the watershed have identified impairments and have been placed on the State of Illinois §303(d) list. TMDL allocations have been set for fecal coliform, chloride and dissolved oxygen. Additional impairments in the watershed include nutrients and sediment. TMDLs are not provided for these impairments and needed reductions to meet water quality standards are unknown, however, implementation strategies to address nutrient and sediment impairments are provided in the implementation section of this report.

The sources of pollutants in the watershed include NPDES permitted facilities such as wastewater treatment facilities, combined sewer overflows, and regulated stormwater. In addition, sources of nonpoint pollution are largely the result of stormwater runoff in urban and rural areas. Stormwater, while not an actual source of pollutants itself, acts as an important delivery mechanism of multiple sources of each pollutant (e.g., pet waste, wildlife waste, salt application). In urban areas, non-permitted cross connections between sanitary sewers and storm sewers can also occur. Sources of pollutants in rural areas are primarily related to nutrient and sediment loading as a result of crop production in the Lower DuPage River watershed.

A TMDL identifies the total allowable load that a waterbody can assimilate (the loading capacity) and still meet water quality standards or targets. The loading capacity for fecal coliform or chloride stream impairments is determined using a load duration curve framework. The loading capacity for low dissolved oxygen impairments is derived using the receiving water model Qual2K. TMDLs and needed load reductions are presented in Section 7. The TMDL, or loading capacity, is distributed among point sources as wasteload allocations and nonpoint and background sources as load allocations. A margin of safety is provided to account for uncertainty. The required pollutant reductions vary between zero and 96%, depending on the waterbody, flow regime, and pollutant.

An implementation plan is provided in Section 8 which includes potential implementation activities to address the various pollutant sources in the watershed. The implementation plan covers only the DuPage River watershed portion of the TMDL. An implementation planning effort is underway for the Salt Creek watershed by the Chicago Metropolitan Agency for Planning, DuPage County Stormwater Management, and the DuPage River Salt Creek Workgroup that will address both the impaired waters in the Salt Creek watershed as well as other water quality concerns. The implementation plan, when combined with the TMDLs, is expected to meet U.S. EPA's Nine Elements for Clean Water Act section 319 funding requirements and includes an analysis of critical areas, extent of needed implementation, schedule, milestones, partners, and estimated costs.

1.0 Introduction

This final Stage 3 Total Maximum Daily Load (TMDL) report is presented by Illinois Environmental Protection Agency (Illinois EPA) as part of the state's Clean Water Act (CWA) Section 303(d) compliance obligations. The purpose of the project is to develop TMDLs for fifteen designated waterbodies in the DuPage River and Salt Creek watersheds in northeastern Illinois.

Section 303(d) of the CWA and U.S. Environmental Protection Agency's (USEPA) Water Quality Planning Regulations (40 CFR Part 130) require states to develop TMDLs for impaired waterbodies that are not meeting designated uses or water quality standards. A TMDL is a calculation of the maximum amount of pollutants that a waterbody can receive and still meet the water quality standards and targets necessary to protect the designated beneficial use (or uses) for that waterbody. The TMDL process establishes the allowable loadings of pollutants for a waterbody based on the relationship between pollutant sources and water quality conditions, so that states and local communities can establish water quality based controls to reduce pollutants from both point and nonpoint sources and restore and maintain the quality of their water resources. In addition to TMDL development, Load Reduction Strategies (LRS) may be included to address additional pollutants in the watershed that do not have water quality standards, namely nutrients and sediment in streams. In the case of the DuPage River and Salt Creek watersheds, no LRSs are provided. This is primarily due to the presence of the DuPage River Salt Creek Work Group and the Lower DuPage River Watershed Coalition and their high level of activity addressing water quality and impairments in the watershed.

United States policies and regulations, such as the CWA, were created and are implemented to help maintain the quality of our water resources in the United States. The USEPA, via the CWA, charged each state with developing water quality standards (WQS). These WQS are laws or regulations that states authorize to protect and/or enhance water quality, to ensure that a waterbody's designated use (or uses) is (are) not compromised by poor water quality and to protect public health and welfare. In general, WQS consist of three elements:

- The designated beneficial use (e.g., recreation, protection of aquatic life, aesthetic quality and public and food processing water supply) of a waterbody or segment of a waterbody
- The water quality criteria necessary to support the designated beneficial use of a waterbody or segment of a waterbody
- An anti-degradation policy, so that water quality improvements are conserved, maintained and protected

The Illinois Pollution Control Board (IPCB) established its WQS and includes it in Title 35: Environmental Protection, Subtitle C: Water Pollution, Chapter 1: Pollution Control Board, Part 302: Water Quality Standards. Every two years the Illinois EPA submits the Illinois Integrated Water Quality Report and Section 303(d) List. This report documents surface and groundwater conditions throughout the state and identifies impaired waterbodies, grouped by watershed, and identifies suspected sources of impairment.

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

Illinois EPA uses a three-stage approach to develop TMDLs for a watershed:

Stage 1 – Watershed characterization, historical dataset evaluation, data analysis, methodology selection, data gap identification (see Appendix A)

Stage 2 – Data collection to fill in data gaps, if necessary

Stage 3 – Model calibration, TMDL scenarios, and implementation plans

The purpose of Stage 1 (Appendix A) is to characterize the watershed background; verify impairments in the listed waterbody by comparing observed data with water quality standards or appropriate targets; evaluate spatial and temporal water quality variation; provide a preliminary assessment of sources contributing to impairments; and describe potential TMDL development approaches. If available water quality data collected for the watershed are deemed sufficient by Illinois EPA, Stage 2 may be omitted and Stage 3 will be completed. If sufficient water quality data or supporting information are lacking for an impaired waterbody, then Stage 2 is required and field samplings will be conducted in order to obtain necessary data to complete Stage 3. For the DuPage River/Salt Creek Watershed, Stage 2 sampling was conducted for sediment oxygen demand (SOD) in the West Branch and mainstem of the DuPage River (Appendix B). In addition, additional data collected was conducted on select segments to further characterize dissolved oxygen conditions. These data, while collected as part of Stage 2, are incorporated throughout the document where applicable. Stage 3 includes model development, allocations and reductions needed for waterbody improvement, and implementation actions for local stakeholders.

1.1 Definition of a Total Maximum Daily Load (TMDL)

According to the 40 CFR Part 130.2, the TMDL (the maximum load a waterbody can receive without exceeding water quality standards or result in non-attainment of a designated use) for a waterbody is equal to the sum of the individual loads from point sources (i.e., waste load allocations or WLAs) and load allocations (LAs) from nonpoint sources (including natural background conditions). Section 303(d) of the CWA also states that the TMDL must be established at a level necessary to achieve the applicable water quality standards with seasonal variations and a margin of safety (MOS) that takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. A reserve capacity (RC) can be included to account for future growth. In equation form, a TMDL may be expressed as follows:

TMDL = WLA + LA + MOS + RC

where:

WLA =	Waste Load Allocation (i.e., loadings from point sources)
LA =	Load Allocation (i.e., loadings from nonpoint sources including natural background)
MOS =	Margin of Safety
RC=	Reserve Capacity

The MOS accounts for the lack of knowledge or uncertainty concerning the true relationship between loading and attainment of water quality standards. This uncertainty is often a product of data gaps, either temporally or spatially, in the measurement of water quality. The MOS should be proportional to the anticipated level of uncertainty; the higher the uncertainty, the greater the MOS. The MOS can be either explicit or implicit. If an explicit MOS is used, a portion of the total allowable loading is allocated to the MOS. If the MOS is implicit, a specific value is not assigned to the MOS, but is already factored in during the TMDL development process. Use of an implicit MOS is appropriate when assumptions used to develop the TMDL are believed to be so conservative that they sufficiently account for the MOS. An RC is set aside to accommodate future growth in the watershed; this allocation can then be assigned to the appropriate permitted facility as needed. No specific reserve capacity is set aside at this time. TMDLs also shall take into account the seasonal variability of pollutant loading and hydrology to ensure water quality standards are met in all seasons and during all hydrologic conditions.

1.2 Targeted Waterbodies for TMDL Development

Several waters within the DuPage River/Salt Creek watershed have been placed on the State of Illinois §303(d) list (Table 1, Figure 1, and Figure 2) and require development of TMDLs. Appendix C includes photographs of several streams in the watershed.

Each waterbody has one or more designated uses, which may include aquatic life, aesthetic quality, indigenous aquatic life (for specific Chicago-area waterbodies), primary contact (swimming), secondary contact (recreation), public and food processing water supply, and fish consumption. The degree of support (attainment) of a designated use in a waterbody (or segment) is assessed as Fully Supporting (good), Not Supporting (fair), or Not Supporting (poor). Waters in which at least one applicable use is not fully supported is designated as “impaired.” Potential causes and sources of impairment are also identified for these waters. The 303(d) List is prioritized on a watershed basis based on the requirements of 40 CFR Part 130.7(b)(4).

Fifteen river segments are identified as impaired in the DuPage River/Salt Creek Watershed on the 2014 and 2016 draft 303(d) lists. Water quality assessments are based on biological, physicochemical, physical habitat, and toxicity data. The causes of impairment include pollutants such as fecal coliform, nickel, copper and chloride. Other causes of impairment include pH, low dissolved oxygen, total phosphorus, sedimentation/siltation, and total suspended solids. For impairments caused by low dissolved oxygen, the dissolved oxygen parameter itself is not calculated as a TMDL but is addressed by developing a TMDL for the parameters determined to be the primary cause of the dissolved oxygen impairment.

Table 1. DuPage River and Salt Creek watershed impairments and pollutants (2014 and 2016 Draft Illinois 303(d) List)

Waterbody ID	Waterbody Name	Watershed Area (square miles)	Designated Use	TMDL Pollutant(s)	Other Pollutant(s) Not Addressed [a]	Potential Source(s)
IL_GB-01	DuPage River	373	Aquatic Life	--	Total Phosphorus	Dam or Impoundment, Municipal Point Source Discharges, Source Unknown
IL_GB-11	DuPage River	331	Aquatic Life	**Chloride**	Total Phosphorus, Sediment/Siltation	Loss of Riparian Habitat, Municipal Point Source Discharges, Urban Runoff/Storm Sewers, Impacts from Hydrostructure Flow Regulation/Modification, Site Clearance (Land Development or Redevelopment), Upstream Impoundments, Dam or Impoundment, Source Unknown
			Primary Contact Recreation	**Fecal Coliform**		
IL_GB-16	DuPage River	256	Aquatic Life	**Dissolved Oxygen (Total Phosphorus, 5-day Carbonaceous Biochemical Oxygen Demand, and Ammonia)**	Total Phosphorus	Impacts from Hydrostructure Flow Regulation/modification, Municipal Point Source Discharges, Site Clearance (Land Development or Redevelopment), Urban Runoff/Storm Sewers, Source Unknown
			Primary Contact Recreation	**Fecal Coliform**		
IL_GBK-05	West Branch DuPage River	103	Aquatic Life	--	Total Phosphorus, Sediment/Siltation, Total Suspended Solids	Impacts from Hydrostructure Flow Regulation/modification, Municipal Point Source Discharges, Site Clearance (Land Development or Redevelopment), Urban Runoff/Storm Sewers, Source Unknown
			Primary Contact Recreation	**Fecal Coliform**		
IL_GBK-09	West Branch DuPage River	34	Aquatic Life	--	Total Phosphorus, Sediment/Siltation	Municipal Point Source Discharges, Urban Runoff/Storm Sewers, Site Clearance (Land Development or Redevelopment)
			Primary Contact Recreation	**Fecal Coliform**		Channelization, Municipal (Urbanized High Density Area), Urban Runoff/Storm Sewers

Waterbody ID	Waterbody Name	Watershed Area (square miles)	Designated Use	TMDL Pollutant(s)	Other Pollutant(s) Not Addressed [a]	Potential Source(s)
IL_GBK-14	West Branch DuPage River	5	Aquatic Life	**Dissolved Oxygen (Dissolved Oxygen Deficit)**	*pH*	Channelization, Agriculture, Urban Runoff/ Storm Sewers, Source Unknown
			Primary Contact Recreation	**Fecal Coliform**		
IL_GBKA	Spring Brook	4	Aquatic Life	**Dissolved Oxygen (Dissolved Oxygen Deficit)**	Total Phosphorus, Chloride [b]	Municipal Point Source Discharges, Urban Runoff/Storm Sewers, Site Clearance (Land Development or Redevelopment) Channelization, Municipal (Urbanized High Density Area), Urban Runoff/Storm Sewers
			Primary Contact Recreation	**Fecal Coliform**		
IL_GBKA-01	Spring Brook	7	Aquatic Life	--	Total Phosphorus, *Copper*	Channelization, Agriculture, Urban Runoff/ Storm Sewers, Source Unknown
			Primary Contact Recreation	**Fecal Coliform**		
IL_GBL-08	East Branch DuPage River	22	Aquatic Life	--	Total Phosphorus, Sediment/Siltation, Total Suspended Solids, *pH*	Channelization; Site Clearance (Land Development or Redevelopment); Upstream Impoundments; Impacts from Hydrostructure Flow Regulation/Modification; Dam or Impoundment; Urban Runoff/Storm Sewers; Highways, Roads, Bridges, Infrastructure (New Construction); Municipal Point Source Discharges; Source Unknown
IL_GBL-10	East Branch DuPage River	59	Aquatic Life	--	Total Phosphorus, *pH*	Channelization, Municipal Point Source Discharges, Urban Runoff/Storm Sewers, Source Unknown
			Primary Contact Recreation	**Fecal Coliform**		
IL_GL	Salt Creek	33	Aquatic Life	--	Total Phosphorus	Channelization; Site Clearance (Land Development or Redevelopment); Upstream Impoundments; Impacts from Hydrostructure Flow Regulation/Modification; Dam or Impoundment; Urban Runoff/Storm Sewers; Highways, Roads, Bridges, Infrastructure (New Construction); Municipal Point Source Discharges; Source Unknown
IL_GL-09	Salt Creek	120	Aquatic Life	--	Total Phosphorus, Sediment/Siltation	Combined Sewer Overflows, Municipal Point Source Discharges, Urban Runoff/Storm Sewers, Impacts from Hydrostructure Flow Regulation/Modification, Upstream Impoundments, Dam or Impoundment, Source Unknown
			Primary Contact Recreation	**Fecal Coliform**		

Waterbody ID	Waterbody Name	Watershed Area (square miles)	Designated Use	TMDL Pollutant(s)	Other Pollutant(s) Not Addressed [a]	Potential Source(s)
IL_GL-10	Salt Creek	56	Aquatic Life	--	pH [b], Nickel [b]	Combined Sewer Overflows, Municipal Point Source Discharges, Urban Runoff/Storm Sewers, Impacts from Hydrostructure Flow Regulation/Modification, Upstream Impoundments, Dam or Impoundment, Source Unknown
			Primary Contact Recreation	**Fecal Coliform**		
IL_GL-19	Salt Creek	148	Aquatic Life	--	Total Phosphorus	Channelization, Combined Sewer Overflows, Municipal Point Source Discharges, Urban Runoff/Storm Sewers, Source Unknown
			Primary Contact Recreation	**Fecal Coliform**		
IL_GLA-02	Addison Creek	23	Aquatic Life	--	Total Phosphorus, Nickel [b]	Channelization, Combined Sewer Overflows, Municipal Point Source Discharges, Urban Runoff/Storm Sewers, Source Unknown
			Primary Contact Recreation	**Fecal Coliform**		

a. Other pollutants are not addressed as part of this TMDL study, those in italics are proposed for delisting on the 2016 Draft 303(d) List.

b. Segment was determined to not be impaired in Section 5.0, therefore no TMDL is developed.

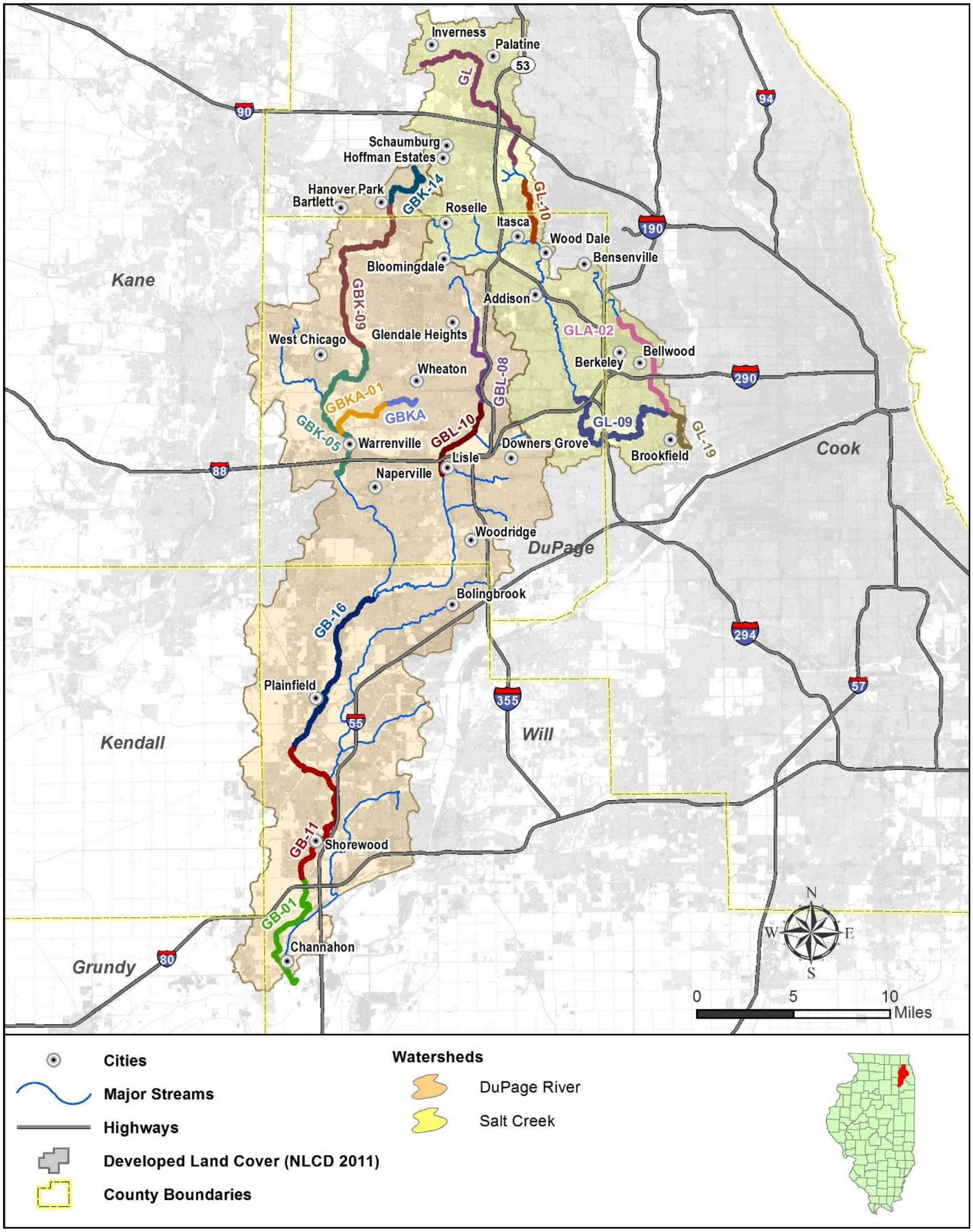

Figure 1. DuPage River/Salt Creek watershed.

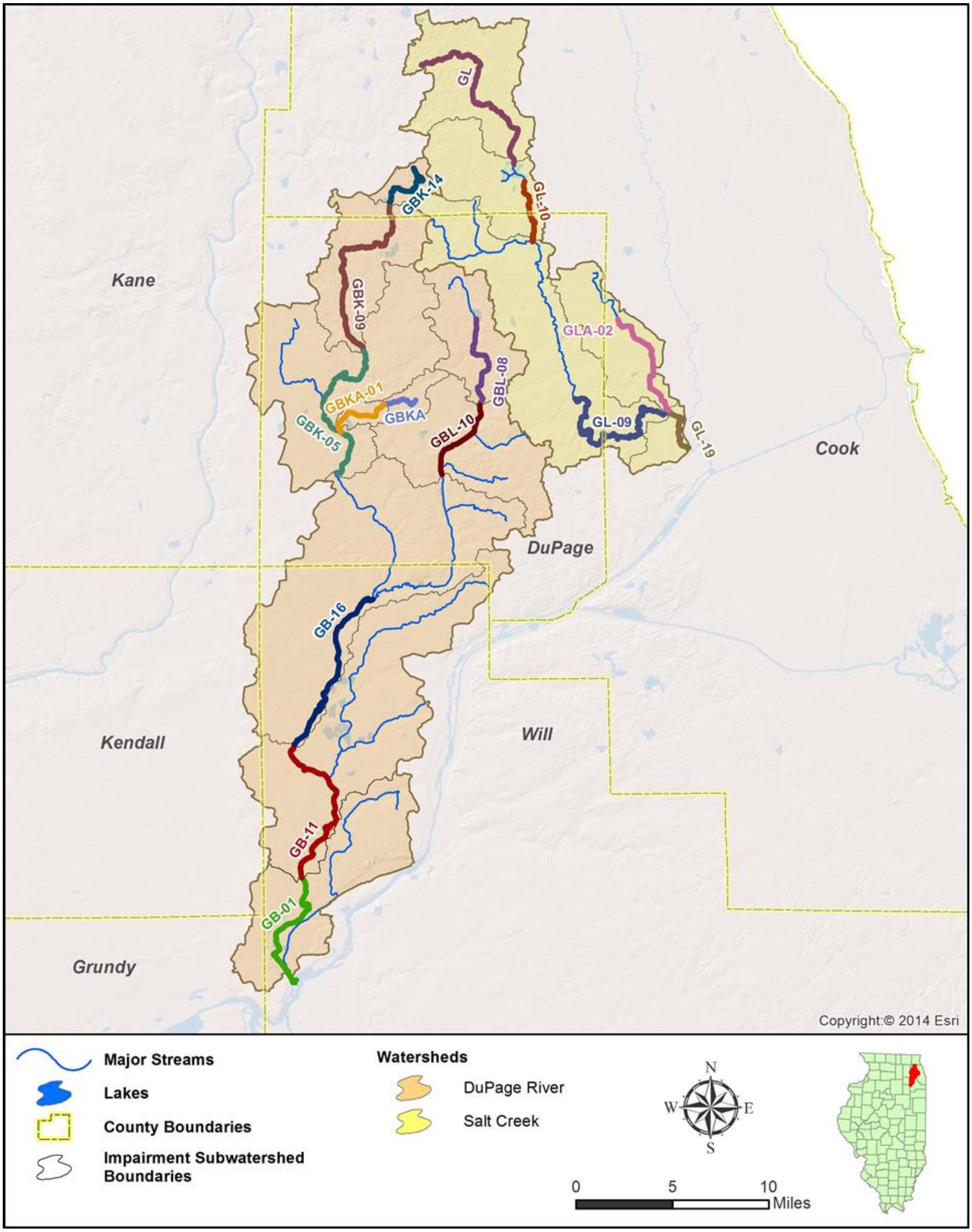

Figure 2. DuPage River/Salt Creek segment watersheds.

2.0 Public Participation and Involvement

The Illinois EPA is committed to keeping the watershed stakeholders and general public informed and involved throughout the TMDL process. Success for any TMDL implementation plan relies on a knowledgeable public to assist in follow-through required for attainment of water uses within their watershed. It is important to engage the local citizens as early in the process as possible by providing opportunities to learn and process information. This ensures that concerns and issues are identified at an early stage, so that they can be addressed and facilitate maximum cooperation in the implementation of the recommended courses of actions identified in the TMDL process. All stakeholders should have access to enough information to allay concerns, gain confidence in the TMDL process and understand the purpose and the regulatory authority or other responsible party that will implement recommendations.

General information regarding the process of TMDL development in Illinois can be found at https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Pages/default.aspx. The public notice/meeting and information about the draft stage 3 TMDL report was available at the Agency's Public Notices webpage at https://www2.illinois.gov/epa/public-notices/Pages/default.aspx.

Background information regarding watersheds, watershed management, best management practices and the CWA can be found on the EPA's water website at http://www.epa.gov/watertrain/.

For other reports and studies concerning the DuPage River and Salt Creek watershed, please visit the DuPage River Salt Creek Workgroup (http://www.drscw.org/) and the Lower DuPage River Watershed Coalition (http://www.dupagerivers.org/). The websites contains reports, data and additional links related to this watershed. In addition, DuPage County has conducted several watershed planning and implementation projects (http://www.dupageco.org/swm/) and Chicago Metropolitan Area Planning is currently conducting watershed planning activities in the Salt Creek watershed (http://www.cmap.illinois.gov/programs-and-resources/lta/lower-salt-creek).

2.1 Public Input

The Illinois EPA regularly met with the DuPage River Salt Creek Workgroup and Lower DuPage River Watershed Coalition to keep them informed on the TMDL progress.

A stage one public meeting was held in Elmhurst on January 28, 2009 (6:00 pm). The Illinois EPA provided public notices for all meetings by placing an ad in the local newspapers in the watershed; the Chicago Daily Herald, The Will-South DuPage Report and the Central Cook Suburban. These notices gave the date, time, location, and purpose of the meetings. It also provided references to obtain additional information about this specific site, the TMDL Program and other related issues. Individuals and organizations were also sent the public notice by first class mail. An additional stakeholder meeting was held March 31, 2009 (10:00 am) in Plainfield, IL. The draft TMDL Report was available for review at the Elmhurst City Hall and on the Agency's web page at https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Pages/reports.aspx.

The first public meeting was attended by approximately 50 people and the second stakeholder meeting was attended by 20 people. The meeting record remained open until midnight, April 17, 2009. A responsiveness summary was developed to address comments (Appendix D).

A public meeting, held jointly with the DuPage River Salt Creek Workgroup bi-monthly meeting, occurred on April 24, 2019 at the village of Lombard village hall to present the draft stage 3 TMDL report and kick-off the 30-day public comment period. Over 60 people attended the meeting. The meeting record remained open through May 24, 2019 and a responsiveness summary was developed to address comments (Appendix D). Original comments are also provided in Appendix D.

2.2 Previous TMDL Development in Watersheds

Previous TMDL reports have been developed and approved in the DuPage River and Salt Creek watersheds. The development of the West Branch DuPage River, East Branch DuPage River, and Salt Creek TMDLs began in 2000. Table 2 summarizes the TMDLs developed for each of these watersheds. In response to these TMDLs, stakeholders in the watershed organized the DuPage River Salt Creek Workgroup (DRSCW), a group that community groups, municipalities, and environmental organizations. DRSCW was formed to better determine the stressors in the aquatic system through a long-term monitoring program and develop and implement viable implementation projects. For more information on this group, please visit their website at www.drscw.org.

Table 2. Summary of Existing TMDL in the DuPage River/Salt Creek Watershed

TMDL Project	TMDL Approval	Impaired Segments Addressed by TMDL	Pollutants Addressed by TMDL	Notes
East Branch DuPage River	2004	GBL-05	Chloride [a], Ammonia, 5-day Carbonaceous Biochemical Oxygen Demand	33% reduction in chloride required
		GBL-10	Chloride [a], Ammonia, 5-day Carbonaceous Biochemical Oxygen Demand	33% reduction in chloride required
		GBL-08	Ammonia, 5-day Carbonaceous Biochemical Oxygen Demand	Multiple scenarios provided to meet TMDL requiring a combination of point source load reduction, SOD reduction, increased DO through artificial reaeration, and dam removal
West Branch DuPage River	2004	GBK-07	Chloride	35% reduction in chloride required
		GBK-09	Chloride	
		GBK-05	Chloride	
		GBK-12	Chloride	
Salt Creek	2004	GL-03	Chloride [a]; Ammonia, 5-day Carbonaceous Biochemical Oxygen Demand, Volatile Suspended Solids [b]	8% reduction in chloride required at mouth of Salt Creek
		GL-09	Chloride [a]	8% reduction in chloride required at mouth of Salt Creek
		GL-10	Chloride [a]	8% reduction in chloride required
		GL-19	Ammonia, 5-day Carbonaceous Biochemical Oxygen Demand, Volatile Suspended Solids [b]	Two scenarios provided to meet TMDL: 34-56% reduction in $CBOD_5$ ad 38% reduction in NH_3
		GLA-02	Chloride	41% reduction in chloride required at mouth of Addison Creek
		GLA-04	Ammonia, 5-day Carbonaceous Biochemical Oxygen Demand, Volatile Suspended Solids [b]	Two scenarios provided to meet TMDL: 34-56% reduction in $CBOD_5$ ad 38% reduction in NH_3
		GLB-01	Ammonia, 5-day Carbonaceous Biochemical Oxygen Demand, Volatile Suspended Solids [b]	
		GLBA	Ammonia, 5-day Carbonaceous Biochemical Oxygen Demand, Volatile Suspended Solids [b]	
		RGZX	Ammonia, 5-day Carbonaceous Biochemical Oxygen Demand, Volatile Suspended Solids [b]	

a. One chloride TMDL was set at the mouth of the river to address all chloride impairments.
b. One TMDL was developed to address all dissolved oxygen-impaired segments in the Salt Creek watershed.

3.0 Watershed Characterization

This section describes the general characteristics of the DuPage River/Salt Creek watershed including location, topography, land cover, soil information, population, climate and precipitation, and hydrology. The DuPage River/Salt Creek Watershed is located in northeastern Illinois and is approximately 520 mi^2 (332,600 acres). The watershed includes the DuPage River (USGS HUC 0712000408) and Salt Creek (USGS HUC 0712000404) which are within Cook, Kendall, Will, Gundy, and DuPage counties. The DuPage River originates from two branches, the East Brach DuPage River and the West Branch DuPage River. The two rivers meet near Bolingbrook to create the main branch of the DuPage River. The main stem of the DuPage River flows approximately 30 miles before the confluence with the Des Plaines River near the town of Channahon, IL. Salt Creek is approximately 40 miles long and drains to the Des Plaines River. The Des Plaines River flows southwest, and after its confluence with the DuPage River, joins the Illinois River, a major tributary of the Mississippi River.

3.1 Topography

Topography influences soil types, precipitation, and subsequently, watershed hydrology and pollutant loading. For the DuPage/Salt Creek watershed, a USGS 30-meter resolution digital elevation model (DEM) was obtained from the Illinois Natural Resources Geospatial Data Clearinghouse to characterize the topography (Figure 3). In general, the watershed is at a higher elevation in the north and west and grades down to a lower elevation in the south or east toward the Des Plaines River, resulting in overall surface water flow from northwest to southeast. There is a ridge that separates the Salt Creek and DuPage River watersheds. The elevation across the DuPage River/Salt Creek Watershed ranges from 974 feet to 475 feet.

The elevation at the Salt Creek headwaters is 895 feet and the stream flows approximately 43 miles before it enters the Des Plaines River (elevation of 607 feet), resulting in a stream gradient of 6.72 feet per mile (0.0013 slope). The elevation at the DuPage River headwaters is 974 feet and flows into the Des Plaines River 63 miles downstream (elevation of 475 feet). The resulting stream gradient is 7.92 feet per mile (0.0015 slopes).

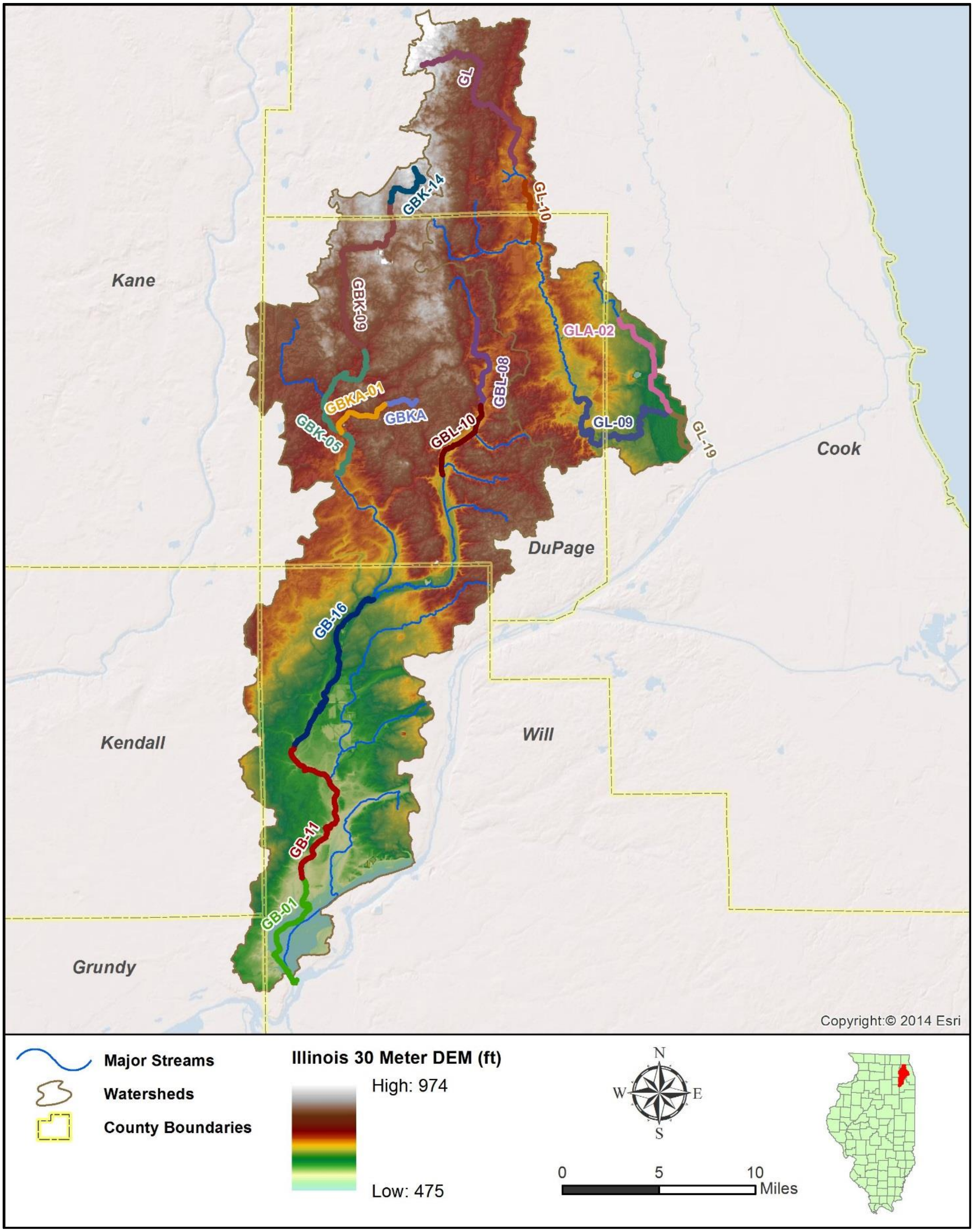

Figure 3. DuPage River/Salk Creek watershed topography.

3.2 Land Cover

Land cover is as dynamic as the water moving throughout a watershed. It is constantly changing and has a large impact on the quality of a watershed. Land cover data for the watershed were extracted from the 2011 National Land Cover Database (NLCD). Table 3 and Table 4 summarize the land cover for the DuPage River and Salt Creek watersheds, respectively. Figure 4 shows land cover in the DuPage River/Salt Creek Watershed and indicates that developed land cover is dominant in both sub-watersheds, accounting for 75% of the total area in the DuPage River watershed and 93% in the Salt Creek watershed. In the DuPage River and Salt Creek watersheds, low intensity development is the predominant land cover (40 and 45% of the total land cover, respectively). Agricultural land accounts for 14% of land cover in the DuPage River watershed, but less than 1% in the Salt Creek watershed.

Table 3. Summary of land cover data (NLCD 2011) for the DuPage River watershed

NLCD 2011 Land Cover Classification	Acreage	Percent	Summarized Acreage	Summarized Percentage
Open Water	3,984	2%	3,984	2%
Developed, Open Space	30,846	13%	183,058	75%
Developed, Low Intensity	96,695	39%		
Developed, Medium Intensity	39,918	17%		
Developed, High Intensity	14,464	6%		
Barren Land	1,135	<1%		
Deciduous Forest	8,068	3%	10,268	4%
Evergreen Forest	48	<1%		
Mixed Forest	2,152	1%		
Shrub/Scrub	399	<1%	6,721	3%
Herbaceous	6,322	3%		
Hay/Pasture	4,481	2%	32,218	14%
Cultivated Crops	27,737	12%		
Woody Wetlands	4,417	2%	4,752	2%
Emergent Herbaceous Wetlands	335	<1%		

Table 4. Summary of land cover data (NLCD 2011) for the Salt Creek watershed

NLCD 2011 Land Cover Classification	Acreage	Percent	Summarized Acreage	Summarized Percentage
Open Water	1,202	1%	1,202	1%
Developed, Open Space	13,323	14%	87,488	93%
Developed, Low Intensity	42,597	45%		
Developed, Medium Intensity	20,517	22%		
Developed, High Intensity	11,049	12%		
Barren Land	2	<1%		
Deciduous Forest	2,083	2%	2,689	3%
Evergreen Forest	55	<1%		
Mixed Forest	551	1%		
Shrub/Scrub	262	<1%	734	1%
Herbaceous	472	1%		
Hay/Pasture	95	<1%	234	<1%
Cultivated Crops	139	<1%		
Woody Wetlands	2,324	2%	2,495	2%
Emergent Herbaceous Wetlands	171	<1%		

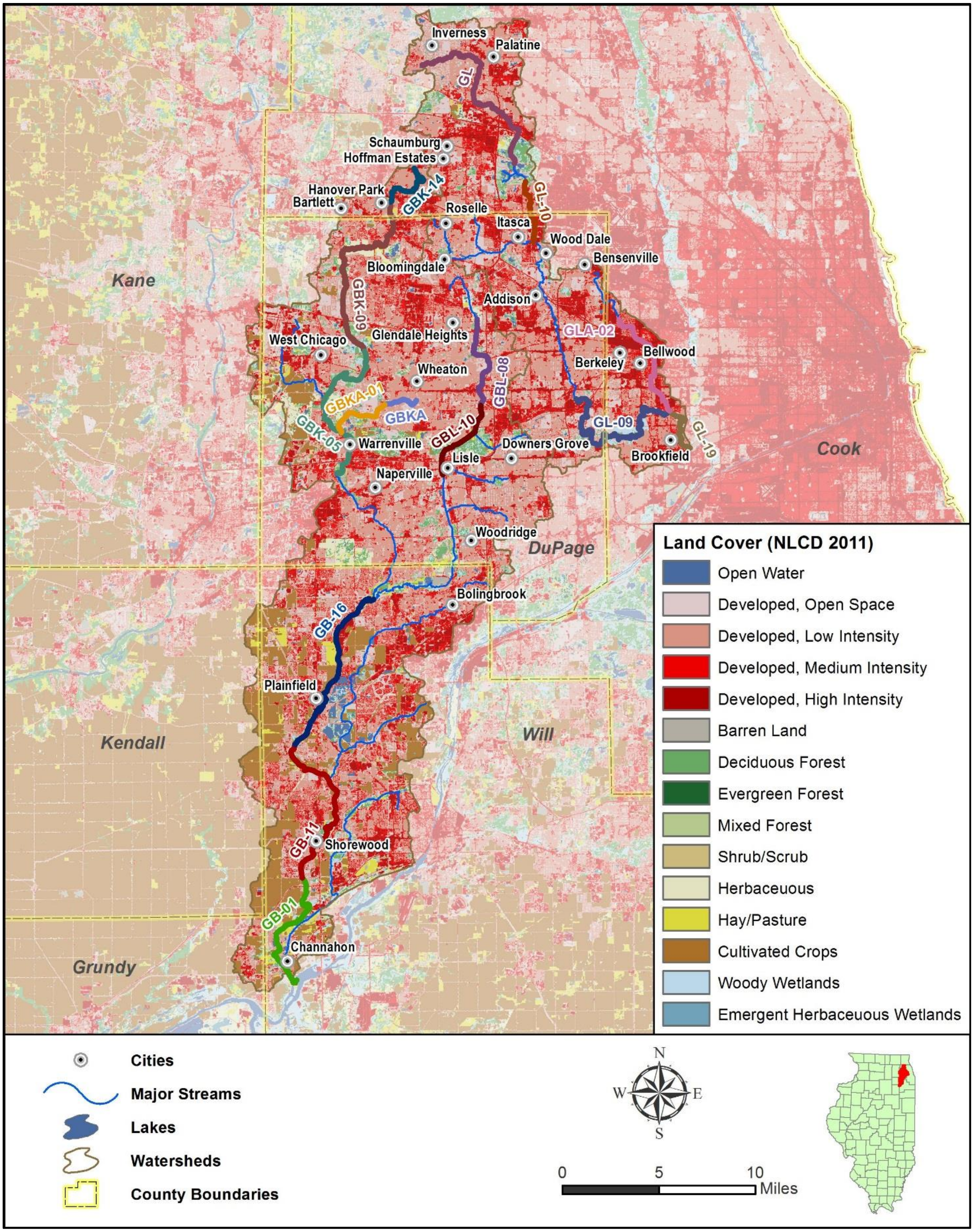

Figure 4. DuPage River/Salt Creek watershed land use.

3.3 Soils

Soils data and Geographic Information Systems (GIS) files from the Natural Resources Conservation Service (NRCS) were used to characterize soils in the DuPage River and Salt Creek watershed. General soils data and map unit delineations for the country are provided as part of the Soil Survey Geographic (SSURGO) database. Field mapping methods using national standards are used to construct the soil maps in the SSURGO database. Mapping scales generally range from 1:12,000 to 1:63,360; SSURGO is the most detailed level of soil mapping prepared by the NRCS. A map unit is composed of several soil series having similar properties. Identification fields in the GIS coverage can be linked to a database that provides information on chemical and physical soil characteristics. The SSURGO database contains many soil characteristics associated with each map unit.

The SSURGO data were analyzed based on hydrologic group (Figure 5) and K-factor (Figure 6), a coefficient of the Universal Soil Loss Equation. The hydrologic soil group classification identifies soil groups with similar infiltration and runoff characteristics during periods of prolonged wetting. Typically, clay soils that are poorly drained have lower infiltration rates, while well-drained sandy soils have the greatest infiltration rates. USDA has defined four hydrologic soil groups (A, B, C, or D) for soils. Group A soil has high infiltration while D soil has very low infiltration rate. Table 5 summarizes the group characteristics and shows the distribution of hydrologic soil groups. Generally, areas to the east contain a moderate to slow infiltration rate (group C), while areas near the lakes on the western side of the watershed contain both slow (group D) to moderately high infiltration rates (group B).

Table 5. Relative characteristics of hydrologic soil groups

Hydrologic Soil Group	Runoff Potential	Infiltration Rate
A	Low	High
B	Moderate	Moderate
C	High	Low
D	High	Very Low

A commonly used soil attribute of interest is the K-factor, a coefficient used in the Universal Soil Loss Equation. The K-factor is a dimensionless measure of a soil's natural susceptibility to erosion. Factor values may range from 0 for water surfaces to 1.00 (although in practice, maximum K-factor values do not generally exceed 0.67). Large K-factor values reflect greater potential for soil erodibility.

The compilation of K-factors from the SSURGO data was done in several steps. Soils are classified in the SSURGO database by map unit symbol. Each map unit symbol is made up of components and each component as part of that map unit is further broken down into horizons (or layers). The K-factor was determined by selecting the dominant components in the most surficial horizon per each map unit. The distribution of K-factor values in the DuPage River and Salt Creek watershed is shown in Figure 6. K-factors range from 0.02 to 0.43 in this watershed. Areas with the highest K-factor are dispersed throughout the watershed with the greatest concentration within DuPage County.

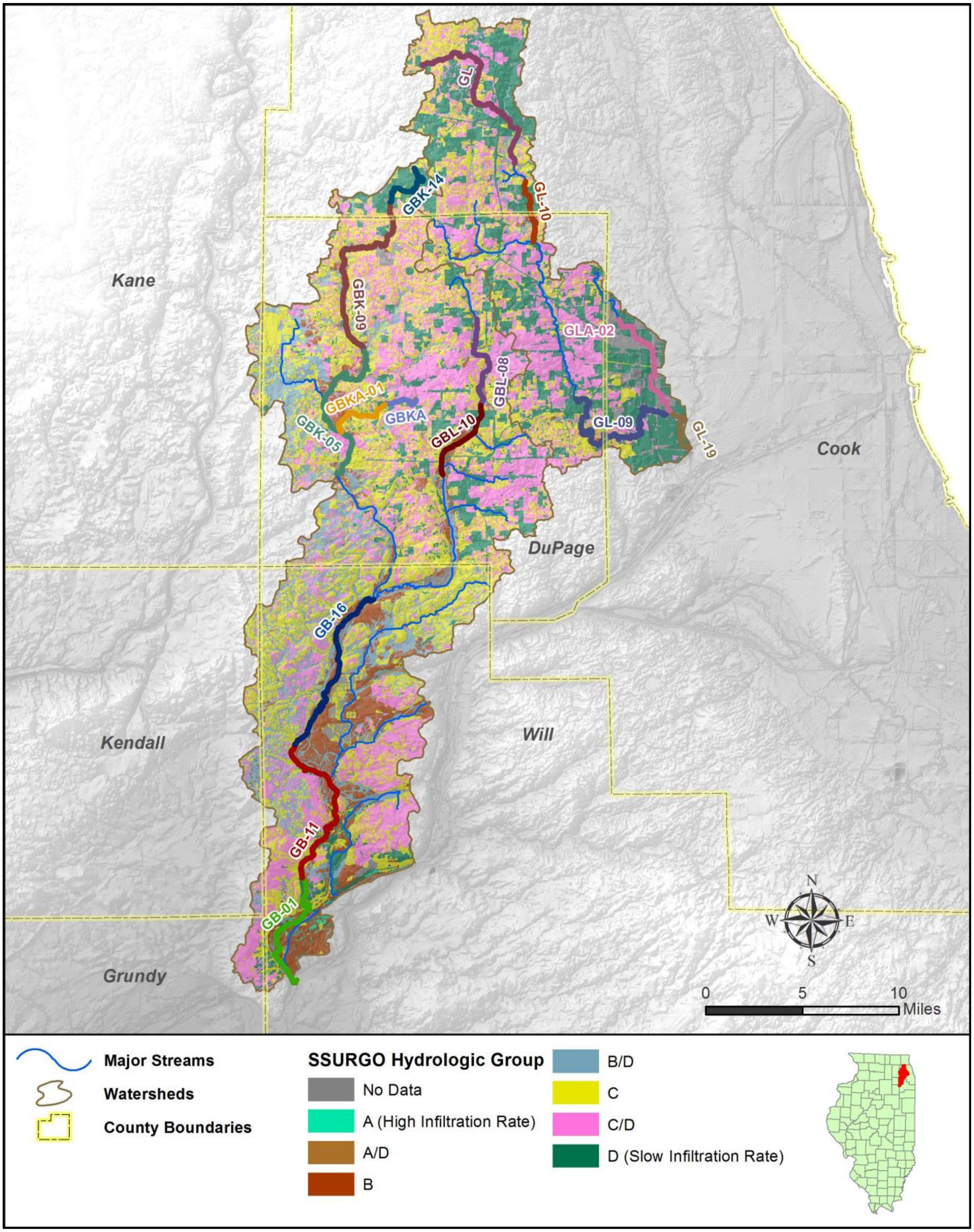

Figure 5. DuPage River/Salt Creek watershed hydrologic soil groups.

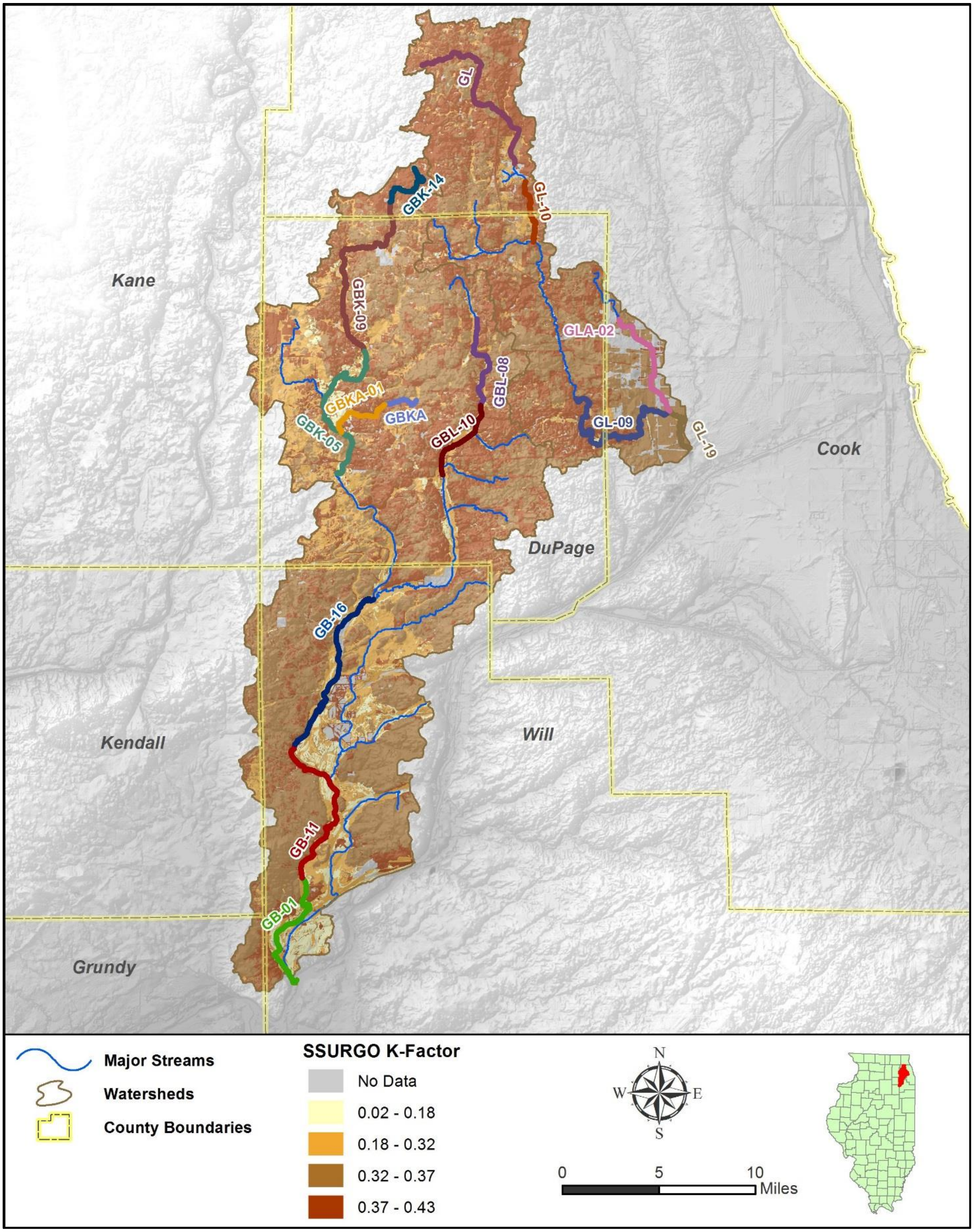

Figure 6. DuPage River/Salt Creek watershed SSURGO K-Factor.

3.4 Population

Circumstances in the DuPage River/ Salt Creek watershed today are not only the product of the geologic and natural processes that have occurred in the watershed, but also a reflection of human impacts and population growth. Development has changed the watershed's natural drainage system as channelization and dredging have replaced slow moving shallow streams and wetlands. This alteration has affected the way water runs off of the landscape both in increased volume and velocity, resulting in the potential increase in pollutant transport.

In 2000, approximately 4.8 million, people resided in the DuPage River/Salt Creek watershed, roughly 9,250 persons per square mile. The Salt Creek watershed accounts for nearly 80% of the population, but only 40% of the area. Census blocks with the greatest populations occur in the central and southern areas of the DuPage River watershed in Aurora, Naperville, and Joliet. The Chicago Metropolitan Agency for Planning (CMAP) provides population projections by municipality on their website ("Population Forecast"; updated in 2014). Figure 7 depicts the projected percent population change in the watershed from 2010 to 2040. In general, the southern portion of the watershed is expected to have the most growth, with greater than 200% combined growth across smaller municipalities within Kendall and Will counties. The larger municipalities of Plainfield and Shorewood are projected to grow an average of 142 and 13%, respectively. Based on these data, development will grow dramatically in the southern portion of the watershed, but in general, the entire watershed will continue to increase in population over the upcoming years.

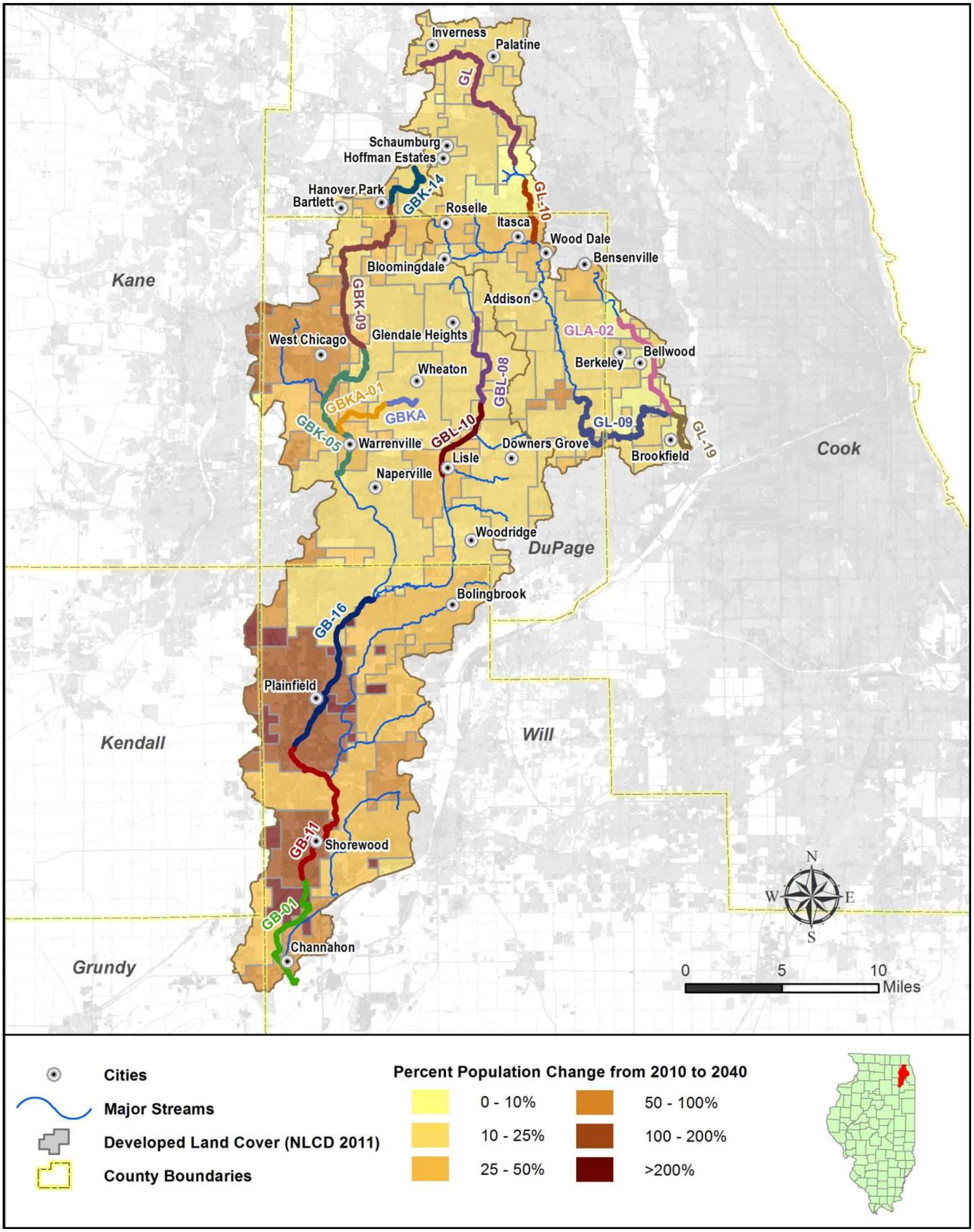

Figure 7. DuPage River/Salt Creek watershed population projection.

3.5 Climate

Northeast Illinois has a continental climate with highly variable weather. The temperatures of continental climates are not buffered by the influence of a large waterbody (like an ocean, inland sea or Great Lake). Areas with continental climates often experience wide temperature fluctuations throughout the year. Temperature and precipitation data were obtained from the Illinois State Climatologist Office website. The nearest monitoring station to the DuPage River/Salt Creek Watershed is the City of Wheaton, which is located in the central area of the watershed. For the DuPage River/Salt Creek watershed, the highest temperatures in the summer can range from high 80s to over 100 degrees Fahrenheit and the lowest winter temperatures might range between sub-zero and the teens. Precipitation in the form of rainfall is greatest in the growing season (April through September) (Figure 8).

Climate data were analyzed for the City of Wheaton between the years of 1950 and 2008, although data were not available for all years. The mean high summer temperature was 84.2° F and the mean low temperature in winter was 17.9° F. Mean annual high temperatures were approximately 61° F, while mean annual low temperatures were approximately 40° F (Table 6). Mean monthly precipitation data in Wheaton are displayed in Figure 8. Wheaton receives most of its precipitation in the spring and summer months, with maximum precipitation occurring in June (4.1 inches). The least amount of average rainfall precipitation occurs in February (1.6 inches). Annual total precipitation average was approximately 35.2 inches.

Table 6. Temperature characterization, Wheaton, IL (1950-2008)

	Average High (°F)	Average Low (°F)	Average Number of Days with High > 90 (°F)	Average Number of Days with Low < 32 (°F)	Mean (°F)
January	31.36	14.63	0.00	28.50	23.02
February	36.35	18.37	0.00	25.13	27.38
March	47.61	27.31	0.00	22.28	37.49
April	62.05	38.05	0.12	8.69	50.09
May	73.41	47.59	1.12	1.35	60.52
June	82.76	57.47	6.52	0.02	70.14
July	85.83	62.26	8.51	0.02	74.07
August	84.00	60.94	5.86	0.00	72.49
September	77.50	52.96	2.08	0.20	65.26
October	65.45	42.22	0.04	5.48	53.86
November	49.19	31.29	0.00	17.07	40.26
December	36.04	20.02	0.00	26.25	28.00
Annual	61.27	39.69	23.98	129.03	50.51
Spring	61.04	37.64	1.20	31.53	49.37
Summer	84.24	60.28	20.68	0.03	72.29
Fall	64.10	42.18	2.16	22.16	53.16
Winter	34.59	17.88	0.00	77.51	26.29

Annual/seasonal values may differ from the sum of the monthly values due to rounding.
Source: www.sws.uiuc.edu

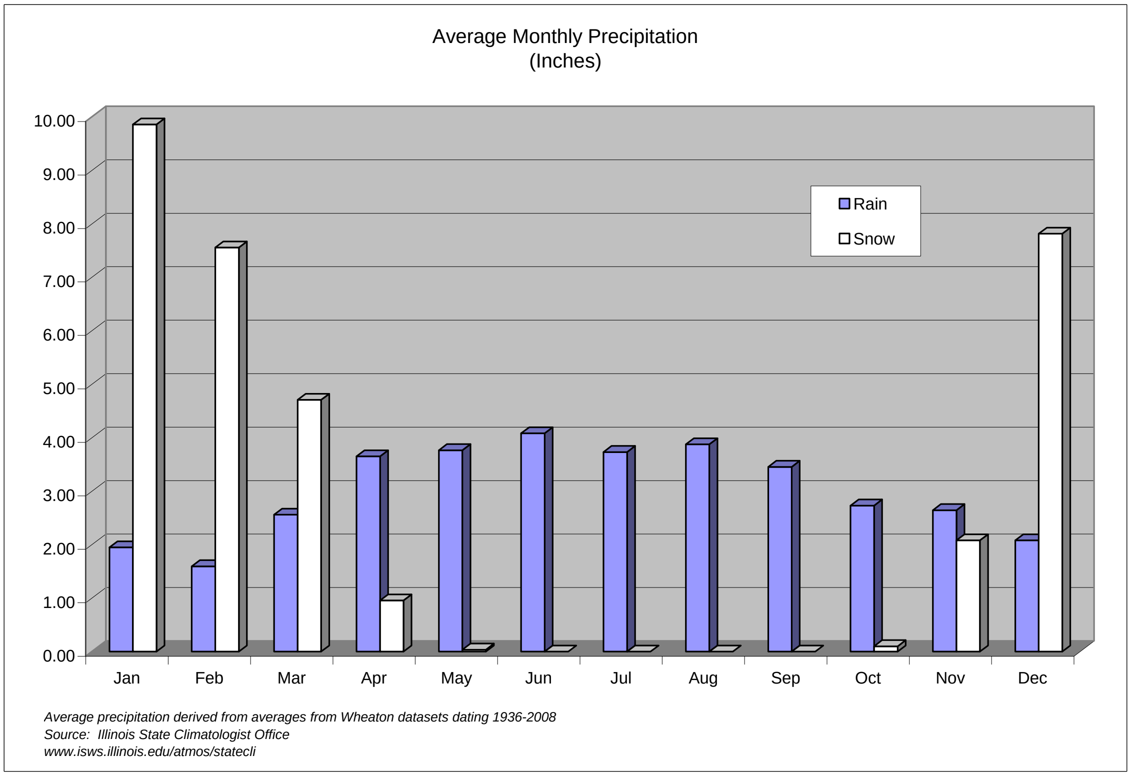

Figure 8. Mean Monthly Precipitation in Wheaton, IL.

3.6 Hydrology

Understanding how water moves and flows is an important component of understanding a watershed. All of the parameters listed in the previous sections (i.e., topography, soils, and precipitation) impact the hydrology of a watershed. Hydrological data are available from the USGS website. The USGS maintains stream gages throughout the U.S. and it monitors conditions such as gage height and stream flow, and at some locations, precipitation and water quality (Figure 9).

Point sources, described in Section 5.3, create effluent-dominated conditions in the watershed during low flow periods. Effluent dominated streams may be high in nutrients and other pollutants, however the effluent also provides a steady baseflow for the river. Streamflow data collected by the USGS at station 5540500 (area-weighted to the mouth of the DuPage River) was used in combination with flow records provided by the permitted point sources (2013 – 2015) in the watershed to determine the approximate percentage of flow that is effluent under various flow conditions. The analysis does not take into account any loss of flow through the system, but assumes that all point source discharges are delivered to the outlet of the watershed. As summarized in Table 7, more than half of the flow in the River is effluent under mid-range and drier conditions.

Table 7. Approximate percent of flow attributed to point source effluent

Flow Category	Median Flow (cfs)	% Time Flow is Exceeded	% of River that is Point Source Effluent
Low Flows	145	95%	>100%
Dry Conditions	211	75%	85%
Mid-Range Flows	322	50%	56%
Moist Conditions	554	25%	32%
High Flows	1,485	5%	12%

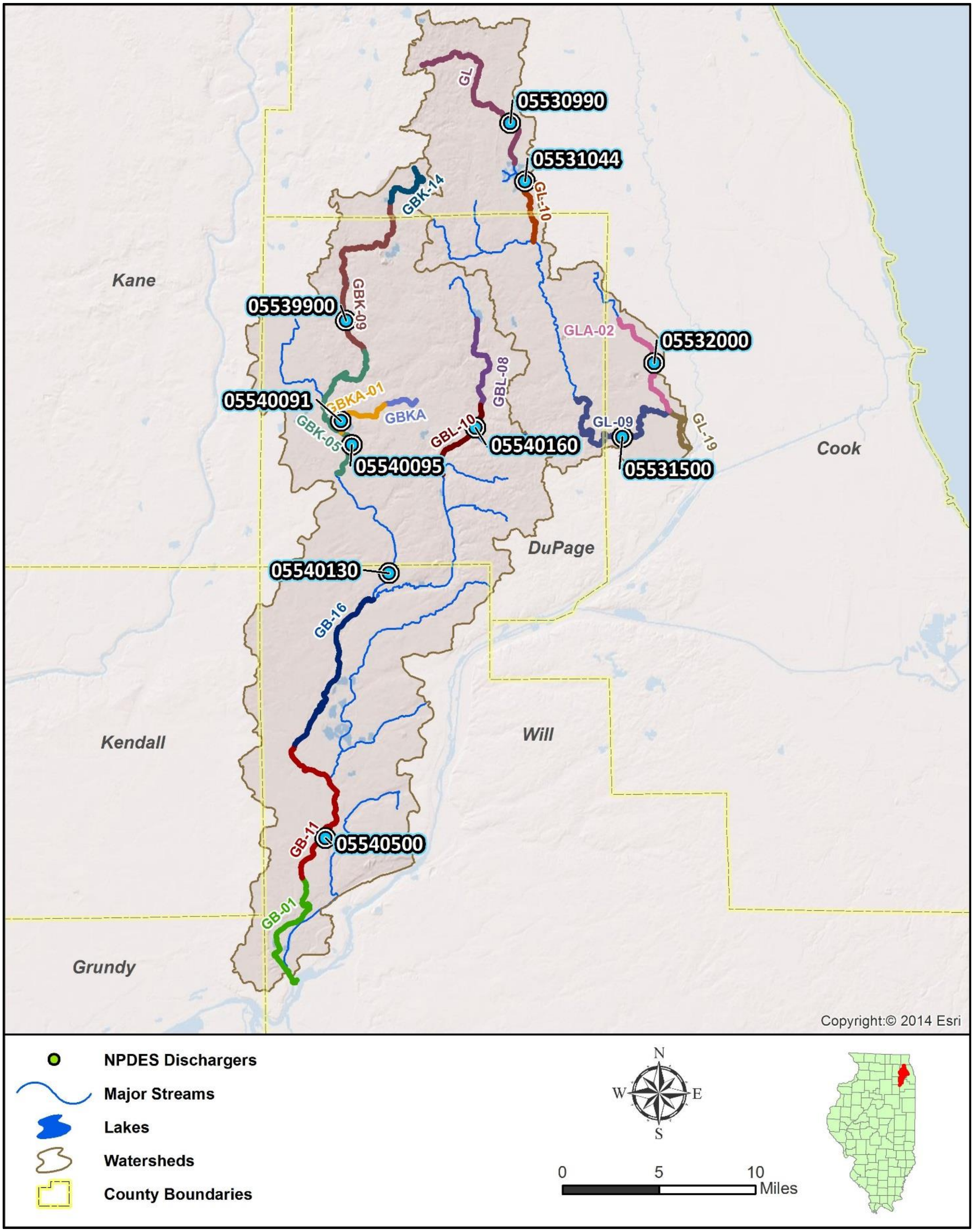

Figure 9. DuPage River/Salt Creek watershed USGS gaging stations.

Dams also influence hydrologic and water quality conditions throughout the watershed (Figure 10). Dams regulate the depth of water in the river and affect flows. They can also serve to prevent fish migration and contribute to low dissolved oxygen conditions due to slow moving or stagnant waters in upstream pools. Six dams have been removed or modified to address these issues.

Four gage stations within the DuPage River/Salt Creek Watershed were chosen to evaluate stream flow: East Branch of DuPage River at Downers Grove, IL (05540160), West Branch of DuPage River at Naperville, IL (05540130), DuPage River at Shorewood, IL (05540500), and Salt Creek at Western Springs, IL (05531500). The Salt Creek gage is located just upstream from the Addison Creek confluence near the confluence with the Des Plaines River. The East Branch is located upstream of the confluence with the West Branch. The West Branch of the DuPage River gage station is located immediately upstream of the confluence with the East Branch. Finally, the DuPage River at Shorewood is located immediately upstream of the confluence of the DuPage River main stem and the Des Plains River. Figure 9 shows the location of these four USGS gages, and others, throughout the watershed. Figure 11 depicts the stream flow measured at Salt Creek for the period of 1945 to 2007. The drainage area upstream of this gage was 115 square miles. The highest average monthly stream flows at Salt Creek were measured in April (233.0 cubic feet per second [cfs]), while the lowest monthly stream flows were measured in September (93.9 cfs). Overall the highest stream flow for this gage occurs during the late winter and spring months, while low flows occur during the fall. The annual stream flow for the Salt Creek gage was measured at about 136.8 cfs.

The East Branch DuPage gage drains an area of 26.6 square miles, and data at this gage exist from 1989 to 2007. Over this period the average stream flow of the East Branch was 49.5 cfs (Figure 12). Similar to the Salt Creek gage, stream flows were highest in the late winter and spring months with lower flows in the fall. Maximum average monthly flows occurred in April (69.0 cfs) while lowest average monthly flows occurred in September (35.2 cfs).

Figure 13 displays the stream flow measured at the West Branch DuPage River for the period ranging from 1988 to 2007. The drainage area upstream of this gage was 123 square miles and the highest average monthly stream flows at the West Brach were measured in April (230.6 cfs). Minimum average monthly stream flows of 102.0 cfs were measured in September. The annual stream flow for the West Branch gage was approximately 152.9 cfs.

Data from the main stem of the DuPage River gage exist from 1940 to present. This gage drains an area of 324 square miles and over the duration of its existence the average stream flow of the DuPage was 307.3 cfs (Figure 14). Peak stream flows occur in the late winter and spring months, with lower flows in the fall. Maximum monthly flow occurred in April (517.7 cfs) while lowest monthly flows were measured in September (189.9 cfs).

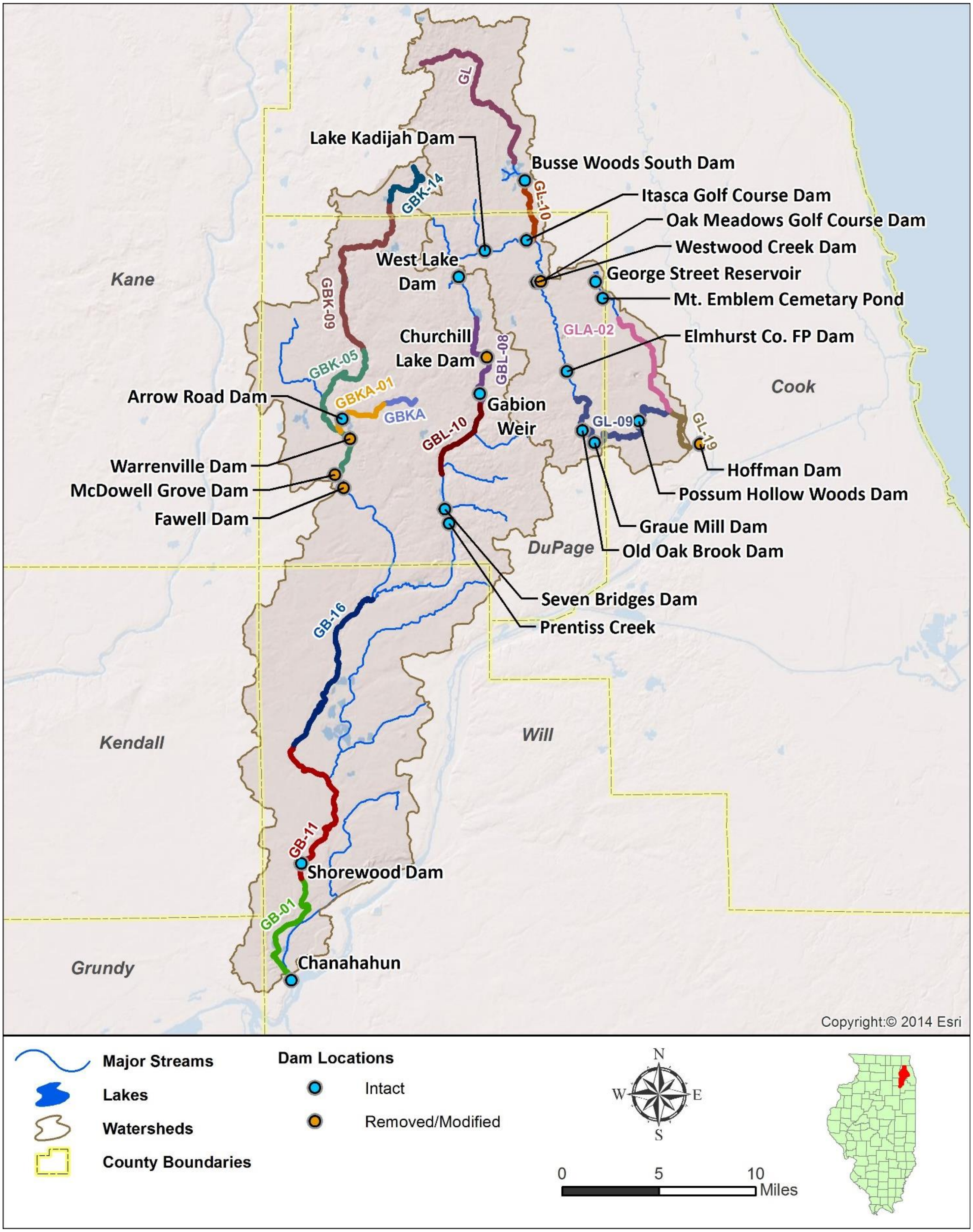

Figure 10. Dam locations.
Data provided by the Conservation Foundation (12/20/2018)

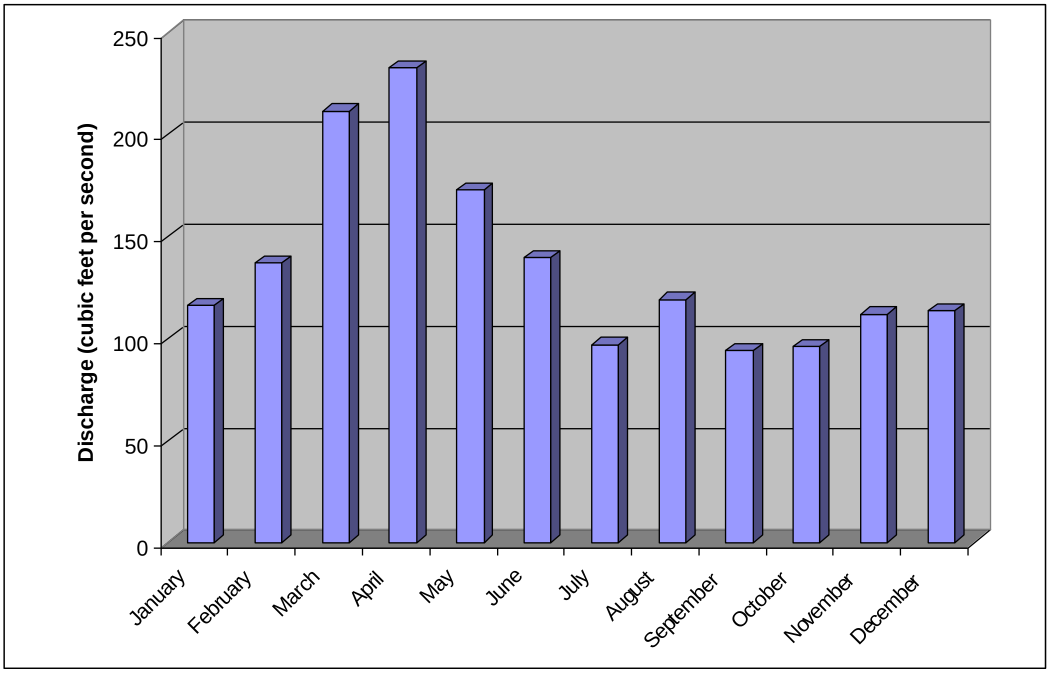

Figure 11. Mean monthly flow in Salt Creek at Western Springs, IL USGS Station 1945-2007.

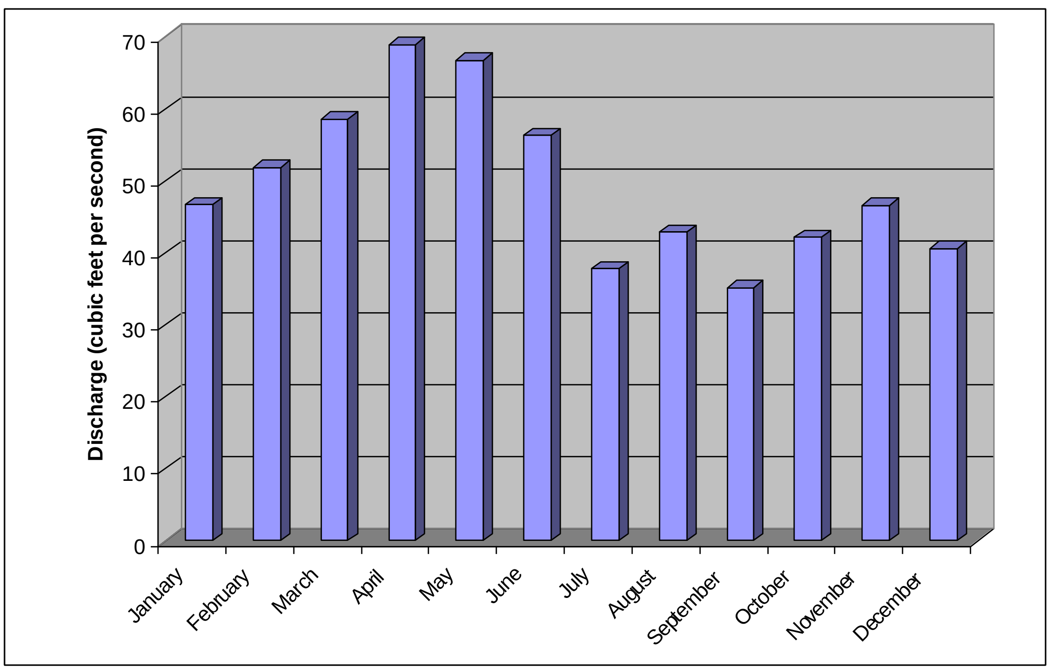

Figure 12. Mean monthly flow in East Branch of DuPage River at Downers Grove, IL USGS 1989-2007.

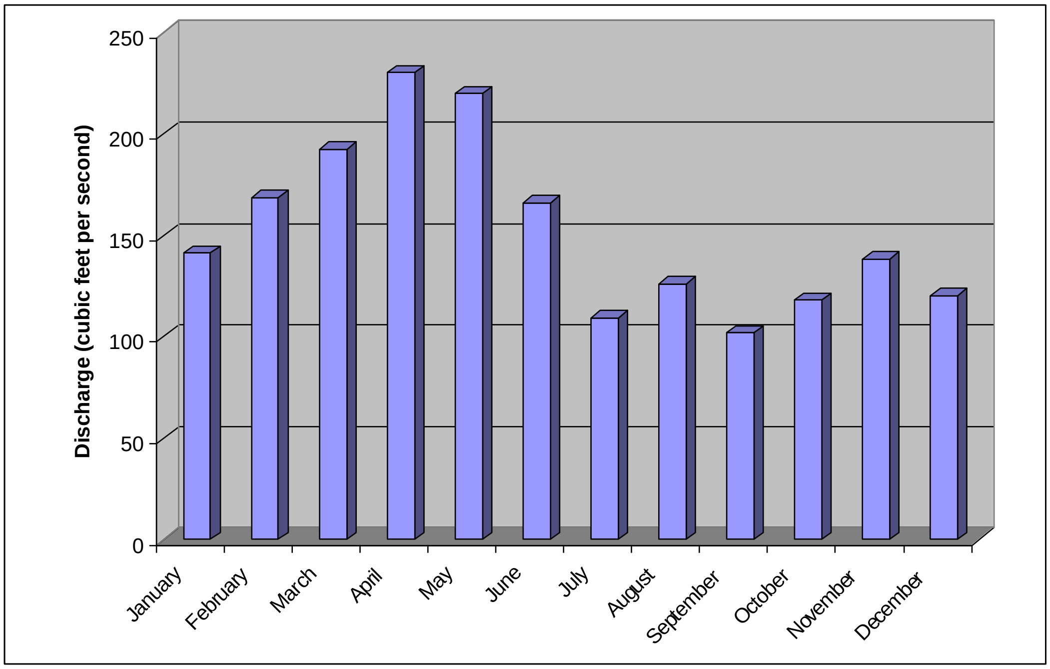

Figure 13. Mean monthly flow for West Branch of DuPage River at Naperville, IL USGS Station 1988-2007.

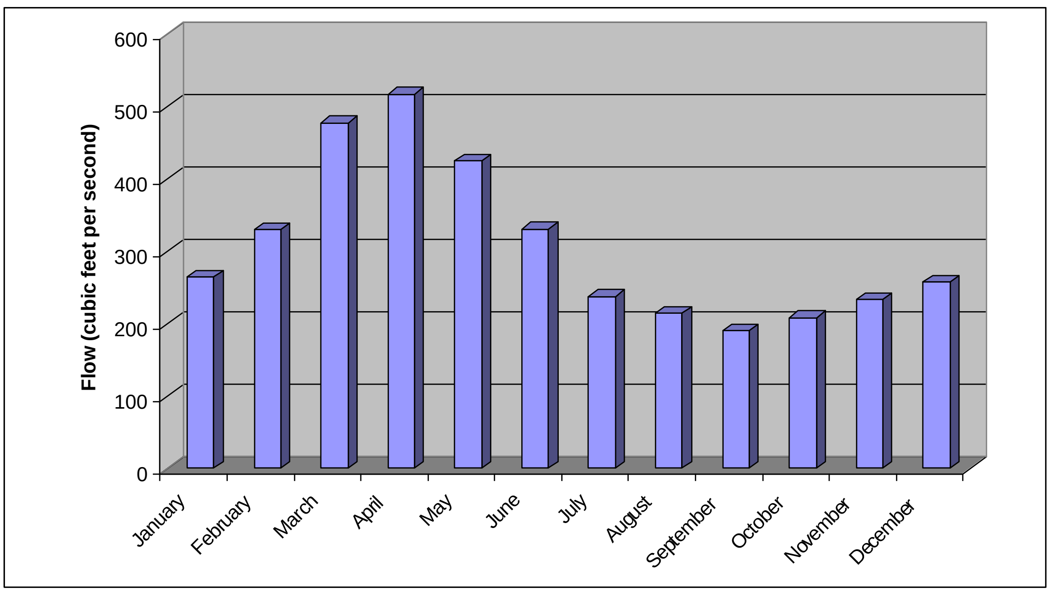

Figure 14. Mean monthly flow for DuPage River at Shorewood, IL USGS Station 1940-2007.

3.7 Watershed Studies and Other Watershed Information

There are a number of organizations and counties in the DuPage River and Salt Creek watersheds that have collected and developed information and studies that are pertinent to this TMDL. For reports and studies concerning the DuPage River and Salt Creek watersheds, please visit the DuPage River Salt Creek Workgroup (http://www.drscw.org/) and the Lower DuPage River Watershed Coalition (http://www.dupagerivers.org/). The websites contains reports, data and additional links related to this watershed. In addition, DuPage County has conducted several watershed planning and implementation projects (http://www.dupageco.org/swm/) and Chicago Metropolitan Area Planning is currently conducting watershed planning activities in the Salt Creek watershed (http://www.cmap.illinois.gov/programs-and-resources/lta/lower-salt-creek. Section 8.0 provides additional information on watershed partners and organizations.

In addition, Illinois EPA conducted Stage 2 monitoring activities in the West Branch and Mainstem DuPage River, results are included in Appendix B of this TMDL.

4.0 Applicable Water Quality Standards and TMDL Endpoints

Water pollution control programs are designed to protect the beneficial uses of the water resources within the state. Each state has the responsibility to set water quality standards (WQS) that protect these beneficial uses, also called designated uses. Illinois waters are designated for various uses including aquatic life, primary contact (e.g., swimming, water skiing), secondary contact (e.g., boating, fishing), industrial use, drinking water, food-processing water supply and aesthetic quality. Illinois' WQS provide the basis for assessing whether the beneficial uses of the state's waters are being attained.

4.1 Illinois Pollution Control Program

The Illinois Pollution Control Board (IPCB) is responsible for setting WQS to protect designated uses. The federal Clean Water Act requires states to review and update WQS every three years. Illinois EPA, in conjunction with USEPA, identifies and prioritizes those standards to be developed or revised during this three-year period. The IPCB has established four primary sets (or categories) of narrative and numeric water quality standards for surface waters: general use; public and food processing; secondary contact and indigenous aquatic life; and Lake Michigan basin standards. Each set of standards is intended to help protect various designated uses established for each category.

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. These responsibilities were subsequently assumed by the Illinois Department of Energy and Natural Resources who, in July 1995, became part of the Illinois Department of Natural Resources. The Illinois WQS are established in the Illinois Administrative Rules Title 35, Environmental Protection; Subtitle C, Water Pollution; Chapter I, Pollution Control Board; Part 302, Water Quality Standards.

4.2 Designated Uses

The waters of Illinois are classified by designated uses (Table 8). Designated uses applicable to the DuPage River/Salt Creek watershed TMDL include aquatic life and primary contact recreation. The corresponding water quality standard classification for these designated uses is the General Use Standard. The General Use classification is defined by IPCB as: The General Use standards will protect the state's water for aquatic life, wildlife, agricultural use, secondary contact use and most industrial uses and ensure the aesthetic quality of the state's aquatic environment. Primary contact uses are protected for all General Use waters whose physical configuration permits such use.

Table 8. Illinois Designated Uses and applicable Water Quality Standards

Illinois EPA Designated Uses	Illinois waters where Designated Use and Standards apply	Applicable Illinois Water Quality Standards
Aquatic Life	Streams, Inland Lakes	General Use Standards
	Lake Michigan Basin waters	Lake Michigan Basin Standards
Aesthetic Quality	Inland Lakes	General Use Standards
	Lake Michigan Basin Waters	Lake Michigan Basin Standards
Indigenous Aquatic Life	Specific Chicago area Waters	Secondary Contact and Indigenous Aquatic Life Standards
Primary Contact	Streams, Inland Lakes	General Use Standards
	Lake Michigan Basin Waters	Lake Michigan Basin Standards
Secondary Contact	Streams, Inland Lakes	General Use Standards
	Lake Michigan Basin Waters	Lake Michigan Basin Standards
	Specific Chicago area Waters	Secondary Contact and Indigenous Aquatic Life Standards
Public and Food Processing Water Supply	Streams, Inland Lakes, Lake Michigan basin Waters	Public and Food Processing Water Supply Standards
Fish Consumption	Streams, Inland Lakes	General Use Standards
	Lake Michigan Basin Waters	Lake Michigan Basin Standards
	Specific Chicago Area Waters	Secondary Contact and Indigenous Aquatic Life Standards

4.3 Applicable Illinois Water Quality Standards

Environmental regulations for the State of Illinois are contained within the Illinois Administrative Code, Title 35. Specifically, Title 35, Part 302 contains water quality standards promulgated by the Illinois Pollution Control Board. This section presents the standards applicable to impairments within the study area. Water quality standards to be used for water quality assessment (Section 5.0) and TMDLs (Section 7.0) in the DuPage River/Salt Creek watersheds are provided in Table 9.

Table 9. Summary of water quality standards

Parameter	Units	General Use Water Quality Standard
Water Quality Standards for Impairment Assessment and TMDL Development		
Chloride	mg/L	500
Dissolved Oxygen [a]	mg/L	**For most waters:** March-July > 5.0 min. & > 6.0 7-day mean Aug-Feb > 3.5 min, > 4.0 7-day mean, & > 5.5 30-day mean **For waters with enhanced protection (i.e., GB-16):** March-July > 5.0 min & > 6.25 7-day mean Aug-Feb > 4.0 min, > 4.5 7-day mean, & > 6.0 30-day mean
Fecal Coliform	count/100 mL	400 in <10% of samples [b] during May-October
		Geometric mean < 200 [c] during May-October
Water Quality Standards for Impairment Assessment Only		
pH	s.u.	Within the range of 6.5 – 9.0 except for natural causes
Nickel, Dissolved	µg/L	Acute standard: $e^{A+Bln(H)} \times 0.998$, where A=0.5173 and B=0.8460; H=hardness Chronic standard: $e^{A+Bln(H)} \times 0.997$, where A=-2.286 and B=0.8460; H=hardness
Copper, Dissolved	µg/L	Acute standard: $e^{A+Bln(H)} \times 0.960$, where A=-1.464 and B=0.9422; H=hardness Chronic standard: $e^{A+Bln(H)} \times 0.960$, where A=-1.465 and B=0.8545; H=hardness

a. Applies to the dissolved oxygen concentration in the main body of all streams, in the water above the thermocline of thermally stratified lakes and reservoirs, and in the entire water column of unstratified lakes and reservoirs. Additional dissolved oxygen criteria are found in 35 Ill Adm. Code 302.206, including the list of waters with enhanced dissolved oxygen protection and methods for assessing attainment of dissolved oxygen minimum and mean values.
b. Standard shall not be exceeded by more than 10% of the samples collected during any 30-day period.
c. Geometric mean based on a minimum of 5 samples taken over not more than a 30-day period.

DuPage River segment GB-16 is designated for dissolved oxygen enhanced protection according to 35 Ill Adm. Code 302.206. Waters with enhanced protection have a more stringent dissolved oxygen standard than all other waters of the State. These waters were chosen based on the potential biota (fish early life stages present) and the dissolved oxygen needed for these biota to thrive. All other dissolved oxygen impaired waters in the DuPage River and Salt Creek watersheds are not considered enhanced protection waters and the standard for “most waters” applies.

Due to limited resources, fecal coliform bacteria is not normally sampled at a frequency necessary to apply the General Use standard, i.e., at least five times per month during May through October. Therefore, assessment guidelines are based on application of the standard when sufficient data are available to determine standard exceedances; but, in most cases, attainment of the *primary contact* use is based on a broader methodology intended to assess the likelihood that the General Use standard is being attained. To assess the *primary contact* use, Illinois EPA uses all fecal coliform bacteria from water samples collected in May through October, over a five-year period. Based on these water samples, geometric means and individual measurements of fecal coliform bacteria are compared to the concentration thresholds in Table 10. To apply the guidelines, the geometric mean of fecal coliform bacteria concentration is calculated from the entire set of May through October water samples, across the five years. No more than 10% of all the samples may exceed 400/100 ml for a water body to be considered Fully Supporting.

Table 10. Guidelines for assessing primary contact use in Illinois streams and inland lakes

Degree of Use Support	Guidelines
Fully Supporting (Good)	No exceedances of the fecal coliform bacteria standard in the last five years and the geometric mean of all fecal coliform bacteria observations ≤200/100 ml, and ≤10% of all observations exceed 400/100 ml.
Not Supporting (Fair)	One exceedance of the fecal coliform bacteria standard in the last five years (when sufficient data is available to assess the standard) or The geometric mean of all fecal coliform bacteria observations in the last five years ≤200/100 ml, and >10% of all observations in the last five years exceed 400/100 ml or The geometric mean of all fecal coliform bacteria observations in the last five years >200/100 ml, and ≤25% of all observations in the last five years exceed 400/100 ml.
Not Supporting (Poor)	More than one exceedance of the fecal coliform bacteria standard in the last five years (when sufficient data is available to assess the standard) or The geometric mean of all fecal coliform bacteria observations in the last five years >200/100 ml, and >25% of all observations in the last five years exceed 400/100 ml

4.4 TMDL Endpoints

In order for a waterbody to be listed as Fully Supporting, it must meet all of its applicable designated uses. Because WQS are designed to protect those designated uses, a pollutant's numeric WQS is therefore used as the target or endpoint for establishing a TMDL. Table 11 summarizes the endpoints that will be used in the TMDL development for the DuPage River/Salt Creek watershed, only those segments receiving TMDLs are included in this table. All parts of each standard (e.g., two parts for fecal coliform) are required to be met.

Table 11.TMDL endpoints for impaired waterbodies in the DuPage River/Salt Creek watershed

Waterbody ID	Waterbody Name	TMDL Pollutant(s)	TMDL Endpoint
IL_GB-11	DuPage River	Chloride	<500 mg/L
		Fecal Coliform	<400 count/100 ml in <10% of samples and <200 count/100ml (30-day geometric mean of at least 5 samples)
IL_GB-16	DuPage River	Dissolved Oxygen	March-July > 5.0 min & > 6.25 7-day mean Aug-Feb > 4.0 min, > 4.5 7-day mean, & > 6.0 30-day mean
		Fecal Coliform	<400 count/100 ml in <10% of samples and <200 count/100ml (30-day geometric mean of at least 5 samples)
IL_GBK-05	West Branch DuPage River	Fecal Coliform	<400 count/100 ml in <10% of samples and <200 count/100ml (30-day geometric mean of at least 5 samples)
IL_GBK-09	West Branch DuPage River	Fecal Coliform	<400 count/100 ml in <10% of samples and <200 count/100ml (30-day geometric mean of at least 5 samples)
IL_GBK-14	West Branch DuPage River	Dissolved Oxygen	March-July > 5.0 min. & > 6.0 7-day mean Aug-Feb > 3.5 min, > 4.0 7-day mean, & > 5.5 30-day mean
		Fecal Coliform	<400 count/100 ml in <10% of samples and <200 count/100ml (30-day geometric mean of at least 5 samples)
IL_GBKA	Spring Brook	Dissolved Oxygen	March-July > 5.0 min. & > 6.0 7-day mean Aug-Feb > 3.5 min, > 4.0 7-day mean, & > 5.5 30-day mean
		Fecal Coliform	<400 count/100 ml in <10% of samples and <200 count/100ml (30-day geometric mean of at least 5 samples)
IL_GBKA-01	Spring Brook	Fecal Coliform	<400 count/100 ml in <10% of samples and <200 count/100ml (30-day geometric mean of at least 5 samples)
IL_GBL-10	East Branch DuPage River	Fecal Coliform	<400 count/100 ml in <10% of samples and <200 count/100ml (30-day geometric mean of at least 5 samples)
IL_GL-09	Salt Creek	Fecal Coliform	<400 count/100 ml in <10% of samples and <200 count/100ml (30-day geometric mean of at least 5 samples)
IL_GL-10	Salt Creek	Fecal Coliform	<400 count/100 ml in <10% of samples and <200 count/100ml (30-day geometric mean of at least 5 samples)
IL_GL-19	Salt Creek	Fecal Coliform	<400 count/100 ml in <10% of samples and <200 count/100ml (30-day geometric mean of at least 5 samples)
IL_GLA-02	Addison Creek	Fecal Coliform	<400 count/100 ml in <10% of samples and <200 count/100ml (30-day geometric mean of at least 5 samples)

5.0 Water Quality Assessment

An important step in the TMDL development process is the review of water quality conditions, particularly data and information used to list segments. Examination of water quality monitoring data is a key part of defining the problem that the TMDL is intended to address. This section provides a brief review of available water quality information for all impaired waters. All relevant available data are presented below; however only recent data are used when evaluating impairment status. Each data point was reviewed to ensure the use of quality data in the analysis below.

5.1 Water Quality Data

Water quality data for impaired streams (excluding LRS pollutants and those streams being delisted in 2016) in the DuPage River/Salt Creek Watershed are collected by many agencies (Table 12). Figure 15 through Figure 17 show the water quality stations within the watershed that contain relevant data. Data analysis focused on available data collected since the year 2000. The information presented in this section is a combination of Water Quality Portal - formerly known as (USEPA Storage and Retrieval database - STORET) and data from the Illinois EPA database, Wheaton Sanitary District (WSD), Metropolitan Water Reclamation District of Greater Chicago (MWRDGC, now MWRD), US Geological Survey (USGS), and DRSCW.

Table 12. Monitoring station information

Segment	Parameter	Entity
GB-01	None	--
GB-11	Chloride	Illinois EPA, USGS
	Fecal Coliform	Illinois EPA
GB-16	Dissolved Oxygen	Illinois EPA
	Fecal Coliform	Illinois EPA
GBK-05	Fecal Coliform	Illinois EPA, WSD
GBK-09	Fecal Coliform	Illinois EPA, MWRDGC
GBK-14	Dissolved Oxygen	DRSCW
	Fecal Coliform	MWRDGC
GBKA	Chloride	no data on GBKA
	Dissolved Oxygen	DRSCW
	Fecal Coliform	WSD
GBKA-01	Fecal Coliform	WSD
GBL-08	None	--
GBL-10	Fecal Coliform	Illinois EPA
GL	None	--
GL-09	Fecal Coliform	Illinois EPA, MWRDGC
GL-10	pH	MWRDGC, DRSCW
	Nickel	MWRDGC
	Fecal Coliform	MWRDGC
GL-19	Fecal Coliform	MWRDGC
GLA-02	Nickel	Illinois EPA
	Fecal Coliform	Illinois EPA

WSD - Wheaton Sanitary District, MWRDGC - Metropolitan Water Reclamation District of Greater Chicago, USGS - US Geological Survey, DRSCW - DuPage River Salt Creek Workgroup

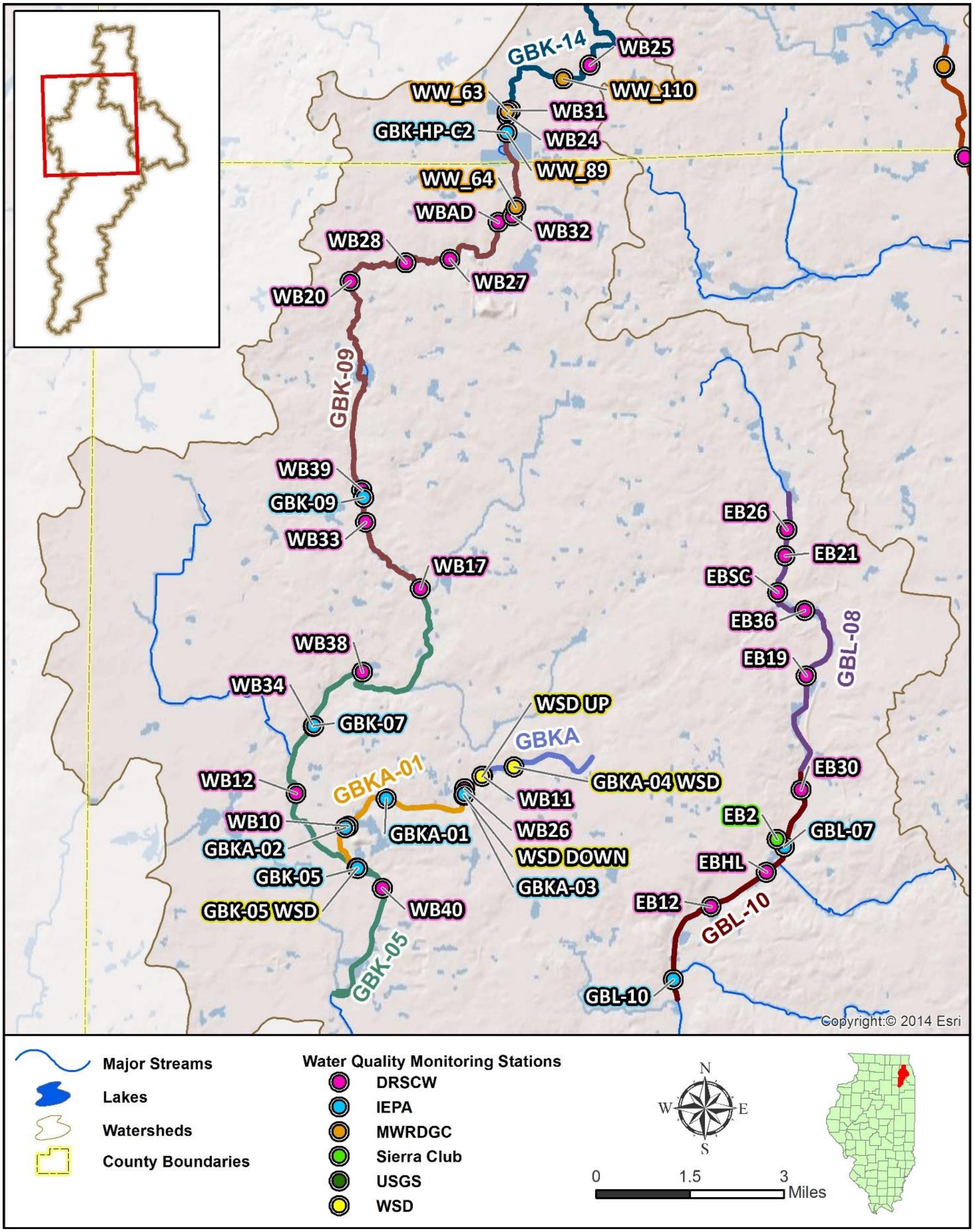

Figure 15. Monitoring stations used for assessing impairments, East and West Branch DuPage River impairments.

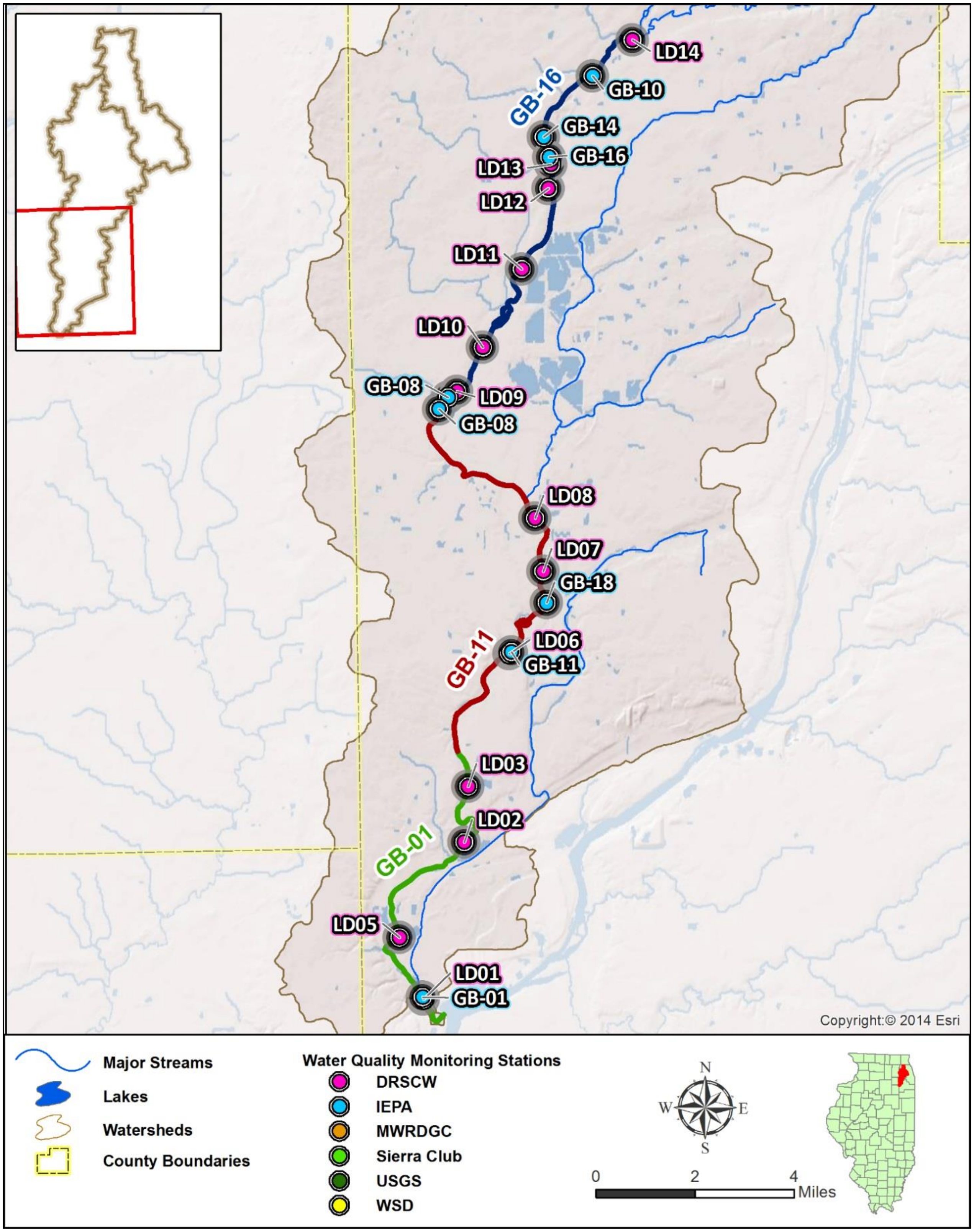

Figure 16. Monitoring stations used for assessing impairments, mainstem DuPage River impairments.

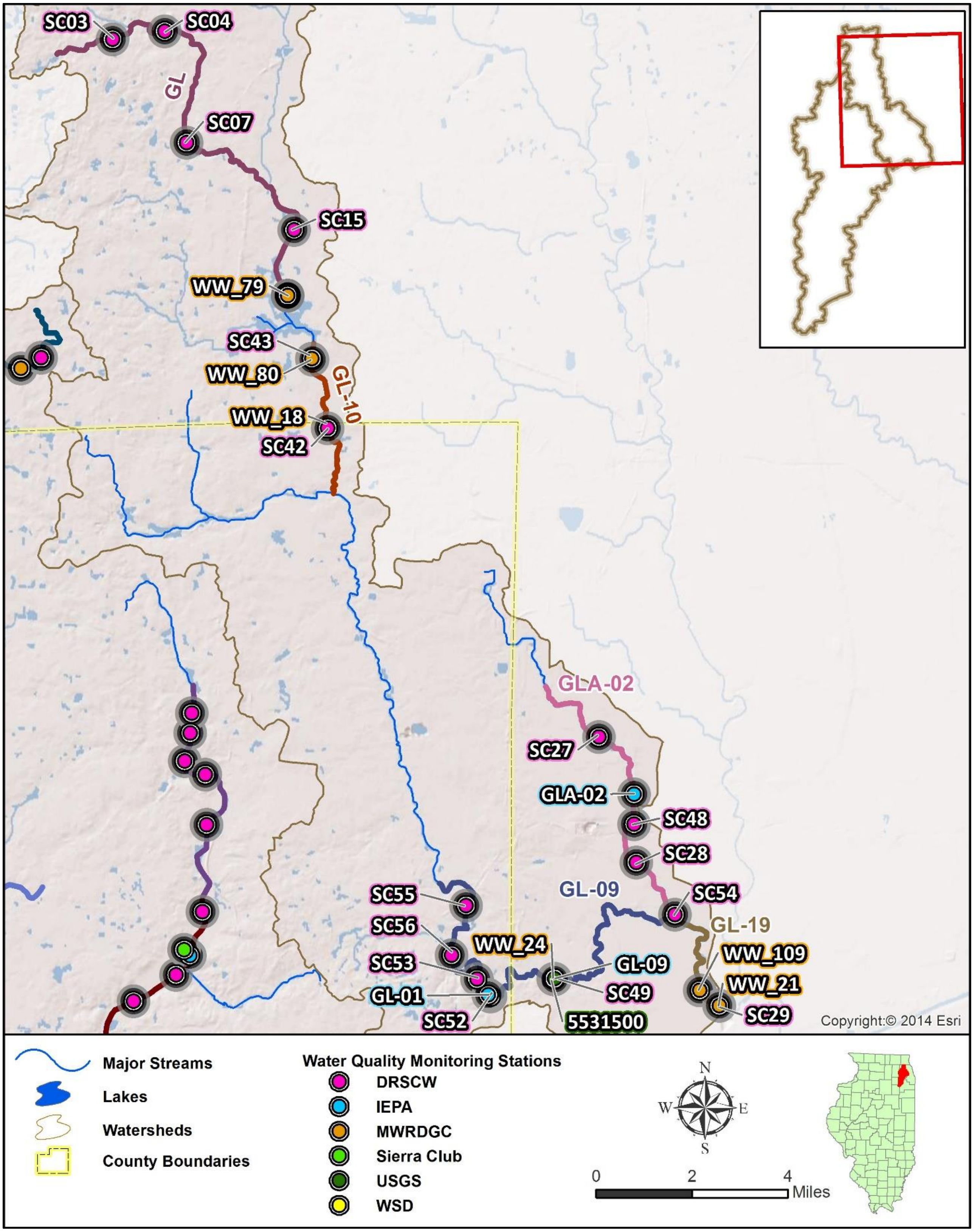

Figure 17. Monitoring stations used for assessing impairments, Salt Creek impairments.

5.1.1 Fecal Coliform

Figure 18 through Figure 20 contain the available fecal coliform data. Data are available from the years indicated in the time series graphs; Table 13 summarizes the data used in the analysis. The WQS for fecal coliform is a 200 cfu/100ml geometric mean based on a minimum of five samples taken over any 30-day period between May and October and a 400 cfu/100ml maximum not to be exceeded in more than 10% of samples taken during any 30-day period between May and October. Due to the unlikelihood of having five fecal coliform samples per month upon which to judge compliance, a single exceedance of 400 cfu/100 ml will be interpreted as a violation of the WQS for assessment purposes. Fecal coliform impairment is verified for all of the listed segments.

Table 13. Fecal coliform data summary

Segment	Stations	Data Years	No. of Samples	Violations >400	Min	Max	Average	Median
					cfu/100ml			
GB-11	IEPA GB-11	1999-2006, 2009-2013	54	11	10	1,233	271	205
GB-16	IEPA GB-10 & 16	2001- 2006	30	10	10	11,400	836	201
GBK-05	IEPA GBK-05 WSD GBK-05	1999-2009, 2011-2013	87	42	25	56,000	2,590	380
GBK-09	IEPA GBK-09 MWRDGC WW_64, 89	1999- 2013	92	40	20	25,545	1,770	265
GBK-14	MWRDGC WW_63 & 110	2001,2003-2013	58	55	99	550,000	22,671	2,850
GBKA	WSD GBKA-04	2005- 2008	23	19	63	9200	2,192	1,067
GBKA-01	WSD GBKA-02 & 03	2005- 2008	40	10	1	4,600	514	163
GBL-10	IEPA GBL-10	1999-2009, 2011-2013	52	35	69	20,000	1,654	590
GL-09	IEPA GL-09 MWRDGC WW_24	1999-2013	123	47	20	86,000	2,019	250
GL-10	MWRDGC WW_18, 80	2001- 2013	113	32	9	14,000	669	170
GL-19	MWRDGCWW_21, 109	2001- 2013	70	47	10	200,000	7,417	650
GLA-02	IEPA GLA-02	1999- 2013	55	51	90	27,800	5,716	2,600

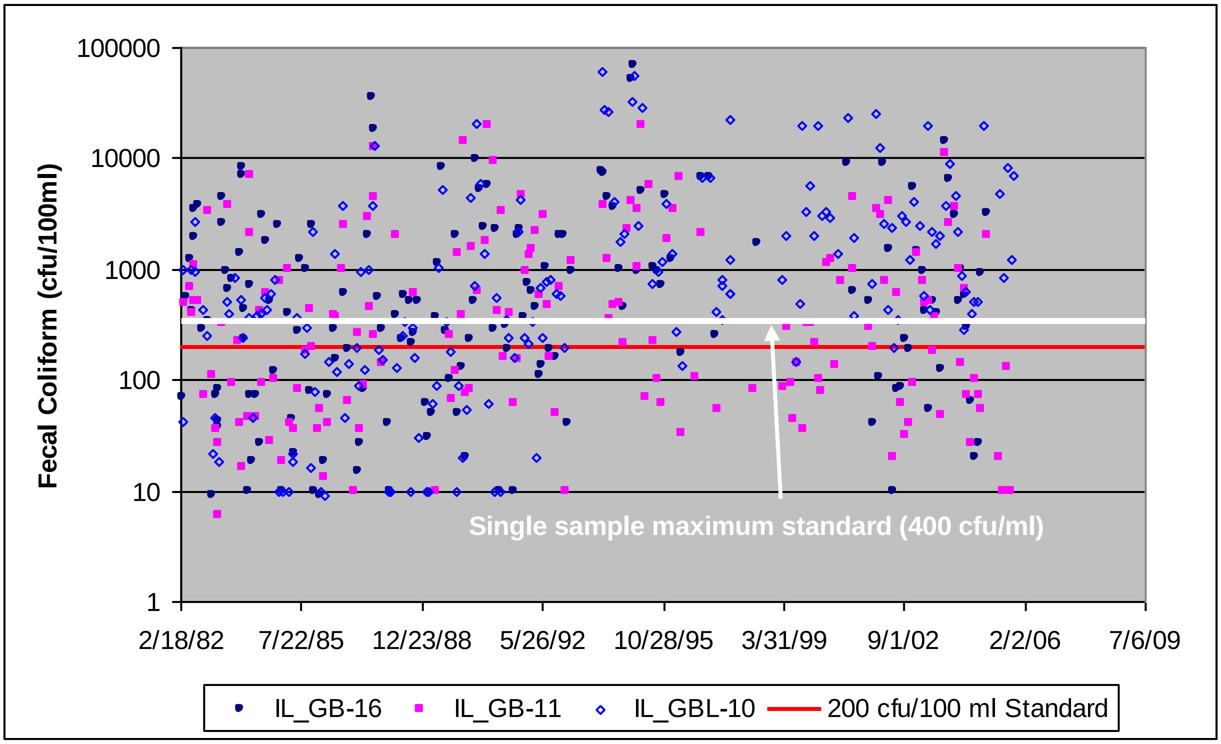

Figure 18. Fecal coliform time series for GB-16, GB-11, and GBL-10.

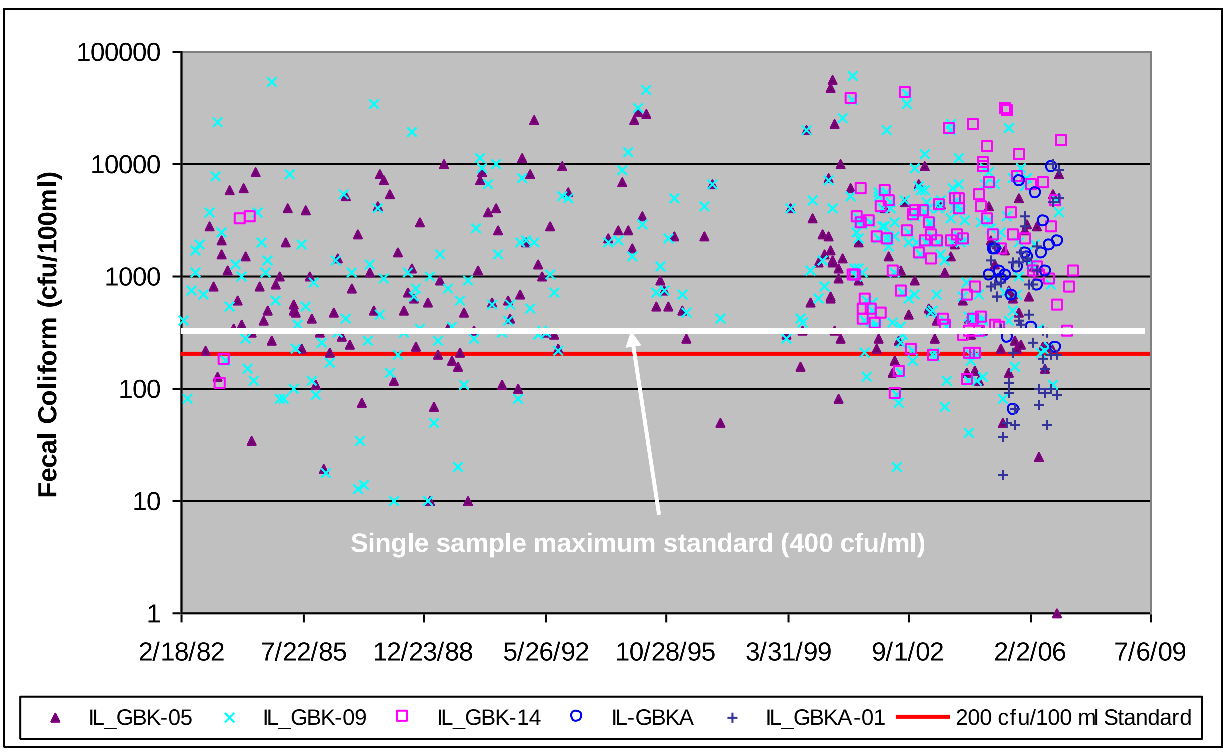

Figure 19. Fecal coliform time series for GBK-05, GBKA, and GBKA-01.

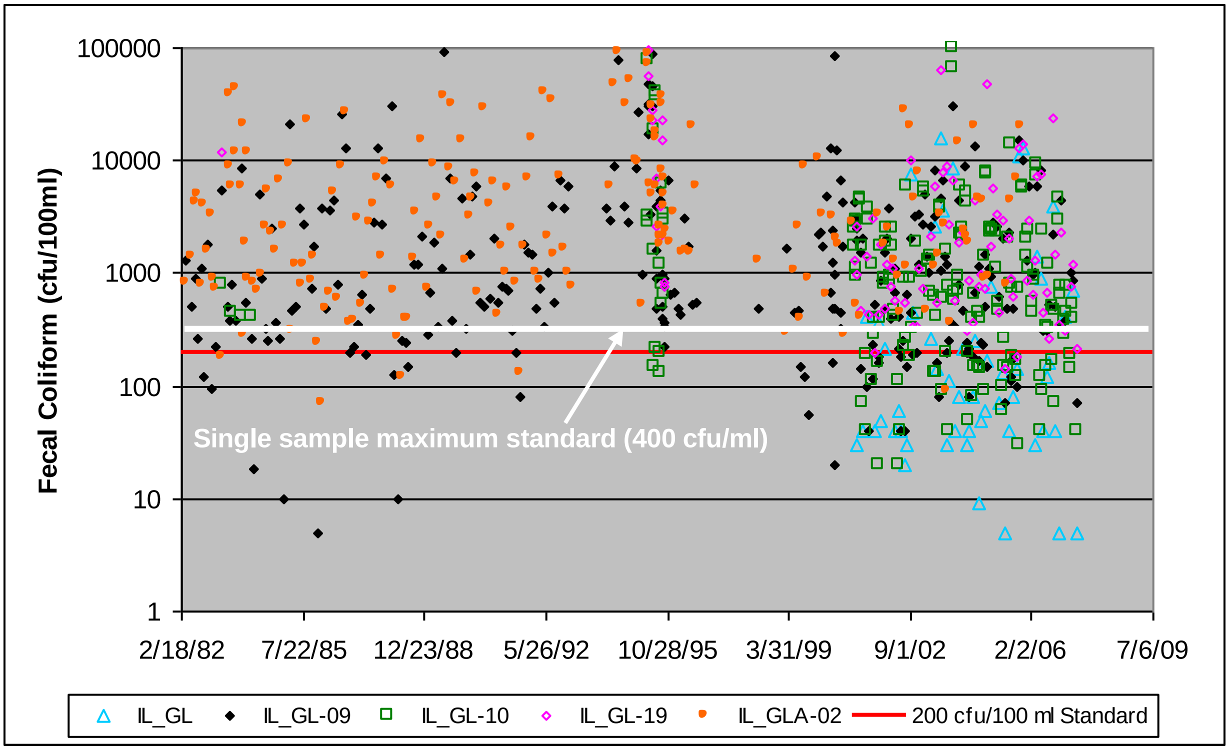

Figure 20. Fecal coliform time series for GL, GL-09, GL-10, GL-19, and GLA-02.

5.1.2 Dissolved Oxygen

The dissolved oxygen WQS for all segments except GB-16 is a 5.0 mg/L instantaneous minimum for March through July and 3.5 mg/L for August through February. Segment GB-16 is subject to enhanced protection so the WQS is a 5.0 mg/L instantaneous minimum for March through July and 4.0 mg/L for August through February. Three waterbody segments are listed as impaired due to low dissolved oxygen. Data from 2004 through 2016 were evaluated (Table 14).

Figure 21 contains summary information for Illinois EPA monthly dissolved oxygen data for GB-16 enhanced waterbody, and Figure 22 contains continuous hourly monitoring data for GB-16. Discrete dissolved oxygen measurements taken after 2006 by the Lower DuPage River Watershed Coalition confirm the impairment (Figure 23). The DRSCW collected continuous dissolved oxygen data during low flow summer conditions in 2016 at GBK-14 (Springsmuth Road) and at two sites along GBKA (Figure 24, Figure 25). These data clearly show impairment of the streams.

Sediment oxygen demand (SOD) data were collected as part of a Stage 2 monitoring effort, see Appendix B for the full Stage 2 report. Collected SOD data indicated high levels of SOD in the watershed ranging from 2.45 g/m2/day at Hanover Park (the upstream sampling location on the West Branch DuPage River) to 6.19 g/m2/day at West Chicago at ambient temperature. SOD is the sum of all biological and chemical processes in sediment that utilize oxygen.

Table 14. Dissolved oxygen data summary

Segment	Stations	Data Years	Observations	Violations	Minimum mg/L
GB-16	IEPA GB-08 IEPA GB-16 [a]	2000- 2006	443	28	3.54
GBK-14	DRSCW Springsmuth Site [a]	2016	Continuous between 9/1/2016-9/7/2016	Yes	1.06
GBKA	DRSCW School Site [a]	2016	Continuous between 7/26/2016-8/2/2016	Yes	2.66

a. Continuous monitoring data

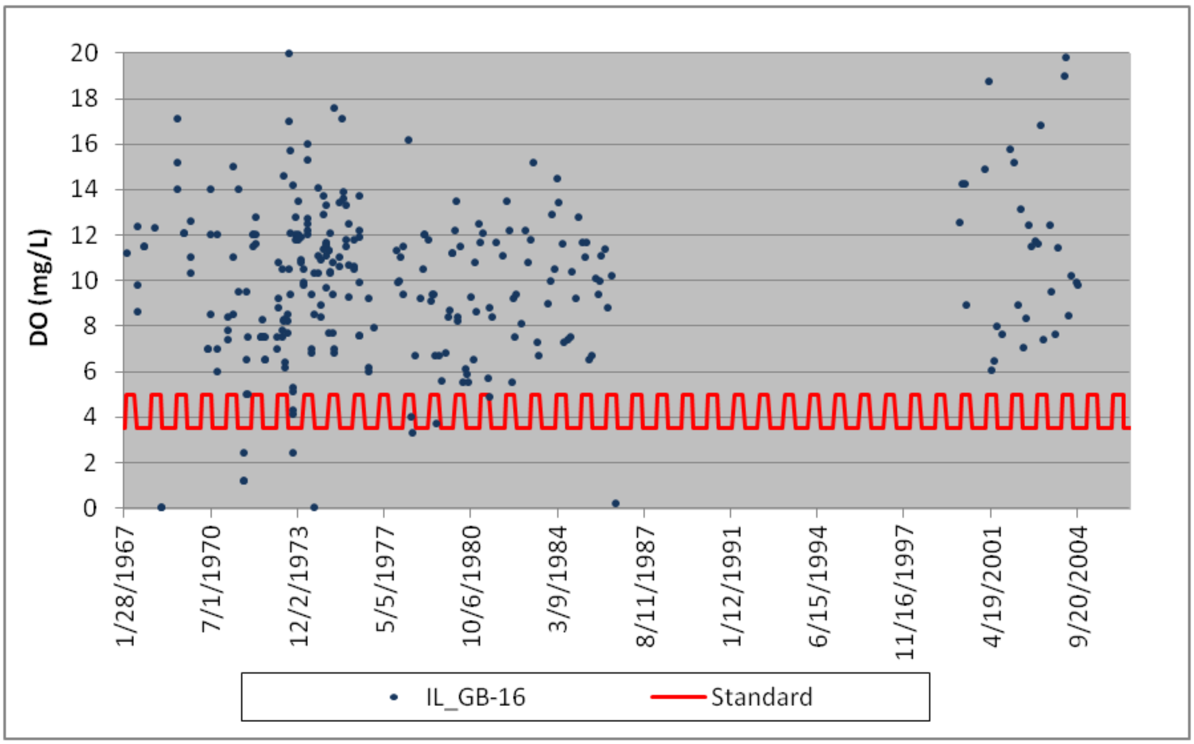

Figure 21. Dissolved oxygen time series for GB-16 (monthly monitoring).

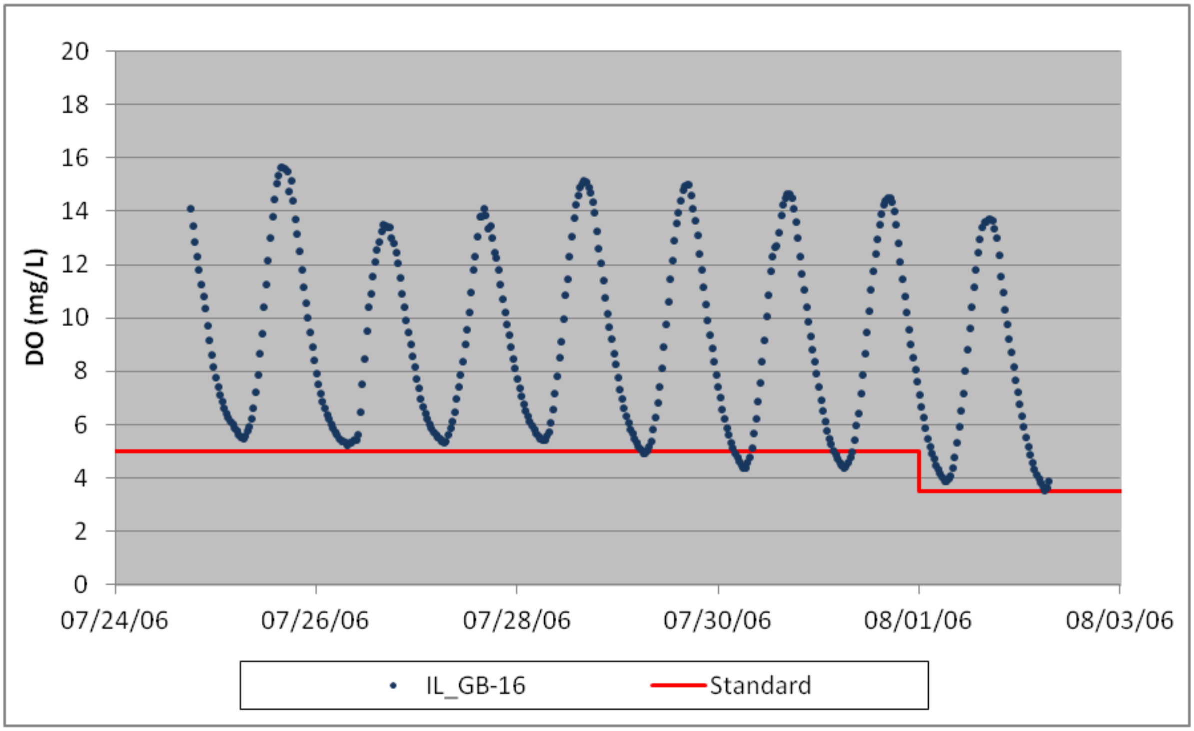

Figure 22. Dissolved oxygen data for GB-16 provided by Illinois EPA (continuous hourly monitoring).

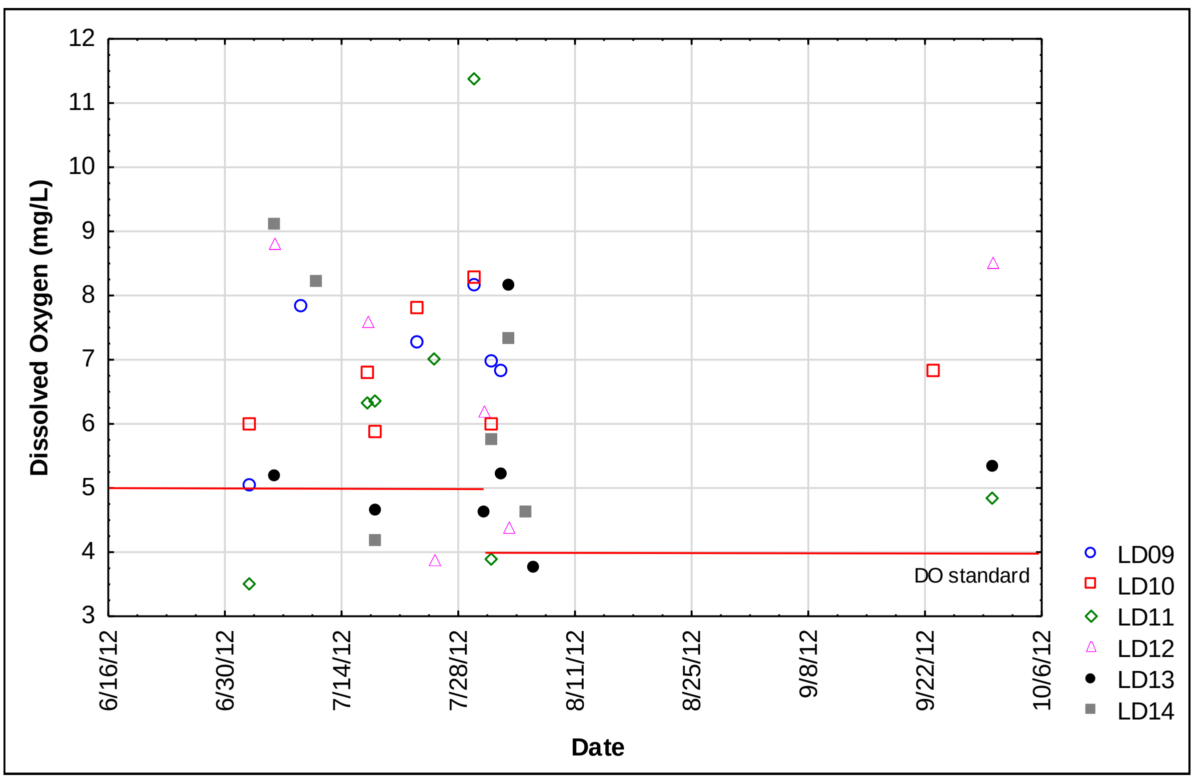

Figure 23. 2012 dissolved oxygen data for GB-16 provided by Lower DuPage River Watershed Coalition.

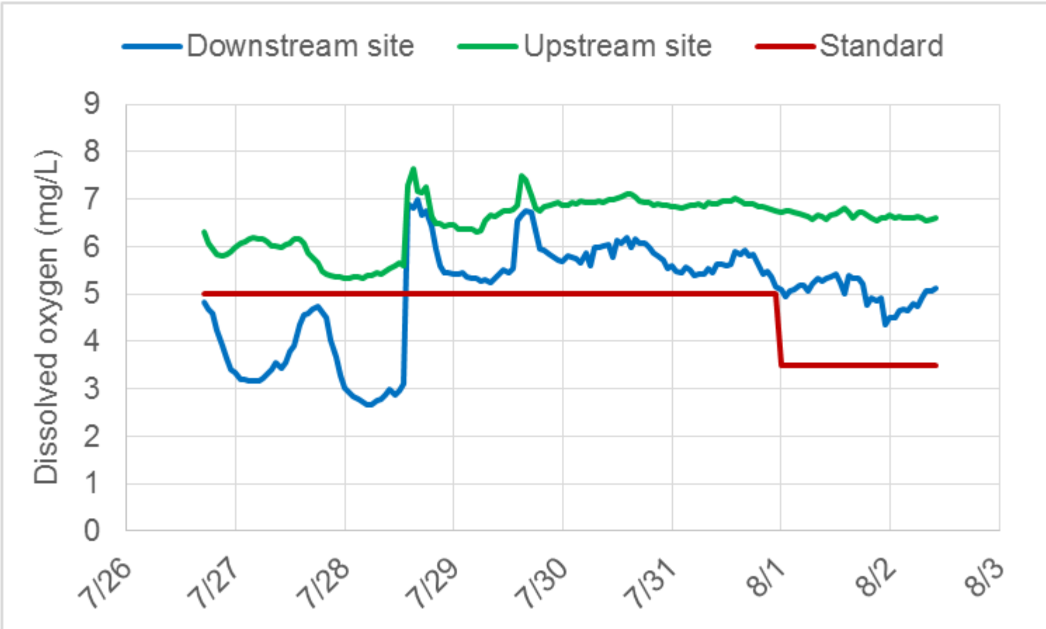

Figure 24. 2016 dissolved oxygen data for GBKA provided by DRSCW.

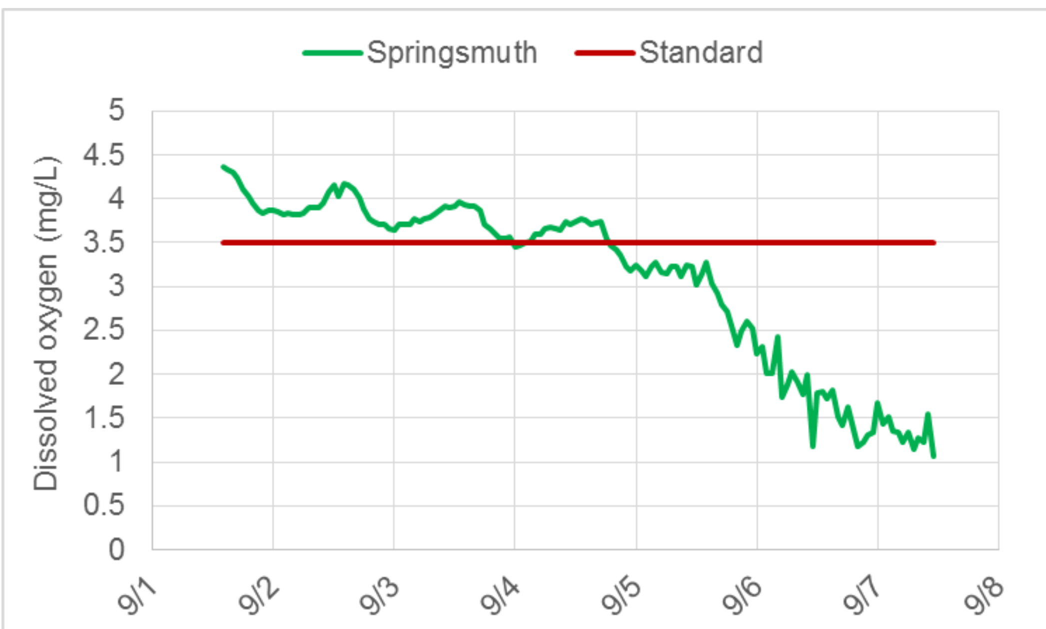

Figure 25. 2016 dissolved oxygen data for GBK-14 provided by DRSCW.

5.1.3 pH

The WQS dictates an acceptable pH range between 6.5 and 9.0 s.u. Four segments are listed as impaired; three of these segments are being delisted on the 2016 303(d) list including GBK-14, GBL-08, and GBL-10 and are therefore not evaluated. Table 15 summarizes the available data for the remaining segment GL-10. Figure 26 displays pH data available from 2004–2013 for GL-10. All pH data on GL-10 meet the pH water quality criteria, based on these data the waterbody is not impaired.

Table 15. pH data summary

Segment	Stations	Data Years	Observations	Violations	Min	Max
					s.u.	
GL-10	MWRDGC WW_80, DRSCW SC42, SC43	2001-2007	97	0	6.6	8.2

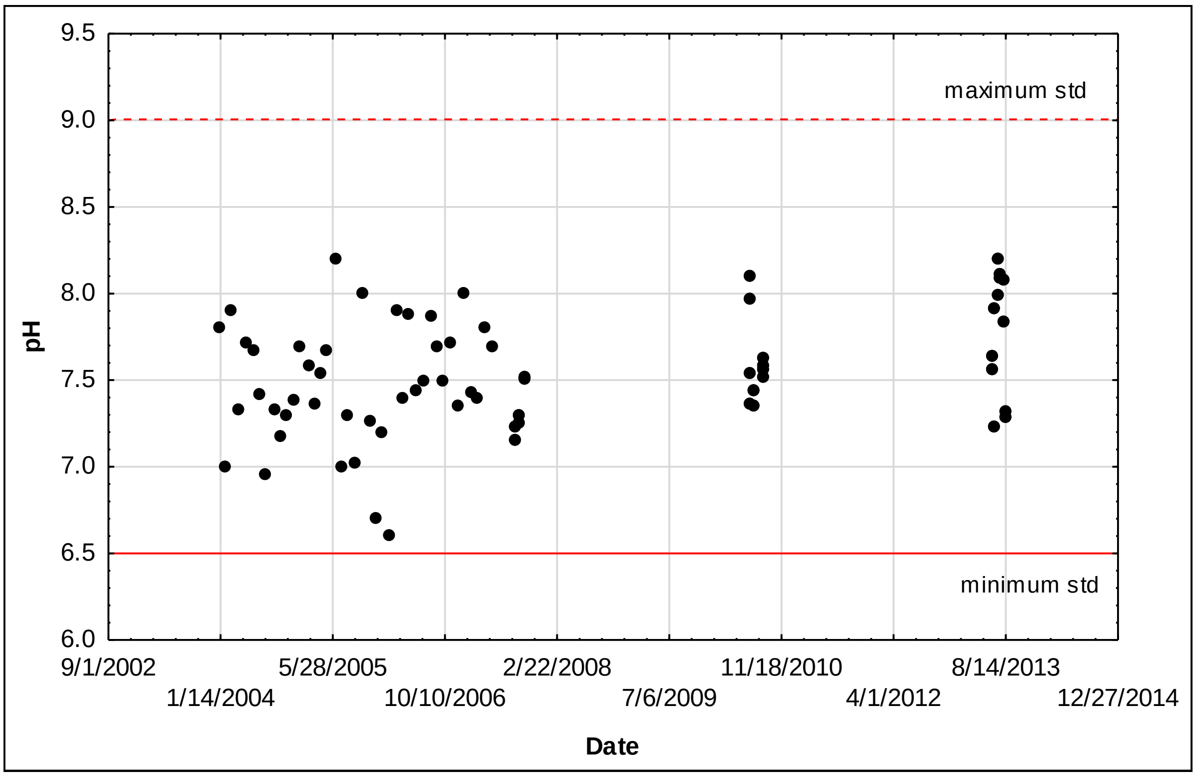

Figure 26. pH time series for GL-10.

5.1.4 Chloride

Two segments are listed as impaired for chloride: GBKA and GB-11. The general use water quality standard for chloride is 500 mg/L. Table 16 and Figure 27 summarize the available chloride data.

Two chloride exceedances have been recorded on GB-11 (Figure 27). Data at GBKA-01, located immediately downstream of GBKA, are used to assess GBKA for impairment. There were no monitored water quality standard exceedances on this reach (Figure 28). A chloride TMDL has also been approved downstream of GBKA on GBK-05 which addresses chloride sources in the entire watershed, including GBKA. The data do not indicate impairment of GBKA, and no chloride TMDL is proposed for this segment.

Table 16. Chloride data summary

Segment	Stations	Data Years	Observations	Violations	Min	Max	Average	Median
					mg/L			
GB-11	GB-08,11,18, DRSCW LD06, 07, 08, 05540500	1977 - 2013	366	5	19	1,680	193	172
GBKA	WB10, WB11, WB26, WSD DOWN, WSD UP	2004 - 2013	33	0	34	205	144	150

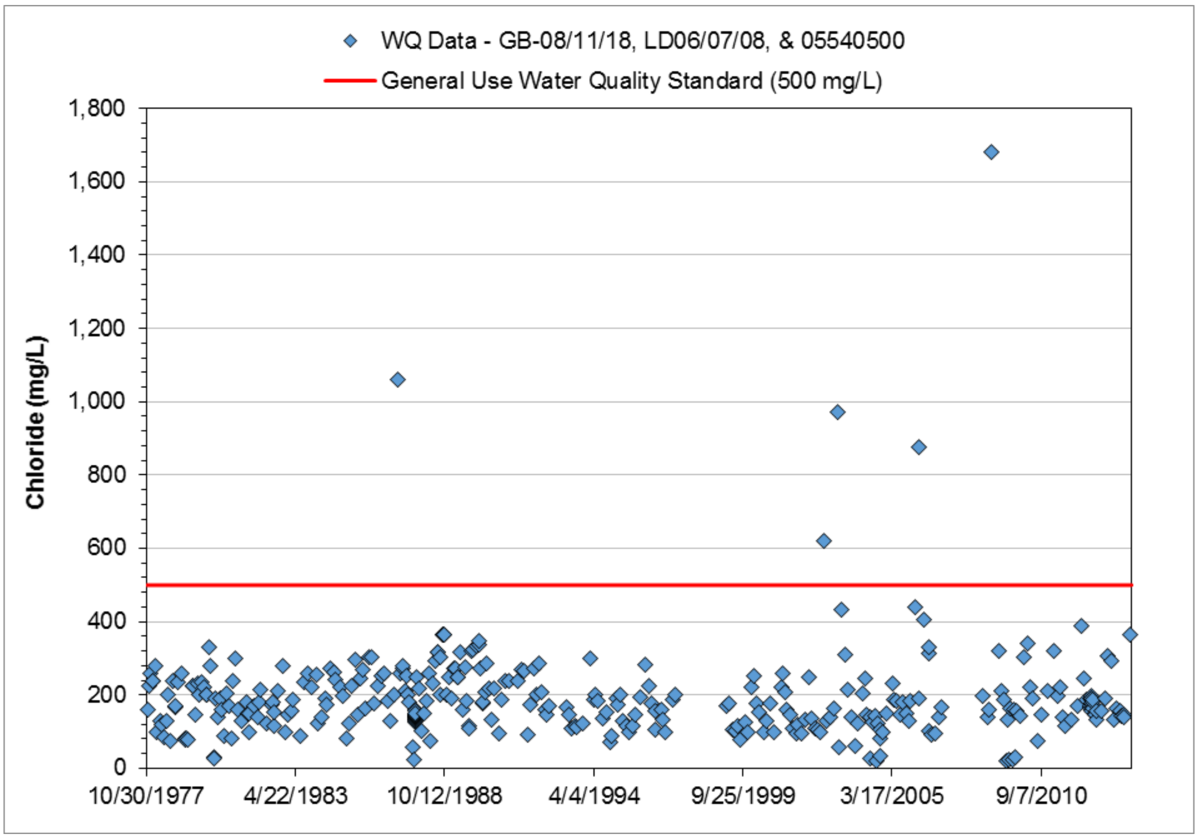

Figure 27. Chloride time series for GB-11, provided by Illinois EPA.

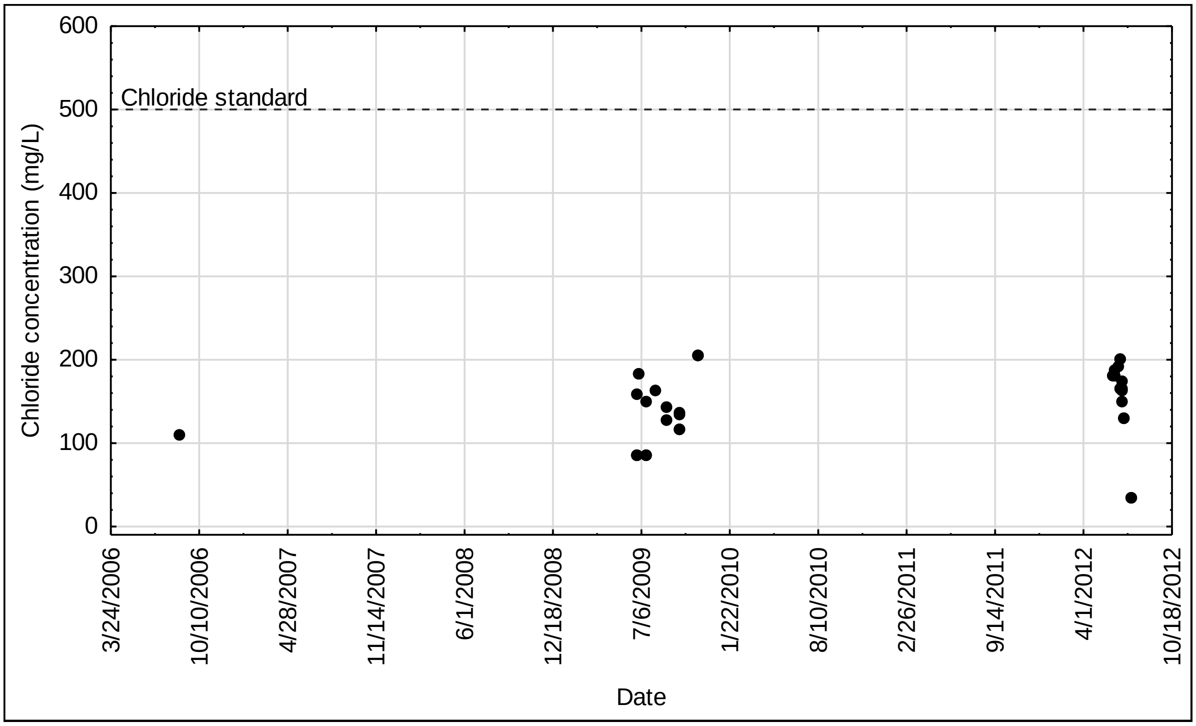

Figure 28. Chloride time series for GBKA (measured at GBKA-01), provided by Illinois EPA.

5.1.5 Copper

One segment is listed as impaired for copper: Spring Brook (GBKA-01), however this segment is being delisted as part of the 2016 303(d) list. No water quality analysis is provided for this segment.

5.1.6 Nickel

Two segments are listed for nickel impairment within the DuPage River/Salt Creek Watershed: GL-10 on the main stem of Salt Creek and GLA-02 on Addison Creek. The WQS is based on dissolved nickel and is hardness dependent. Both a chronic and acute standard are applicable. The median hardness value for each impaired reach was used to derive applicable water quality targets. In this case, the acute standard for IL_GL-10 is 160 µg/L, and the chronic standard is 9.7 µg/L. The acute standard for IL_GLA-02 is 172 µg/L, and the chronic standard is 10.4 µg/L.

Table 17 summarizes available nickel data. Data collected for GL-10 and GLA-02 indicate that the dissolved nickel water quality standard was not violated during the monitoring period between 2004 and 2013 on either reach (Figure 29 and Figure 30). There were no monitored exceedances of the acute or chronic standard (based on four consecutive samples) in the streams. The available data do not indicate impairment of these segments; TMDLs will not be developed. Concurrent monitoring of both dissolved nickel and hardness could be used to justify delisting of these segments.

Table 17. Dissolved nickel data summary

Segment	Stations	Data Years	Observa-tions	Violations (acute standard)	Violations (chronic standard)	Min	Max	Average	Median
						µg/L			
GL-10	WW_80	2004-2007	48	0	0	0	8.4	1.3	0
GLA-02	GLA-02	2004-2013	80	0	0	0.56	13[a]	3.8	2.5

a. Two of the individual samples were greater than the chronic standard (10.4 µg/L; however, the standard was not violated because the average of four consecutive samples did not exceed the standard.

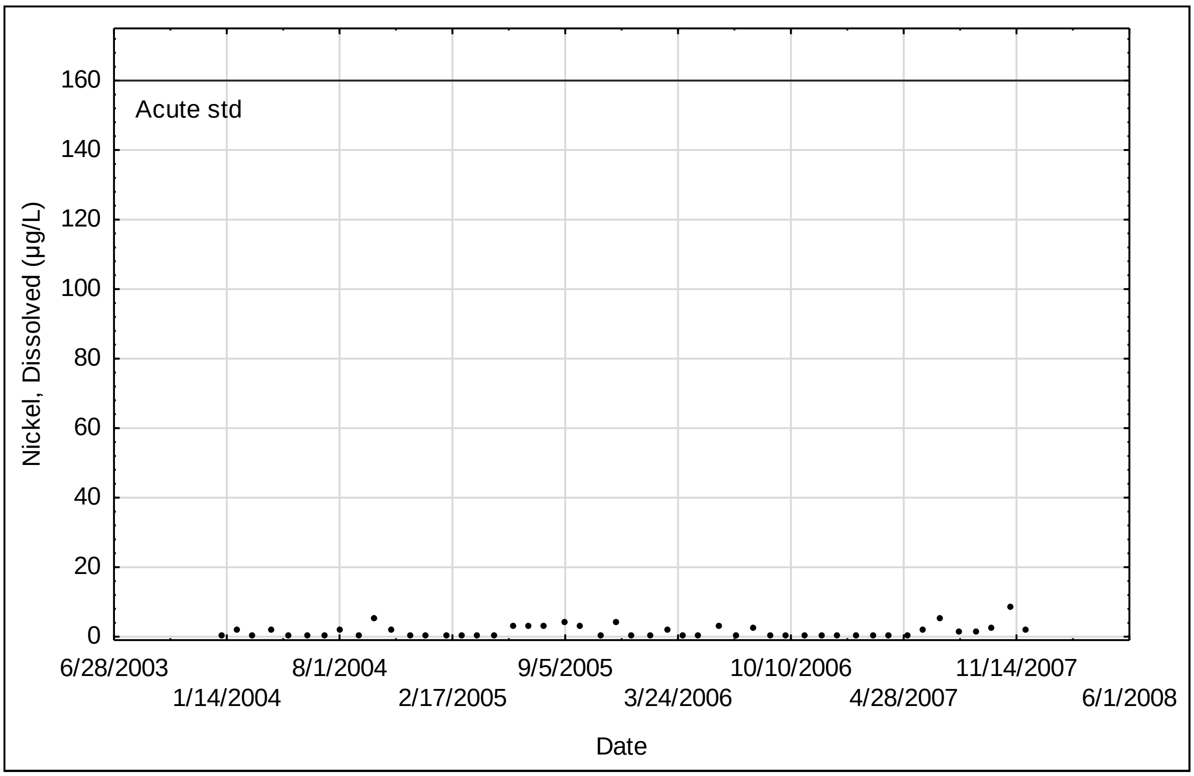

Figure 29. Nickel time series for GL-10.

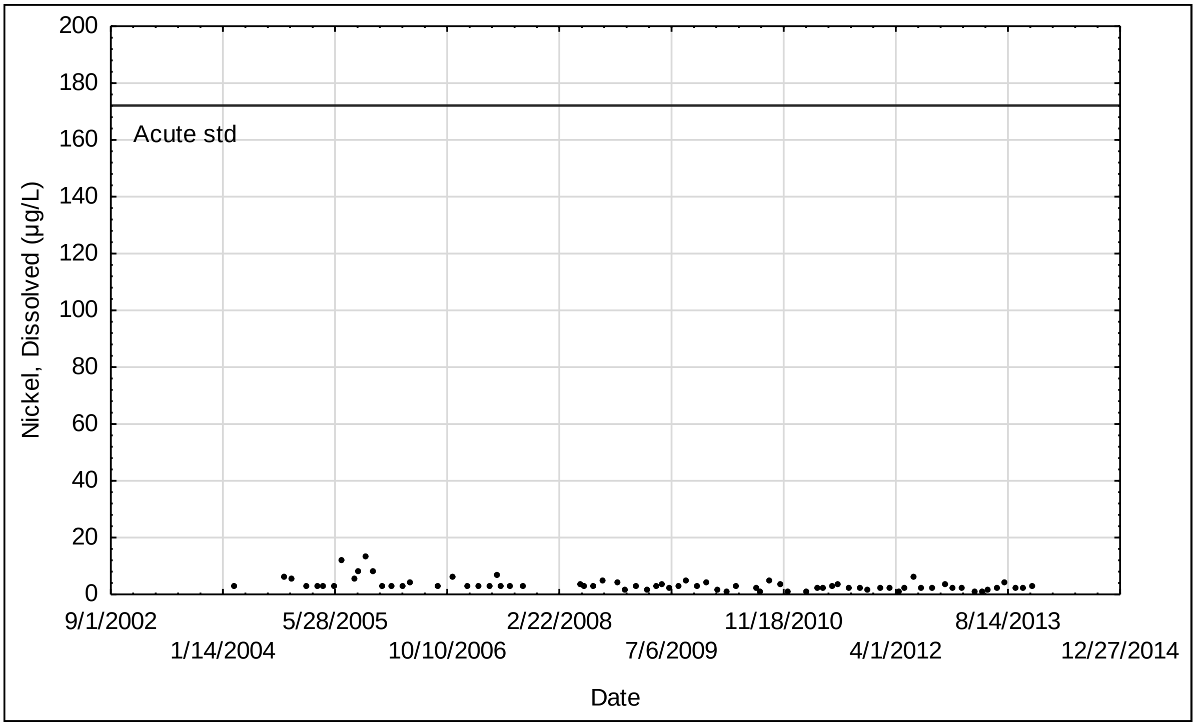

Figure 30. Nickel time series for GLA-02.

5.2 Pollutants of Concern for TMDL Development

Based on the water quality data provided in the previous section, pollutants of concern further evaluated in this TMDL include fecal coliform, chlorides, and parameters influencing dissolved oxygen levels. Dissolved oxygen in streams can be affected by biochemical oxygen demand, phosphorus, ammonia, and sediment oxygen demand in addition to non-pollutant causes such as a lack of reaeration. These pollutants can originate from an array of sources including point and nonpoint sources. Eutrophication (high levels of algae) is also often linked directly to low dissolved oxygen conditions and high pH, and therefore nutrients are also a pollutant of concern. The following sections provide a summary of potential point and nonpoint sources that contribute to the impaired waterbodies.

5.3 Point Sources

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

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

Under the CWA, all point sources are regulated under the NPDES program. A municipality, industry, or operation must apply for an NPDES permit if an activity at that facility discharges wastewater to surface water. Point sources can include facilities such as municipal wastewater treatment plants (WWTPs), industrial facilities, CAFOs, or regulated storm water including municipal separate storm sewer systems (MS4s). There are no permitted CAFOs in the watershed.

5.3.1 NPDES Permitted Facilities

NPDES facilities within the watershed include municipal and industrial wastewater treatment plants (Figure 31). Nutrients and other oxygen-demanding substances found in WWTP discharge can contribute to low dissolved oxygen conditions in the watershed. WWTPs are also a source of fecal coliform and chloride.

Table 18 and Table 19 summarize the individual NPDES permitted facilities within the DuPage Salt Creek watershed as provided by Illinois EPA. The average and maximum design flow for each facility are also listed when available. These facilities are or will be required to reduce their total phosphorus loadings to comply with an existing 1 mg/l total phosphorus effluent concentration limit in wastewater as part of special conditions set forth in NPDES permits issued by the Illinois EPA; these reductions will help to meet dissolved oxygen conditions in the Lower DuPage River and improve instream phosphorus conditions throughout the watershed. In addition to a phosphorus limit, facilities are required to comply with a series of special conditions that addresses watershed chloride reduction and in-stream habitat as part of their NPDES permits (Appendix G).

Eight facilities also have permitted combined sewer overflows (CSOs) in the DuPage River Salt Creek watershed (Table 19 and Figure 32). CSOs are the result of wet weather, which is not the critical condition for dissolved oxygen. When CSOs occur, wastewater enters rivers and streams untreated, discharging pollutants including fecal coliform, solids, chloride, and phosphorus. CSOs are summarized based on the maximum CSO flow during the time period 2013–2015, as reported in Illinois EPA's discharge monitoring reports (DMRs) or as provided by the permitted entity. The status of Long-Term Control Plans (LTCPs) is also provided. One facility is exempt from developing a LTCP (GLENBARD WW AUTH-LOMBARD) because due to CSO controls, permittee has achieved 4 overflows/year as required under the Presumption Approach, and, as allowed in Special Condition 10.10b in its permit, is exempt from developing a LTCP unless required to develop and implement by Special Condition 10.10c. Four facilities are part of the MWRD's Tunnel and Reservoir Plan (TARP) System, which conveys combined sewer flow through tunnels to storage reservoirs. After an event is over, the water in the reservoirs is pumped to a water reclamation plant, treated, and discharged to surface waters. These facilities are not required to submit separate LTCPs.

Two WWTPs have disinfection exemptions in the watershed that allow a facility to discharge wastewater without disinfection. One of the facilities discharges downstream of the impaired segments (IL0021121). The other facility discharges to a tributary of Salt Creek just upstream of impaired segment GL-09 (IL0052817). Facilities with disinfection exemptions may be required to provide Illinois EPA with updated information to demonstrate compliance with these requirements and facilities directly discharging into a fecal-impaired segment may have their disinfection exemption re-evaluated through future NPDES permitting actions.

Due to the large number of facilities draining to fecal coliform impairments, facilities identified as sources of fecal coliform by Illinois EPA are identified in Table 18. These facilities have a fecal coliform limit included in their NPDES permit, are a CSO, or have a fecal coliform monitoring requirement in the case of one WWTP (IL0052817).

Table 18. Existing NPDES discharges in the DuPage River/Salt Creek watershed

Watershed	NPDES Number	Facility and Outfall Number(s)	Receiving Water	Downstream Impairments	Design Average Flow (MGD)	Design Maximum Flow (MGD)	DMR Flows (average of 2013-2015 data)[a] MGD	Fecal Coliform Source [c]
DUPAGE R- MAIN STEM	IL0069744	BOLING-BROOK WRF #3 – 001	DUPAGE RIVER	GB-16, GB-11	2.8 current, 4.2 future	7.0 current, 10.5 future	3.1	Yes
DUPAGE R- MAIN STEM	IL0045381	CAMELOT UTILITIES INC. STP – 001	DUPAGE RIVER	None (GB-01)	0.1	0.25	0.1	NA

Watershed	NPDES Number	Facility and Outfall Number(s)	Receiving Water	Downstream Impairments	Design Average Flow (MGD)	Design Maximum Flow (MGD)	DMR Flows (average of 2013-2015 data)[a] MGD	Fecal Coliform Source [c]
DUPAGE R- MAIN STEM	IL0021121	CREST HILL WEST STP – 001 [b]	ROCK RUN CREEK	None (GB-01)	1.3	3.0 (also an excess flow	1.5	NA
DUPAGE R- MAIN STEM	IL0055913	MINOOKA STP – 001	DUPAGE RIVER TO DES PLAINES RIVER	None (GB-01)	2.2	5.8	3.4	NA
DUPAGE R- MAIN STEM	IL0034061	NAPERVILLE SPRING-BROOK WRC – 001	DUPAGE RIVER	GB-16, GB-11	26.25 current, 30 future	55.13 current, 63 future	18.9	Yes
DUPAGE R- MAIN STEM	IL0074373	PLAINFIELD NORTH STP – 001	DUPAGE RIVER-DES PLAINES	GB-16, GB-11	7.5	15.0	4.5	Yes
DUPAGE R- MAIN	IL0076414	JOLIET AUX SABLE WWTP – 001	DUPAGE RIVER	GB-11	3.2	7.8	2.7	Yes
EAST BR DUPAGE R	IL0032735	BOLING-BROOK WRF #2 – 001	E. BR. DUPAGE RIVER	GB-16, GB-11	3	7.5	2.8	Yes
EAST BR DUPAGE R	IL0028967	GLENDALE HEIGHTS STP – 001 [b]	ARMITAGE DITCH	GBL-10, GB-16, GB-11	5.26	10.52	3.1	Yes
EAST BR DUPAGE R	IL0021130	BLOOMING-DALE-REEVES WRF – B01 [b]	E. BR. DUPAGE RIVER	GBL-10, GB-16, GB-11	3.45	8.625	2.6	Yes
EAST BR DUPAGE R	IL0032689	BOLING-BROOK STP #1 – B01 [b]	E BR DUPAGE RIVER	GB-16, GB-11	2.04	4.51	1.6	Yes
EAST BR DUPAGE R	IL0028380	DOWNERS GROVE SD WTC – B01 [b]	E. BR. DUPAGE RIVER & ST. JOSEPH CREEK	GBL-10, GB-16, GB-11	11	22.0	11.1	Yes
EAST BR DUPAGE R	IL0031844	DUPAGE COUNTY-WOODRIDGE-GREEN VALLEY STP – 001 [b]	E. BR. DUPAGE RIVER	GB-16, GB-11	12	28.6	10.3	Yes

Watershed	NPDES Number	Facility and Outfall Number(s)	Receiving Water	Downstream Impairments	Design Average Flow (MGD)	Design Maximum Flow (MGD)	DMR Flows (average of 2013-2015 data)[a] MGD	Fecal Coliform Source [c]
EAST BR DUPAGE R	ILG840204	ELMHURST CHICAGO STONE-BARBER – 001, 002, 002A	E. BR. DUPAGE RIVER	GB-16, GB-11	No design flows, discharge is pit pumpage and stormwater runoff		7.6	No
EAST BR DUPAGE R	IL0021547	GLENBARD WW AUTH-GLENBARD – 001	E. BR. DUPAGE RIVER	GBL-10, GB-16, GB-11	16.02	47	11.4	Yes
EAST BR DUPAGE R	IL0022471	GLENBARD WW AUTH-LOMBARD – 001	E. BR. DUPAGE RIVER	GBL-10, GB-16, GB-11	No design flows, discharge is from combined sewage treatment facility and combined sewer overflow		0.8 (excess flow)	Yes
SALT CR	IL0033812	ADDISON NORTH STP – B01 [b]	SALT CREEK	GL-09, GL-19	5.3	7.6	3.7	Yes
SALT CR	IL0027367 (See Table 19)	ADDISON SOUTH-A.J. LAROCCA STP – B01 [b]	SALT CREEK	GL-09, GL-19	3.2	8.0	1.9	Yes
SALT CR	IL0021849	BENSENVILLE STP – 001 [b]	ADDISON CREEK	GLA-02, GL-19	4.7	10.0	3.6	Yes
SALT CR	ILM580032	BROOKFIELD CSOS – 001, 002, 003, 005, 006, 007	SALT CREEK	GL-19	See Table 19			Yes
SALT CR	IL0035831	CONGRESS DEV HILSIDE LANDFILL – 001	DES PLAINES RIVER	GLA-02, GL-19	No design flows, discharge is stormwater		0.2	No
SALT CR	IL0028746	ELMHURST WWTP – 001[b]	SALT CREEK,	GL-09, GL-19	8	20.0	7.8	Yes
SALT CR	IL0079073	ITASCA STP – 001	SALT CREEK	GL-09, GL-19	3.2	8.2	2.0	Yes
SALT CR	IL0036340	MWRDGC EGAN WRP – 001 [b]	SALT CREEK	GL-10, GL-09, GL-19	30	50	24.5	Yes
SALT CR	IL0028053	MWRDGC STICKNEY WRP CSOS – 150	ADDISON CREEK	GLA-02, GL-19	See Table 19			Yes

Watershed	NPDES Number	Facility and Outfall Number(s)	Receiving Water	Downstream Impairments	Design Average Flow (MGD)	Design Maximum Flow (MGD)	DMR Flows (average of 2013-2015 data)[a] MGD	Fecal Coliform Source [c]
SALT CR	IL0066427	PRAIRIE MATERIAL SALES, INC. – 001	STORM SEWER TRIB TO SALT CREEK	GL-10, GL-09, GL-19	No design flows, discharge is stormwater, average flow of 0.007488 MGD reported in permit		0.0006	No
SALT CR	IL0030813	ROSELLE STP – B01 [b]	SALT CREEK	GL-09, GL-19	2	4	1.5	Yes
SALT CR	IL0030953	SALT CREEK SANITARY DISTRICT – 001, 002	SALT CREEK	GL-09, GL-19	3.3	8.0	3.6	Yes
SALT CR	IL0002127	UNION PACIFIC RAILROAD-MELROSE – 001	MUD CREEK TRIB TO ADDISON CREEK	GLA-02, GL-19	No design flows, discharge is stormwater		1.5	No
SALT CR	IL0069124	VANEE FOODS COMPANY-BERKLEY – 001	UNNAMED TRIB TO ADDISON CREEK	GLA-02, GL-19	No design flows, discharge is stormwater and noncontact cooling water (average flow of 0.411 MGD reported in permit for non-contact cooling water)		0.2	No
SALT CR	IL0033618	VILLA PARK WET WEATHER STP CSOS – 001, 002, 003, 004 [b]	SALT CREEK	GL-09, GL-19	See Table 19			Yes
SALT CR	IL0020061	WOOD DALE NORTH STP - 001 [b]	SALT CREEK	GL-09, GL-19	1.97	3.93	1.8	Yes
SALT CR	IL0034274	WOOD DALE SOUTH STP – 001 [b]	SALT CREEK	GL-09, GL-19	1.13	2.33	0.5	Yes
SALT CR	IL0028398	DUPAGE COUNTY-NORDIC PARK STP – 001	SPRING BROOK CREEK	GL-09, GL-19	0.5	1.0	0.3	Yes
SALT CR	IL0052817	STONEWALL UTILITY COMPANY - STP	UNNAMED DITCH TRIB TO SALT CREEK	GL-09, GL-19	0.01	0.07	0.002	Yes

Watershed	NPDES Number	Facility and Outfall Number(s)	Receiving Water	Downstream Impairments	Design Average Flow (MGD)	Design Maximum Flow (MGD)	DMR Flows (average of 2013-2015 data)[a] MGD	Fecal Coliform Source [c]
SALT CR	ILM580008	LAGRANGE PARK CSOS – 001, 002, 003, 004, 005, 006	SALT CREEK	GL-09, GL-19	See Table 19			Yes
SALT CR	ILM580009	VILLAGE OF LAGRANGE CSOS – 001, 002, 003	SALT CREEK	GL-09, GL-19	See Table 19			Yes
SALT CR	IL0045039	VILLAGE OF WESTERN SPRINGS CSOS – 004	SALT CREEK & FLAGG CREEK	GL-09, GL-19	See Table 19			Yes
WEST BR DUPAGE R	IL0026352	CAROL STREAM STP – B01[b]	KLEIN CREEK (DES PLAINES BASIN)	GBK-05, GB-16, GB-11	6.5	13.0	4.7	Yes
WEST BR DUPAGE R	IL0027618	BARTLETT WWTP – B01[b]	W. BR. DUPAGE RIVER	GBK-09, GBK-05, GB-16 GB-11	3.679	5.151	2.3	Yes
WEST BR DUPAGE R	IL0034479	HANOVER PARK STP #1 – B01[b]	W. BR. DUPAGE RIVER	GBK-09, GBK-05, GB-16, GB-11	2.42	8.68	1.4	Yes
WEST BR DUPAGE R	IL0045241	BP AMOCO NAPERVILLE COMPLEX – 001	W. BR. DUPAGE RIVER	GBK-05, GB-16, GB-11	No design flows, discharge is stormwater and noncontact cooling water		1.5	No
WEST BR DUPAGE R	IL0028428	DUPAGE COUNTY-CASCADE STP – 001	W. BR. DUPAGE RIVER	GBK-09, GBK-05, GB-16, GB-11	0.00585	0.0234	0.003	Yes
WEST BR DUPAGE R	IL0063495	WEST CHICAGO ENVIRONMENTAL RESPONSE TRUST – 001	W. BR. DUPAGE RIVER	GBK-05, GB-16, GB-11	No design flows, discharge is stormwater, wash water, and excavation pit water (average design flow of 0.036 MGD reported in permit)		0.02	No
WEST BR DUPAGE R	IL0036137	MWRDGC HANOVER PARK WRP – 007	W. BR. DUPAGE RIVER	GBK-09, GBK-05, GB-16 GB-11	12	22	8.8	Yes
WEST BR DUPAGE R	IL0048721	ROSELLE-BOTTERMAN WWTF – 001	W. BR. DUPAGE RIVER	GBK-09, GBK-05, GB-16, GB-11	1.22	4.60	0.8	Yes

Watershed	NPDES Number	Facility and Outfall Number(s)	Receiving Water	Downstream Impairments	Design Average Flow (MGD)	Design Maximum Flow (MGD)	DMR Flows (average of 2013-2015 data)[a] MGD	Fecal Coliform Source [c]
WEST BR DUPAGE R	IL0023469	WEST CHICAGO STP – B01[b]	W. BR. DUPAGE RIVER	GBK-05, GB-16, GB-11	7.64	20.3	5.5	Yes
WEST BR DUPAGE R	IL0031739	WHEATON S.D. – 001[b]	SPRING CREEK	GBKA-01, GBK-05, GB-16, GB-11	8.9	19.1	6.0	Yes

a. DMR flows do not include combined sewer outfall flows.

b. NPDES-permitted facility with excess flow outfall – excess flows not included within design or DMR flows.

c. Facilities labeled 'NA' do not drain to a fecal coliform impairment.

Table 19. Combined sewer overflows 2013–2015

Watershed	NPDES Number	Facility and Outfall Number(s)	Receiving Water	Downstream Impairments	Maximum CSO Volume (million gallons per event)	Month of Maximum CSO Volume	Status of Long-Term Control Plan
EAST BR DUPAGE R	IL0022471	GLENBARD WW AUTH-LOMBARD – 002/003 Overflows	E. BR. DUPAGE RIVER	GBL-08, GBL-10, GB-16, GB-11	24.6 [a]	February 2014	Exempt
SALT CR	IL0027367	ADDISON SOUTH-A.J. LAROCCA STP – 004 Overflows	SALT CREEK	GL-09, GL-19	17.07	April 2013	Submitted 2009
SALT CR	IL0028053	MWRDGC STICKNEY WRP CSOS – 150 (Westchester Pump Station) Overflows	ADDISON CREEK	GLA-02, GL-19	389	October 2014	TARP (no LTCP required)
SALT CR	IL0033618	VILLA PARK WET WEATHER STP CSOS – 001/002/003/004 Overflows	SALT CREEK	GL-09, GL-19	38.5 [b]	Not applicable	Submitted 2016

Watershed	NPDES Number	Facility and Outfall Number(s)	Receiving Water	Downstream Impairments	Maximum CSO Volume (million gallons per event)	Month of Maximum CSO Volume	Status of Long-Term Control Plan
SALT CR	IL0045039	VILLAGE OF WESTERN SPRINGS CSOS – 001/002 Overflows	SALT CREEK	GL-09, GL-19	No reported CSO volumes	Not applicable	Submitted 2015, update due December 2019
SALT CR	ILM580008	LAGRANGE PARK CSOS – 001/002/003/ 004/005/006 Overflows	SALT CREEK	GL-09, GL-19	124	April 2013	TARP (no LTCP required)
SALT CR	ILM580009	VILLAGE OF LAGRANGE CSOS – 001/002/003 Overflows	SALT CREEK	GL-09, GL-19	No reported CSO volumes	Not applicable	TARP (no LTCP required)
SALT CR	ILM580032	BROOKFIELD CSOS – 001/002, 003/005/006/007 Overflows	SALT CREEK	GL-19	341	April 2013	TARP (no LTCP required)

a. Maximum CSO volume during February 2014 event based on 2013-2015 discharge report provided by facility.
b. Maximum CSO volume based on reported average annual discharge of 154 million gallons provided by facility. Four events are assumed each year (154 MG per year / 4 events = 38.5 MGs per event).

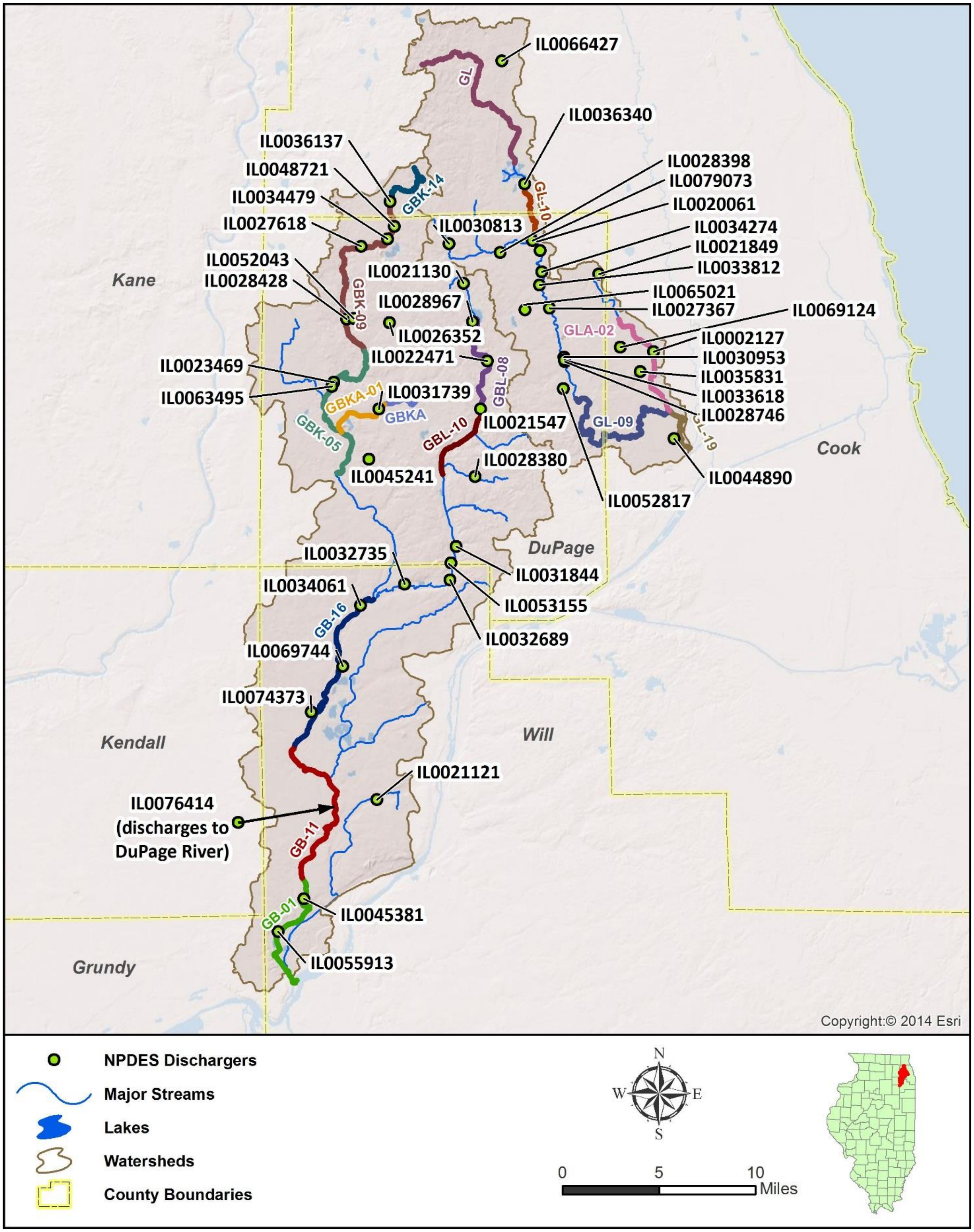

Figure 31. Existing NPDES dischargers in the DuPage River/Salt Creek watershed.

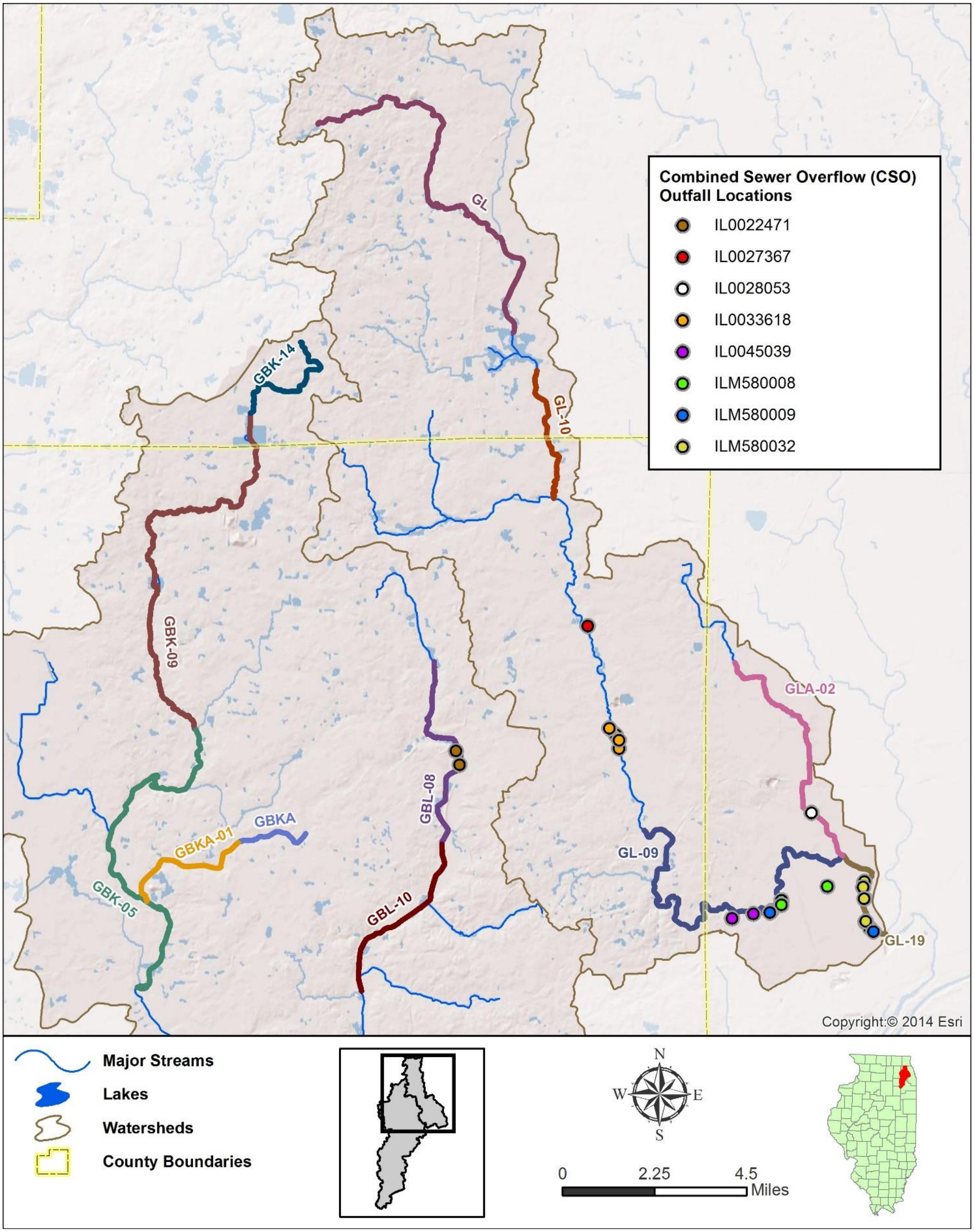

Figure 32. Location of CSO Outfalls for each facility in Table 19.

Facilities that discharge directly to fecal coliform-impaired segments addressed with this TMDL are required to comply with permit requirements as part of this TMDL. Violations of fecal coliform limits were identified at several of these WWTPs between 2013 and 2015 based on discharge monitoring reports (Table 20). There is also one combined sewer overflow (CSO) in the watershed discharging to a fecal coliform-impaired segment along the East Branch DuPage River (Glenbard Wastewater Authority-Lombard). Addressing this CSO is needed to meet fecal coliform water quality standards in the River.

The Glenbard Wastewater Authority-Lombard CSO also discharges into the East Branch DuPage River, which is impaired for dissolved oxygen and chloride. An existing TMDL addresses these impairments and is expected to bring the East Branch DuPage River into compliance with water quality standards prior to the East Branch DuPage River discharging in the mainstem DuPage River. As described in Section 6.0, both the dissolved oxygen TMDL for GB-16 and the chloride TMDL for GB-11 assume that the East Branch DuPage River is meeting standards, per the existing TMDLs.

Table 20. Permitted facilities, excluding CSO facilities, with fecal coliform violations reported between 2013 and 2015 in the DuPage River watershed

Subwatershed	IL Permit ID	Facility Name	Number of Fecal Coliform Violations (2013-2015)
DUPAGE R- MAIN STEM	IL0069744	BOLINGBROOK WRF#3	1
DUPAGE R- MAIN STEM	IL0034061	NAPERVILLE SPRINGBROOK WRC	2
DUPAGE R- MAIN STEM	IL0076414	JOLIET AUX SABLE WWTP	2
EAST BR DUPAGE R	IL0032735	BOLINGBROOK WRF #2	2
EAST BR DUPAGE R	IL0032689	BOLINGBROOK WRF#1	2
EAST BR DUPAGE R	IL0031844	DUPAGE COUNTY-WOODRIDGE – GREEN VALLEY	5
EAST BR DUPAGE R	IL0022471	GLENBARD WW AUTH- LOMBARD	1
SALT CR	IL0021849	BENSENVILLE STP	2
SALT CR	IL0079073	ITASCA STP	1
SALT CR	IL0030813	ROSELLE STP	1
SALT CR	IL0030953	SALT CREEK SANITARY DISTRICT	2
SALT CR	IL0052817	STONEWALL UTILITY COMPANY - STP	4 [a]
WEST BR DUPAGE R	IL0026352	CAROL STREAM STP	2
WEST BR DUPAGE R	IL0027618	BARTLETT WWTP	1
WEST BR DUPAGE R	IL0023469	WEST CHICAGO STP	4

a. This facility does not have a fecal coliform limit in its permit, exceedances are of the 400 cfu/100 mL water quality standard.

5.3.1 Municipal Separate Storm Sewer Systems

Stormwater, while not an actual source of pollutants itself, acts as an important delivery mechanism of multiple sources of each pollutant. The sources of pollutants in stormwater are many including decaying vegetation (leaves, grass clippings, etc.), pet and wildlife waste, soil, deposited particulates from the air, road salt, and oil and grease from vehicles. The most significant sources of pollutants include chloride from de-icing agent used for winter road maintenance (i.e., road salt) and fecal coliform conveyed in stormwater runoff from pet and wildlife waste. In urban areas, non-permitted cross connections between sanitary sewers and storm sewers can also occur. For example, accidental connections between sewer lines of private homes or businesses may occur during construction and go unnoticed. These discharges may also be considered point sources.

Under the NPDES program, municipalities serving populations over 100,000 people are considered Phase I MS4 communities. Municipalities serving populations under 100,000 people are considered Phase II communities. Within Illinois, Phase II communities are allowed to operate under the statewide General

Stormwater Permit (ILR40) which first requires dischargers to file a Notice of Intent, acknowledging that discharges shall not cause or contribute to a violation of water quality standards. To assure pollution is controlled to the maximum extent practical, regulated entities operating under the State General Permit (ILR40) are required to implement six control measures including:

- Public education and outreach on storm water impacts
- Public involvement and participation
- Illicit discharge detection and elimination
- Construction site storm water runoff control
- Post construction storm water management in new development and redevelopment
- Pollution prevention/good housekeeping for municipal operations

The entire project area is regulated under the State General Permit (ILR40). The Illinois Department of Transportation and Illinois Toll Way are regulated road authorities; counties are also regulated MS4s and are responsible for permitting within unincorporated portions of the county. A list of MS4s is provided in Appendix J.

MS4 sources of chloride are primarily related to de-icing agents being applied to sidewalks, parking lots, and roads. A chloride reduction study completed for the DRSCW found that the application of road salt for snow removal was the primary contributor to chloride water quality standard exceedances in the watershed (CDM 2007).

Potential sources of fecal coliform in MS4 runoff include domestic pet and wildlife waste. When pet waste is not disposed of properly, it can be picked up by runoff and washed into nearby waterbodies. Waste from pets can be a source of concern in watersheds with a higher density of developed area. Compared to rural areas, developed areas have higher densities of pets and a higher delivery of waste to surface waters due to connected impervious surfaces. Wildlife such as birds and raccoons can be another source of fecal coliform bacteria.

Low dissolved oxygen can be the result of biochemical oxygen demand (BOD) loads. BOD is the measure of oxygen demand from both biological and chemical processes. Primary sources of BOD from MS4s are organics such as grass clippings and leaves and nutrients from fertilizers. Nutrients can result in algae and macrophyte growth, which in turn increases organic matter in the stream and BOD from biological processes resulting in less available dissolved oxygen.

5.4 Nonpoint Sources

The term nonpoint source pollution is defined as any source of pollution that does not meet the legal definition of point sources. Nonpoint source pollution typically results from overland stormwater runoff that is diffuse in origin, as well as background conditions. It should be noted that stormwater collected and conveyed through a regulated MS4 is considered a controllable point source. Runoff from nonregulated areas, in this case limited to agricultural areas, is the main nonpoint source of pollutants to impaired streams. In addition, sediment oxygen demand in streams also contributes to low dissolved oxygen conditions. Septic systems can also be a source of nonpoint pollution if they are not maintained properly. A pilot study was completed in 2012 to develop a methodology to create an inventory of septic system (CDM Smith 2012) and is available on Illinois EPA's TMDL Reports website: https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Pages/reports.aspx.

Agricultural areas can have significant effects on water quality if proper best management practices are not in place, specifically contributing to high biochemical oxygen demand and nutrients that can affect the dissolved oxygen conditions in streams. Similar to MS4 permitted stormwater water (Section 5.3.2), nonpoint stormwater runoff acts as a delivery mechanism for several sources of pollutants. During wet-weather events (snowmelt and rainfall), pollutants including fecal coliform, chloride and nutrients from fertilizer application, and oxygen-demanding substances (e.g., decaying vegetation) are incorporated into stormwater runoff and can be delivered to downstream waterbodies. Fertilizers used for cropland typically are considered a potential source of nutrient enrichment in waterbodies which results in increased BOD and is linked to lower dissolved oxygen conditions.

Sediment oxygen demand is a result of the biological consumption of organic material at the sediment-water interface and is a component of BOD, however because it is a result of biochemical processes in the stream itself, it is considered a nonpoint source pollutant.

6.0 TMDL Approach and Methods

Table 21 summarizes the TMDL that are being completed based on water quality evaluation and updated 303(d) listings. The following listed impairments have been proposed for delisting as part of the draft 2016 303(d) list, and therefore no TMDLs are prepared:

- pH in the East Branch DuPage River, segments GBL-08 and GBL-10
- pH in the West Branch DuPage River, segment GBK-14
- Copper in Spring Brook, segment GBKA-01

The following impairments were determined to be not exceeding water quality standards based on the most recent data, and therefore no TMDLs are being prepared:

- Nickel in Salt Creek, segment GL-10
- pH in Salt Creek, segment GL-10
- Nickel in Addison Creek, segment GLA-02
- Chloride in Spring Brook, segment GBKA

And finally, Illinois EPA is not completing LRSs to address phosphorus or sediment in this watershed. This is primarily due to the presence of the DuPage River Salt Creek Work Group and the Lower DuPage River Watershed Coalition and their high level of activity addressing water quality and impairments in the watershed.

Table 21. Final list of TMDLs being prepared

Waterbody ID	Waterbody Name	Designated Use	TMDL Pollutant(s)
IL_GB-11	DuPage River	Aquatic Life	Chloride
		Primary Contact Recreation	Fecal Coliform
IL_GB-16	DuPage River	Aquatic Life	Dissolved Oxygen
		Primary Contact Recreation	Fecal Coliform
IL_GBK-05	West Branch DuPage River	Primary Contact Recreation	Fecal Coliform
IL_GBK-09	West Branch DuPage River	Primary Contact Recreation	Fecal Coliform
IL_GBK-14	West Branch DuPage River	Aquatic Life	Dissolved Oxygen
		Primary Contact Recreation	Fecal Coliform
IL_GBKA	Spring Brook	Aquatic Life	Dissolved Oxygen
		Primary Contact Recreation	Fecal Coliform
IL_GBKA-01	Spring Brook	Primary Contact Recreation	Fecal Coliform
IL_GBL-10	East Branch DuPage River	Primary Contact Recreation	Fecal Coliform
IL_GL-09	Salt Creek	Primary Contact Recreation	Fecal Coliform
IL_GL-10	Salt Creek	Primary Contact Recreation	Fecal Coliform
IL_GL-19	Salt Creek	Primary Contact Recreation	Fecal Coliform
IL_GLA-02	Addison Creek	Primary Contact Recreation	Fecal Coliform

The following sections discuss the methodology used for the development of TMDLs for the DuPage River/Salt Creek watershed. While a detailed watershed modeling approach can be advantageous, a simpler approach is often able to efficiently meet the requirements of a TMDL and yet still support a site-specific implementation plan. The final approach was determined in consultation with Illinois EPA based on the following factors:

- Fundamental requirements of a defensible and approvable TMDL
- Data availability
- Fund availability
- Public acceptance
- Complexity of waterbody

6.1 Modeling Approach for Fecal Coliform and Chloride

A waterbody's loading capacity represents the maximum rate of loading of a pollutant that can be assimilated without violating water quality standards (40 CFR 130.2(f)). In the case of fecal coliform, a TMDL is developed or both parts of the water quality standard (see Section 4.0) and both parts must be met. Establishing the relationship between in-stream water quality and source loading is an important component of TMDL development. It allows the determination of the relative contribution of sources to total pollutant loading and the evaluation of potential changes to water quality resulting from implementation of various management options.

A duration curve approach is used to evaluate the relationships between hydrology and water quality and calculate the loading capacity for fecal coliform and chloride. The primary benefit of duration curves in TMDL development is to provide insight regarding patterns associated with hydrology and water quality concerns. The duration curve approach is particularly applicable because water quality is often a function of stream flow. The use of duration curves in water quality assessment creates a framework that enables data to be characterized by flow conditions. The method provides a visual display of the relationship between stream flow and water quality.

Allowable pollutant loads can be determined through the use of load duration curves. Discussions of load duration curves are presented in *An Approach for Using Load Duration Curves in the Development of TMDLs* (U.S. EPA 2007a). This approach involves calculating the allowable loadings over the range of flow conditions expected to occur in the impaired stream by taking the following steps:

1. A flow duration curve for the stream is developed by generating a flow frequency table and plotting the data points to form a curve. The data reflect a range of natural occurrences from extremely high flows to extremely low flows.
2. The flow curve is translated into a load duration (or TMDL) curve by multiplying each flow value (in cubic feet per second) by the water quality standard for a contaminant (mg/L or count/100 mL), then multiplying by conversion factors to yield results in the proper unit (i.e., pounds per day or count/day). The resulting points are plotted to create a load duration curve.
3. Each water quality sample is converted to a load by multiplying the water quality sample concentration by the average daily flow on the day the sample was collected. Then, the individual loads are plotted as points on the TMDL graph and can be compared to the water quality standard, or load duration curve.
4. Points plotting above the curve represent deviations from the water quality standard/target and the daily allowable load. Those plotting below the curve represent compliance with standards and the daily allowable load. Further, it can be determined which locations contribute loads above or below the water quality standard.
5. The area beneath the TMDL curve is interpreted as the loading capacity of the stream. The difference between this area and the area representing the current loading conditions is the load that must be reduced to meet water quality standards.
6. The final step is to determine where reductions need to occur. Those exceedances at the right side of the graph occur during low flow conditions, and may be derived from sources such as illicit sewer connections. Exceedances on the left side of the graph occur during higher flow events, and may be derived from

sources such as runoff. Using the load duration curve approach helps to determine which implementation practices are most effective for reducing loads on the basis of flow regime.

The flow regimes are typically divided into 10 groups, which can be further categorized into the following five hydrologic zones (U.S. EPA 2007a):

- High flow zone: stream flows that plot in the 0 to 10-percentile range, related to flood flows
- Moist zone: flows in the 10 to 40-percentile range, related to wet weather conditions
- Mid-range zone: flows in the 40 to 60-percentile range, median stream flow conditions
- Dry zone: flows in the 60 to 90-percentile range, related to dry weather flows
- Low flow zone: flows in the 90 to 100-percentile range, related to drought conditions

The duration curve approach helps to identify the issues surrounding the impairment and to roughly differentiate among sources. Table 22 summarizes the general relationship between the five hydrologic zones and potentially contributing source areas (the table is not specific to any individual pollutant). For example, the table indicates that impacts from point sources are usually most pronounced during dry and low flow zones because there is less water in the stream to dilute their loads. In contrast, impacts from channel bank erosion is most pronounced during high flow zones because these are the periods during which stream velocities are high enough to cause erosion to occur.

Table 22. Relationship between duration curve zones and contributing sources

Contributing source area	Duration Curve Zone				
	High	Moist	Mid-range	Dry	Low
Point source				M	H
Riparian areas		H	H	M	
Stormwater: Impervious		H	H	H	
Combined sewer overflow	H	H	H		
Stormwater: Upland	H	H	M		
Field drainage: Natural condition	H	M			
Bank erosion	H	M			

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

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

6.2 Modeling Approach for Dissolved Oxygen

The QUAL2K model is used to support TMDL development for streams impaired due to dissolved oxygen. Historical data are used to model stream water quality for GB-16, new data were collected in 2016 for GBK-14 and GBKA to support model development.

QUAL2K simulates up to 15 water quality constituents in branching stream systems. A stream reach is divided into a number of computational elements, and for each computational element, a hydrologic balance in terms of stream flow (e.g., m^3/s), a heat balance in terms of temperature (e.g., degrees C), and a material balance in terms of concentration (e.g., mg/l) are written. Both advective and dispersive transport processes are considered in the material balance. Mass is gained or lost from the computational element by transport processes, wastewater discharges, and withdrawals. Mass can also be gained or lost by internal processes such as release of mass from benthic sources or biological transformations.

QUAL2K simulates changes in flow conditions along the stream by computing a series of steady-state water surface profiles. The calculated stream-flow rate, velocity, cross-sectional area, and water depth serve as a basis for determining the heat and mass fluxes into and out of each computational element due to flow. Mass balance determines the concentrations of conservative minerals, coliform bacteria, and nonconservative constituents at each computational element. In addition to material fluxes, major processes included in the mass balance are transformation of nutrients, algal production, benthic and carbonaceous demand, atmospheric reaeration, and the effect of these processes on the dissolved oxygen balance. QUAL2K uses chlorophyll a as the indicator of planktonic algae biomass. The nitrogen cycle is divided into four compartments: organic nitrogen, ammonia nitrogen, nitrite nitrogen, and nitrate nitrogen. In a similar manner, the phosphorus cycle is modeled by using two compartments. The primary internal sink of dissolved oxygen in the model is biochemical oxygen demand (BOD). The major sources of dissolved oxygen are algal photosynthesis and atmospheric reaeration.

The model is applicable to dendritic streams that are well mixed. It assumes that the major transport mechanisms, advection and dispersion, are significant only along the main direction of flow (the longitudinal axis of the stream or canal). It allows for multiple waste discharges, withdrawals, tributary flows, and incremental inflow and outflow.

Hydraulically, QUAL2K is limited to the simulation of time periods during which both the stream flow in river basins and input waste loads are essentially constant. QUAL2K can operate as either a steady-state or a quasidynamic model, making it a very helpful water quality planning tool. When operated as a steady-state model, it can be used to study the impact of waste loads (magnitude, quality, and location) on instream water quality. By operating the model dynamically, the user can study the effects of diurnal variations in meteorological data on water quality (primarily dissolved oxygen and temperature) and also can study diurnal dissolved oxygen variations due to algal growth and respiration. However, the effects of dynamic forcing functions, such as headwater flows or point loads, cannot be modeled in QUAL2K.

QUAL2K is an appropriate choice for certain types of dissolved oxygen TMDLs that can be implemented at a moderate level of effort. Use of the QUAL2K models in TMDLs is most appropriate when (1) full vertical mixing can be assumed, and (2) water quality excursions are associated with identifiable critical flow conditions. Because the model does not simulate dynamically varying flows, its use is limited to evaluating responses to one or more specific flow conditions including the critical flow.

The dissolved oxygen deficit (DOD) is used to express the loading capacity and allocations for streams without point sources (i.e., Spring Brook GBKA and West Branch DuPage River GBK-14). DOD is a measure of the impacts of all DO-depleting sources and has units of mg-DO/L. The loading capacity for DO is the difference between DO_{sat} (a function of temperature) and the water quality standard, expressed as DOD. A high DOD indicates the presence of significant causes of DO depletion. DOD may also be negative, if DO concentration exceeds DO_{sat} (as often happens during periods of active photosynthesis in dense algal mats), which indicates supersaturated conditions. The ideal situation is for DOD to be zero or close to zero. This would indicate the smallest deviation from the natural equilibrium level of DO_{sat}. Because DO_{sat} varies as a function of temperature, DOD also varies with temperature (Figure 33).

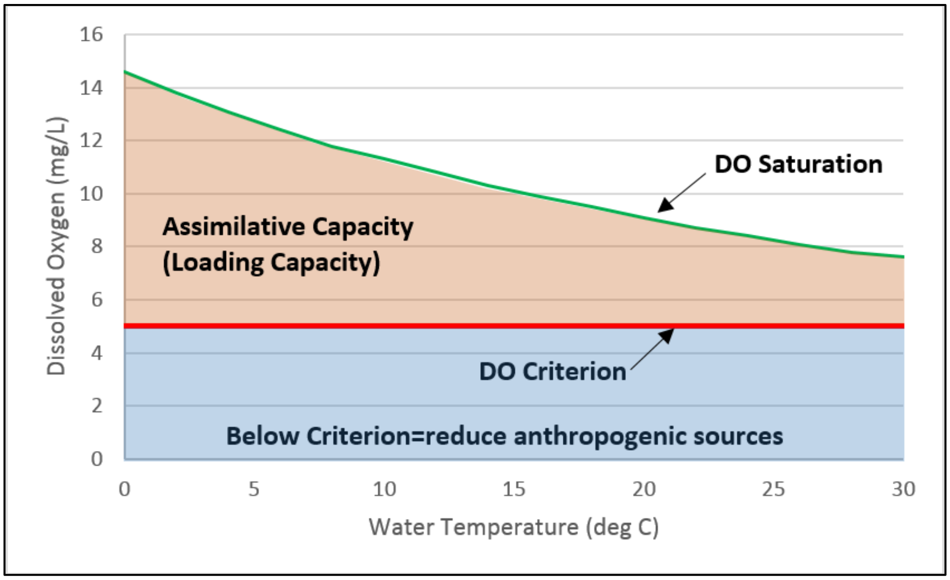

Figure 33. Assimilative capacity as a function of DO saturation.

The DOD load that meets the DO standard can be calculated for a steady-state condition using QUAL2K. Note that QUAL2K cannot be used directly to identify precise DOD impacts of oxygen-demanding sources such as CBOD, NBOD, or algal respiration, but impacts of SOD and headwater DO which dominate the system can be estimated from model output. Like DO, DOD can be converted to a load by multiplying by flow:

$$DOD\left[\frac{kg}{d}\right] = (DO_{sat} - DO)\ [mg/L]\ x\ Q\ [cfs]\ x\ 2.447[conversion\ factor]$$

The conversion factor is the result of the following unit conversions: seconds to days, cubic feet to liters, and milligrams to kilograms.

6.3 Allocations

A TMDL is the total amount of a pollutant that can be assimilated by the receiving water while still achieving water quality standards. TMDLs are composed of the sum of individual wasteload allocations (WLAs) for regulated sources and load allocations (LAs) for unregulated sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. A reserve capacity (RC) can be included to account for future growth. Conceptually, this is defined by the equation:

TMDL = ∑WLAs + ∑LAs + MOS + RC

Section 7.0 presents the allowable loads and associated allocations for each of the impaired waterbodies in the watershed.

Existing fecal coliform loads are based on the 90th percentile observed loads within each flow regime during the standard window of May–October. Observed loads are calculated by multiplying the observed water quality sample concentration by the average daily flow on the day the sample was collected. The fecal coliform TMDLs are based on compliance with both the single sample maximum standard (400 cfu/100 mL) and the geomean standard (200 cfu/100 mL). For the single sample maximum standard, load reductions are based on the existing load and the median allowable load in each flow regime. It was not possible to calculate reductions relative to the geomean standard due to limited monitoring data.

For the chloride TMDL on GB-11, existing loads are based on the maximum observed load within each flow regime. Load reductions are calculated using the existing load and the median allowable load in each flow regime. Existing loads and reductions needed to meet the dissolved oxygen standard in GB-16 are based on Qual2K modeling. Impairments for chloride and dissolved oxygen in the Lower DuPage River watershed (GB-11 and GB-16, respectively) include a boundary condition set at the confluence of the East Branch and West Branch DuPage Rivers. The boundary condition assumes compliance with both chloride and dissolved oxygen standards and is used to represent the outcome of TMDLs approved in 2004 for these rivers.

6.3.1 Wasteload Allocation

Numerous known NPDES facilities are within the watershed with the potential to discharge pollutants. Wasteload allocations (WLAs) are assigned to each permitted point source that contributes to an impairment. For NPDES facilities discharging to fecal coliform impairments, Illinois EPA assumes that facilities with a fecal coliform limit are considered a source of fecal coliform and therefore these facilities are provided a WLA (Table 18). Stonewall Utility Company (IL0052817) does not have a current permit limit but was given a WLA based on a fecal coliform monitoring requirement. A full list of fecal coliform WLAs is provided in Appendix F. Illinois EPA assumes that WWTPs are contributing to chloride and dissolved oxygen impairments and are therefore provided WLAs.

Fecal coliform WLAs are based on NPDES permit information and on meeting both the geometric mean fecal coliform water quality standard and the instantaneous water quality standard. Facility design flows are used to calculate a daily load and serve as the WLA for NPDES permitted facilities. Permitted maximum design flows are used for WLAs under high flow conditions and permitted average design flows are used for moist to low flows. The WLA for Stonewall Utility Company (IL0052817) applies at the end of the disinfection exemption. Facilities with disinfection exemptions may be required to provide Illinois EPA with updated information to demonstrate compliance with these requirements, and facilities directly discharging into a fecal-impaired segment may have their year-round disinfection exemption re-evaluated through future NPDES permitting actions.

There are eight facilities with permitted combined sewer overflows (CSOs) in the watershed (Table 19). WLAs for CSOs are provided during high flow conditions only. The WLAs for non-MWRD's CSOs were calculated to be equal to the maximum flow associated with a CSO event during the time period 2013–2015, as reported in Illinois EPA's discharge monitoring reports (DMRs) or as provided by the permitted entity, multiplied by the water quality standard for fecal coliform. When no flow information was available, a WLA equal to zero was assigned. A categorical WLA was provided to the CSOs that are a part of MWRD's Tunnel and Reservoir Plan (TARP) System, which conveys combined sewer flow through tunnels to storage reservoirs. After an event is over, the water in the reservoirs is pumped to a water reclamation plant, treated, and discharged to surface waters. MWRD's WLA for each impairment is a sum of the maximum estimated volume associated with a CSO event at each of the relevant TARP structures, based on 2013–2015 data provided in MWRD's quarterly reports to Illinois EPA. CSO WLAs apply when the permitted facility is in compliance with their approved Long-Term Control Plans (LTCPs), which will stipulate no more than four overflows per year and that discharge will not cause or contribute to water quality exceedances.

Several NPDES facilities in the watershed also have permitted excess flows. The excess flows at these facilities have primary treatment and disinfection with a fecal coliform limit and occur when the primary treatment facility reaches the maximum flow capacity. Discharges during wet weather events need to be in compliance with all applicable permit requirements. Due to the increased assimilative capacity of the receiving waters during extreme wet weather, daily load allocations are not appropriate. Fecal coliform concentration limits must be met for all flows at all times, including during extreme wet weather events.

Chloride WLAs are based on NPDES permit information and meeting the 500 mg/L general use water quality standard in the effluent. Facility design flows are used to calculate a daily load which serve as the WLA. Permitted maximum design flows are used for WLAs under high flow conditions and permitted average design flows are used for moist to low flows. NPDES permitted facilities that discharge downstream of the boundary condition and are provided a chloride WLA include: Bolingbrook WRF #3 (IL0069744), Joliet Aux Sable WWTP

(IL0076414), Naperville Spring-Brook WRC (IL0034061) and Plainfield North STP (IL0074373). A full list of chloride WLAs is provided in Appendix F.

WLAs for facilities discharging directly to segment GB-16 that is impaired for low dissolved oxygen include Naperville WWTP (IL0034061), Bolingbrook WWTP (IL0069744), and Plainfield WWTP (IL0074373). A boundary condition is set at the upstream boundary of GB-16, as described in Appendix F. WLAs are assigned based on permitted flow conditions and concentrations needed to meet dissolved oxygen conditions in the river, also described in Appendix F.

There are numerous regulated MS4s in the watershed (Appendix J). WLAs for NPDES-permitted MS4s, which do not have numeric effluent limitations, are expressed as a portion of the loading capacity based on area within the watershed. For the fecal coliform TMDLs, a categorical WLA was established for MS4s based on the proportion of the non-agricultural land covers in the impairment watershed (Table 23). For the GB-11 chloride impairment, a categorical WLA was established for the GB-11 watershed area downstream of the boundary condition. A similar categorical WLA was established for all MS4s with the exception of the Illinois Department of Transportation (ILDOT). ILDOT provided road right-of-way widths that were used to calculate an individual WLA based on the proportion of ILDOT road area. The proportion of ILDOT road area in the GB-11 watershed downstream of the boundary condition is 2% and the proportion of non-agricultural land covers is 75%.

Table 23. Land cover distribution within impaired watersheds

Waterbody ID	Waterbody Name	Land Cover Summary (2011 NLCD)			
		Developed	Agriculture	Wetlands/ Water	Barren/Forest/ Shrub/ Herbaceous
IL_GB-11 (Fecal coliform) [a]	DuPage River	78%	11%	3%	8%
IL_GB-11 (Chloride) [b]	DuPage River	67%	23%	3%	5%
IL_GB-16	DuPage River	79%	9%	3%	9%
IL_GBK-05	West Branch DuPage	79%	8%	3%	10%
IL_GBK-09	West Branch DuPage	84%	3%	3%	10%
IL_GBK-14	West Branch DuPage	99%	0%	1%	0%
IL_GBKA	Spring Brook	99%	0%	<1%	<1%
IL_GBKA-01	Spring Brook	82%	4%	5%	9%
IL_GBL-08	East Branch DuPage	94%	0%	1%	5%
IL_GBL-10	East Branch DuPage	88%	2%	2%	8%
IL_GL-09	Salt Creek	89%	3%	4%	4%
IL_GL-10	Salt Creek	87%	2%	4%	7%
IL_GL-19	Salt Creek	89%	3%	4%	4%
IL_GLA-02	Addison Creek	98%	0%	1%	1%

a. Includes all watershed area draining to this segment, including the East Branch and West Branch DuPage Rivers.
b. Includes only that portion of the watershed downstream of the confluence of the East Branch and West Branch DuPage Rivers. The remaining upstream portion of the watershed is addressed by a boundary condition for chloride.

6.3.2 Margin of Safety

The CWA requires that a TMDL include a margin of safety (MOS) to account for uncertainties in the relationship between pollutants loads and receiving water quality. U.S. EPA 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). A 10% explicit MOS has been applied as part of this TMDL for fecal coliform and chloride. A moderate MOS was specified because the use of the load duration curves is expected to provide accurate information on the loading capacity of the stream, but this estimate of the loading capacity may be subject to potential error associated with the method used to estimate flows within the watershed. The MOS for fecal coliform is also implicit because the load duration analysis does not address die-off of pathogens. A MOS was also added to the dissolved oxygen TMDLs by adjusting the standard to be 10% higher. For example, the minimum allowable dissolved oxygen concentration is 4.0 mg/l in August for GB-16; the MOS was incorporated by setting the minimum dissolved oxygen target to 4.4 mg/L for August.

6.3.3 Reserve Capacity

Reserve capacity (RC) is provided to those watersheds that are expected to further develop. No reserve capacity is set aside at this time. For fecal coliform, any new or expanded discharges will be required to comply with permit limits. As long as the facility is meeting the single sample maximum and geomean standards, any new flow and associated load will be in compliance with the TMDL.

No specific reserve capacity is provided for chloride, although chloride is expected to increase as development takes place in the watershed. The current load allocation that accounts for loading from non-MS4 areas is assigned the same chloride loading rate per acre as the current MS4 areas. As non-MS4 areas are developed, the LA should transfer to WLA.

6.3.4 Load Allocation

Load allocations represent the portion of the allowable load that is reserved for nonpoint sources and natural background conditions. The load allocations are based on subtracting the allocations for WLAs and MOS from allowable loads.

6.4 Critical Conditions and Seasonality

The CWA and USEPA’s regulations require that TMDLs include a component to address seasonal variations and critical conditions for stream flow, loading, and water quality parameters. Critical conditions are the period when the greatest reductions in loading are required. The loading capacity is set to achieve desired water quality standards which apply during the entire year. Use of load duration curves, however, analyzes in-stream concentrations on a daily basis over the entire range of observable flows. Therefore, the critical condition for load duration TMDLs is established by hydrologic category, defined as the greatest reduction needed to meet WQS among all hydrologic categories. Dissolved oxygen impairments are modeled during critical conditions, and therefore the loading capacity and targets derived from that modeling directly apply to critical conditions.

7.0 Total Maximum Daily Loads

TMDLs are provided for those impairments included in Table 21. The section is organized by impaired stream.

7.1 DuPage River (IL_GB-11)

7.1.1 Fecal Coliform TMDL

A fecal coliform bacteria TMDL has been developed for the DuPage River segment GB-11. Figure 34 presents the fecal coliform load duration curve and Table 24 and Table 25 summarize the TMDL and required reductions for both the single sample maximum standard and the geomean standard, respectively. Pollutant reductions are needed for all flow conditions, except under dry flows. Table 26 summarizes the individual wasteload allocations.

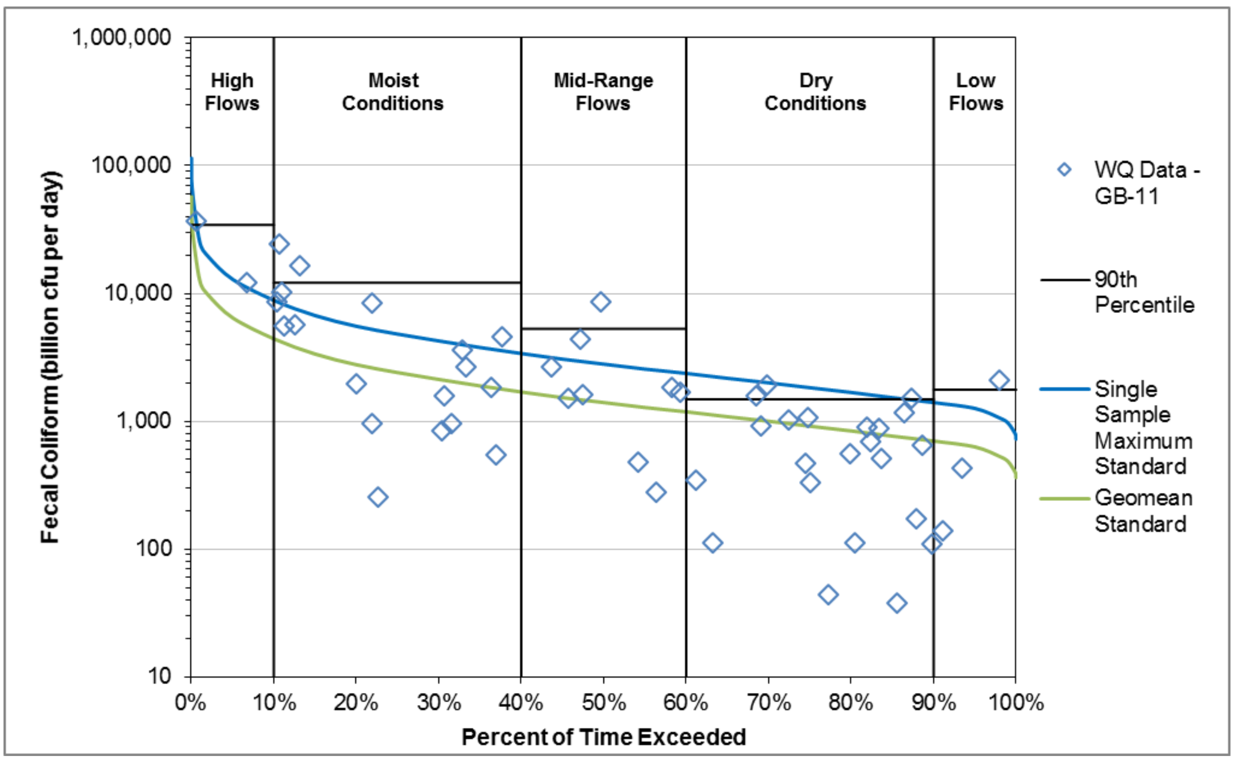

Figure 34. Fecal coliform load duration curve, DuPage River at GB-11.

Table 24. Fecal coliform TMDL summary (single sample maximum standard; DuPage River at GB-11)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [c]	372	-	-	-	-
	NPDES-permitted facilities	4,825	2,134	2,134	b	b
	MS4 [d]	5,641	1,931	339	b	b
Load Allocation		769	263	46	b	b
MOS		1,290	481	280	183	126
Loading Capacity		**12,897**	**4,809**	**2,799**	**1,830**	**1,260**
Existing Load		34,398	12,109	5,271	1,481	1,764
Load Reduction [a]		63%	60%	47%	0%	29%

a. TMDL reduction is based on the observed 90th percentile load in each flow regime.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.
c. CSO events are assumed to occur no more than 4 times per year.
d. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 25. Fecal coliform TMDL summary (geomean standard; DuPage River at GB-11)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [c]	186	-	-	-	-
	NPDES-permitted facilities	2,415	1,065	1,065	b	b
	MS4 [d]	2,819	967	172	b	b
Load Allocation		384	132	23	b	b
MOS		645	240	140	92	63
Loading Capacity		**6,449**	**2,404**	**1,400**	**915**	**630**
Existing Load		34,398	12,109	5,271	1,481	1,764
Load Reduction [a]		Not calculated				

a. Insufficient data to calculate reduction based on the geomean standard.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.
c. CSO events are assumed to occur no more than 4 times per year.
d. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 26. Individual NPDES fecal coliform WLAs, DuPage River at GB-11

Permit ID	Facility Name	Design Average Flow (MGD)	Design Maximum Flow (MGD)	Fecal Coliform WLA (billion cfu per day)	
				High Flows – Design Maximum Flow (single sample maximum/geomean standard)	Moist Conditions to Low Flows – Design Average Flow (single sample maximum/geomean standard)
IL0021130	BLOOMINGDALE-REEVES WRF – B01[a]	3.45	8.625	131 / 65	52 / 26
IL0021547	GLENBARD WW AUTH-GLENBARD – 001	16.02	47	712 / 356	243 / 121
IL0022471	GLENBARD WW AUTH-LOMBARD – 001	0.8[b]		12 / 6	12 / 6
IL0022471	GLENBARD WW AUTH-LOMBARD – 002/003 (CSOs)[c]	24.6 (maximum CSO volume, February 2014)[d]		372 / 186	--
IL0023469	WEST CHICAGO STP – B01[a]	7.64	20.3	307 / 154	116 / 58
IL0026352	CAROL STREAM STP – B01[a]	6.5	13.0	197 / 98	98 / 49
IL0027618	BARTLETT WWTP – B01[a]	3.679	5.151	78 / 39	56 / 28
IL0028380	DOWNERS GROVE SD WTC – B01[a]	11	22.0	333 / 167	167 / 83
IL0028428	DUPAGE COUNTY-CASCADE STP – 001	0.00585	0.0234	0.4 / 0.2	0.1 / 0.05
IL0028967	GLENDALE HEIGHTS STP – B01[a]	5.26	10.52	159 / 80	80 / 40
IL0031739	WHEATON S.D. – 001[a]	8.9	19.1	289 /145	135 / 67
IL0031844	DUPAGE COUNTY-WOODRIDGE STP – 001[a]	12	28.6	433 / 217	182 / 91
IL0032689	BOLINGBROOK STP #1 – B01[a]	2.04	4.51	68 / 34	31 / 15
IL0032735	BOLINGBROOK WRF #2 – 001	3	7.5	114 / 57	45 / 23
IL0034061	NAPERVILLE SPRING-BROOK WRC – 001	30 (future conditions)	63 (future conditions)	954 / 477	454 / 227
IL0034479	HANOVER PARK STP #1 – B01[a]	2.42	8.68	131 / 66	37 / 18
IL0036137	MWRDGC HANOVER PARK WRP – 007	12	22	333 / 167	182 / 91
IL0048721	ROSELLE-BOTTERMAN WWTF – 001	1.22	4.60	70 / 35	18 / 9
IL0069744	BOLINGBROOK WRF #3 – 001	4.2 (future conditions)	10.5 (future conditions)	159 / 79	64 / 32
IL0074373	PLAINFIELD NORTH STP – 001	7.5	15.0	227 / 114	114 / 57
IL0076414	JOLIET AUX SABLE WWTP – 001	3.2	7.8	118 / 59	48 / 24
Total (excluding CSO allocations)				**4,825 / 2,415**	**2,134 / 1,065**

a. NPDES-permitted facility with excess flow outfall – excess flows not included in WLAs.

b. 2013-2015 average DMR flows.

c. CSOs are only allowed to discharge 4 times per year at this level.

d. Maximum CSO volumes from 2013-2015 DMRs.

7.1.2 Chloride TMDL

A chloride TMDL has been developed for the DuPage River segment GB-11. Figure 35 presents the chloride load duration curve and Table 27 summarizes the TMDL and required reductions. Table 28 provides a summary of individual WLAs. Pollutant reductions are needed for mid-range and dry flows.

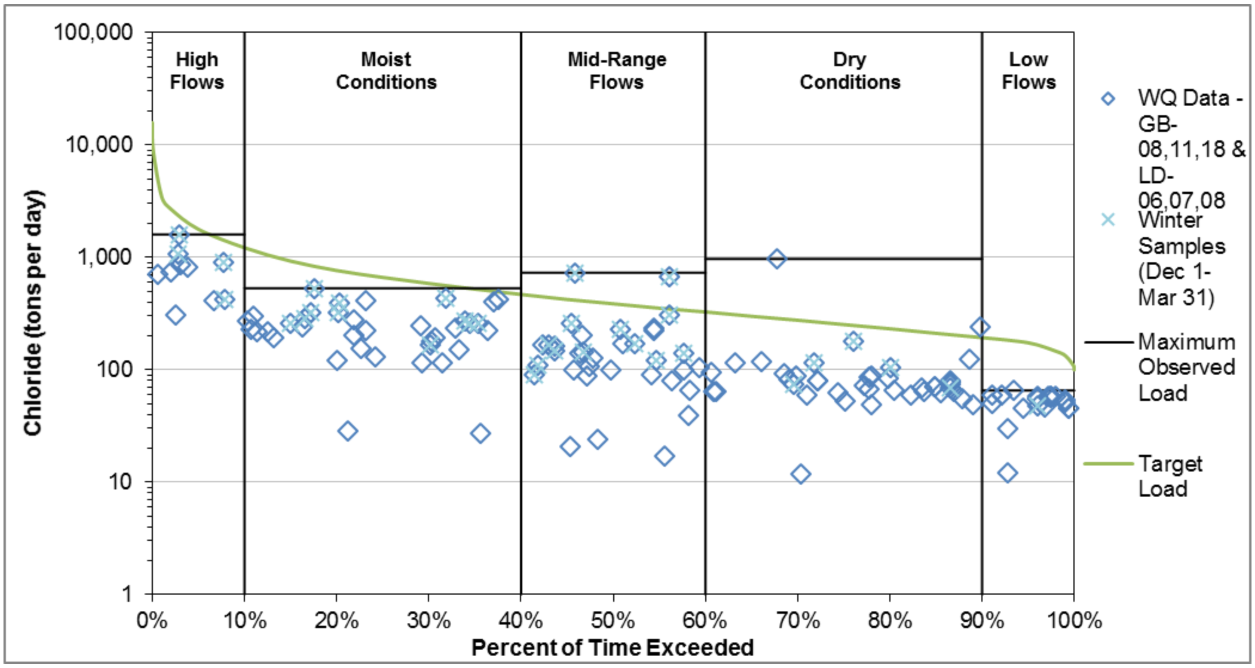

Figure 35. Chloride load duration curve, DuPage River at GB-11.

Table 27. Chloride TMDL summary, DuPage River at GB-11

TMDL Parameter		Flow Zones				
		High Flows	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
		Chloride Load (tons/day)				
Boundary Condition: Upstream Approved TMDLs in East and West Branch DuPage Rivers		1,106	412	240	157	108
Wasteload Allocation	NPDES-permitted facilities	200	95	95	b	b
	ILDOT Roads	6	2	0.2	b	b
	Non-ILDOT MS4s [c]	220	67	9	b	b
Load Allocation		67	21	3	b	b
MOS		178	66	39	25	17
Loading Capacity		**1,777**	**663**	**386**	**252**	**174**
Existing Load		1,592	532	727	967	65
Load Reduction [a]		0%	0%	47%	74%	0%

a. TMDL reduction is based on the observed maximum load in each flow regime.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (500 mg/L). The allowable concentration is based on the water quality standard.
c. The Non-ILDOT MS4 WLA is categorical, see section 6.3.1 for description.

Table 28. Individual NPDES chloride WLAs, DuPage River at GB-11

Permit ID	Facility Name	Design Average Flow (MGD)	Design Maximum Flow (MGD)	Chloride WLA (tons/day)	
				High Flows – Design Maximum Flow	Moist Conditions to Low Flows – Design Average Flow
IL0034061	NAPERVILLE SPRING-BROOK WRC – 001	30 (future conditions)	63 (future conditions)	131	63
IL0069744	BOLINGBROOK WRF #3 – 001	4.2 (future conditions)	10.5 (future conditions)	22	9
IL0074373	PLAINFIELD NORTH STP – 001	7.5	15.0	31	16
IL0076414	JOLIET AUX SABLE WWTP – 001	3.2	7.8	16	7
			Total	**200**	**95**

7.2 DuPage River (IL_GB-16)

7.2.1 Fecal Coliform TMDL

A fecal coliform bacteria TMDL has been developed for the DuPage River segment GB-16. Figure 36 presents the fecal coliform load duration curve and Table 29 and Table 30 summarize the TMDL and required reductions for both the single sample maximum standard and the geomean standard, respectively. Pollutant reductions are needed under high and moist flow conditions. Table 31 summarizes the individual wasteload allocations.

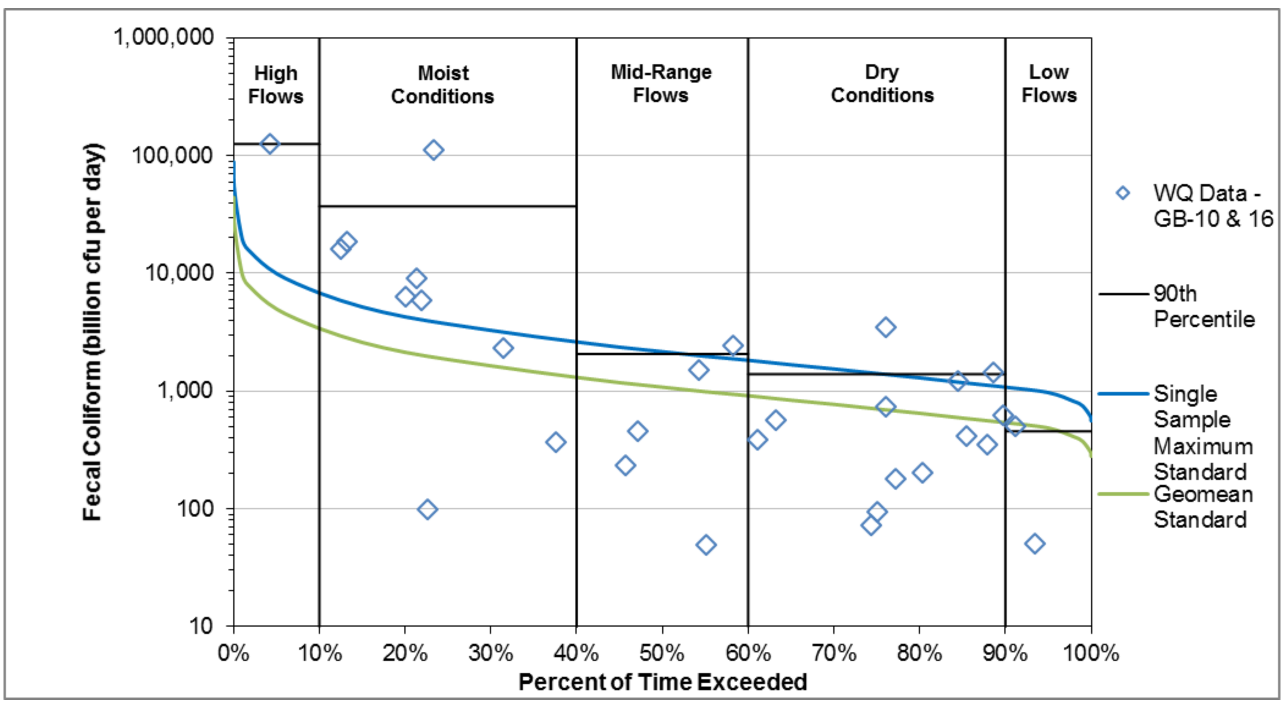

Figure 36. Fecal coliform load duration curve, DuPage River at GB-16.

Table 29. Fecal coliform TMDL summary (single sample maximum standard; DuPage River at GB-16)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [c]	372	-	-	-	-
	NPDES-permitted facilities	4,707	2,086	b	b	b
	MS4 [d]	3,547	1,148	b	b	b
Load Allocation		351	113	b	b	b
MOS		998	372	217	142	97
Loading Capacity		**9,975**	**3,719**	**2,165**	**1,415**	**974**
Existing Load		125,380	37,179	2,069	1,399	456
Load Reduction [a]		92%	90%	0%	0%	0%

a. TMDL reduction is based on the observed 90th percentile load in each flow regime.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards..
c. CSO events are assumed to occur no more than 4 times per year.
d. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 30. Fecal coliform TMDL summary (geomean standard; DuPage River at GB-16)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [c]	186	-	-	-	-
	NPDES-permitted facilities	2,356	1,041	b	b	b
	MS4 [d]	1,771	576	b	b	b
Load Allocation		175	57	b	b	b
MOS		499	186	108	71	49
Loading Capacity		**4,987**	**1,860**	**1,083**	**708**	**487**
Existing Load		125,380	37,179	2,069	1,399	456
Load Reduction [a]		Not calculated				

a. Insufficient data to calculate reduction based on the geomean standard.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards..
c. CSO events are assumed to occur no more than 4 times per year.
d. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 31. Individual NPDES fecal coliform WLAs, DuPage River at GB-16

Permit ID	Facility Name	Design Average Flow (MGD)	Design Maximum Flow (MGD)	Fecal Coliform WLA (billion cfu per day)	
				High Flows – Design Maximum Flow (single sample maximum/geomean standard)	Moist Conditions to Low Flows – Design Average Flow (single sample maximum/geomean standard)
IL0021130	BLOOMINGDALE-REEVES WRF – B01[a]	3.45	8.625	131 / 65	52 / 26
IL0021547	GLENBARD WW AUTH-GLENBARD – 001	16.02	47	712 / 356	243 / 121
IL0022471	GLENBARD WW AUTH-LOMBARD – 001	0.8[b]		12 / 6	12 / 6
IL0022471	GLENBARD WW AUTH-LOMBARD – 002/003 (CSOs)[c]	24.6 (maximum CSO volume, February 2014)[d]		372 / 186	--
IL0023469	WEST CHICAGO STP – B01[a]	7.64	20.3	307 / 154	116 / 58
IL0026352	CAROL STREAM STP – B01[a]	6.5	13.0	197 / 98	98 / 49
IL0027618	BARTLETT WWTP – B01[a]	3.679	5.151	78 / 39	56 / 28
IL0028380	DOWNERS GROVE SD WTC – B01[a]	11	22.0	333 / 167	167 / 83
IL0028428	DUPAGE COUNTY-CASCADE STP – 001	0.00585	0.0234	0.4 / 0.2	0.1 / 0.05
IL0028967	GLENDALE HEIGHTS STP – B01[a]	5.26	10.52	159 / 80	80 / 40
IL0031739	WHEATON S.D. – 001[a]	8.9	19.1	289 /145	135 / 67
IL0031844	DUPAGE COUNTY-WOODRIDGE STP – 001[a]	12	28.6	433 / 217	182 / 91
IL0032689	BOLINGBROOK STP #1 – B01[a]	2.04	4.51	68 / 34	31 / 15
IL0032735	BOLINGBROOK WRF #2 – 001	3	7.5	114 / 57	45 / 23
IL0034061	NAPERVILLE SPRING-BROOK WRC – 001	30 (future conditions)	63 (future conditions)	954 / 477	454 / 227
IL0034479	HANOVER PARK STP #1 – B01[a]	2.42	8.68	131 / 66	37 / 18
IL0036137	MWRDGC HANOVER PARK WRP – 007	12	22	333 / 167	182 / 91
IL0048721	ROSELLE-BOTTERMAN WWTF – 001	1.22	4.60	70 / 35	18 / 9
IL0069744	BOLINGBROOK WRF #3 – 001	4.2 (future conditions)	10.5 (future conditions)	159 / 79	64 / 32
IL0074373	PLAINFIELD NORTH STP – 001	7.5	15.0	227 / 114	114 / 57
Total (excluding CSO allocations)				**4,707 / 2,356**	**2,086 / 1,041**

a. NPDES-permitted facility with excess flow outfall – excess flows not included in WLAs.

b. 2013-2015 average DMR flows.

c. CSOs are only allowed to discharge 4 times per year at this level.

d. Maximum CSO volumes from 2013-2015 DMRs.

7.2.2 Dissolved Oxygen TMDL

$CBOD_5$, total phosphorus, and ammonia TMDLs were developed to address low dissolved oxygen in GB-16 (Table 34). A calibrated QUAL2K model was developed to simulate critical summer conditions and derive the TMDLs (see Appendix E). The calibrated model simulated conditions on 8/1/2006 and a series of scenarios were then evaluated (Table 32 and Figure 37).

Table 32. Model scenarios

Scenario	Scenario Description
1	Critical conditions: • Headwater flow decreased to 1.699 cms (60 cfs) • Headwater DO decreased to 6 mg/L • Point source flows and water quality changed to permit limits (see Table 33)
2	Scenario 1 with the following modifications to meet water quality standards with margin of safety: • SOD rate reduced to 2.04 g/m^2/d • Point source minimum DO increased to 6.5 mg/L • Bolingbrook and Plainfield WWTPs $CBOD_5$ decreased to 10 mg/L • Headwater TP decreased to 1 mg/L • *Naperville WWTP* $CBOD_5$ *decreased to 7.5 mg/L* • *SOD coverage decreased by half to 7.5%*
3	Scenario 1 with the following modifications to meet water quality standards with margin of safety: • SOD rate to 2.04 g/m^2/d • Point Source DO minimum increased to 6.5 mg/L • Bolingbrook and Plainfield WWTPs $CBOD_5$ decreased to 10 mg/L • Headwater TP decreased to 1 mg/L • *Naperville WWTP $CBOD_5$ unchanged* • *SOD coverage decreased to 5.0%*

Table 33. NPDES point source permit monthly average concentration limits

Parameter	Naperville WWTP (IL0034061)	Bolingbrook WWTP (IL0069744)	Plainfield WWTP (IL0074373)
Design average flow (MGD)	30.0	4.2	7.5
Suspended solids (mg/L)	12	25	25
$CBOD_5$ (mg/L)	10	20	20
Ammonia (mg/L)	1.4	1.5	1.5
Total Phosphorus (mg/L)	1	1	1
DO (mg/L)	6.0	6.0	6.0

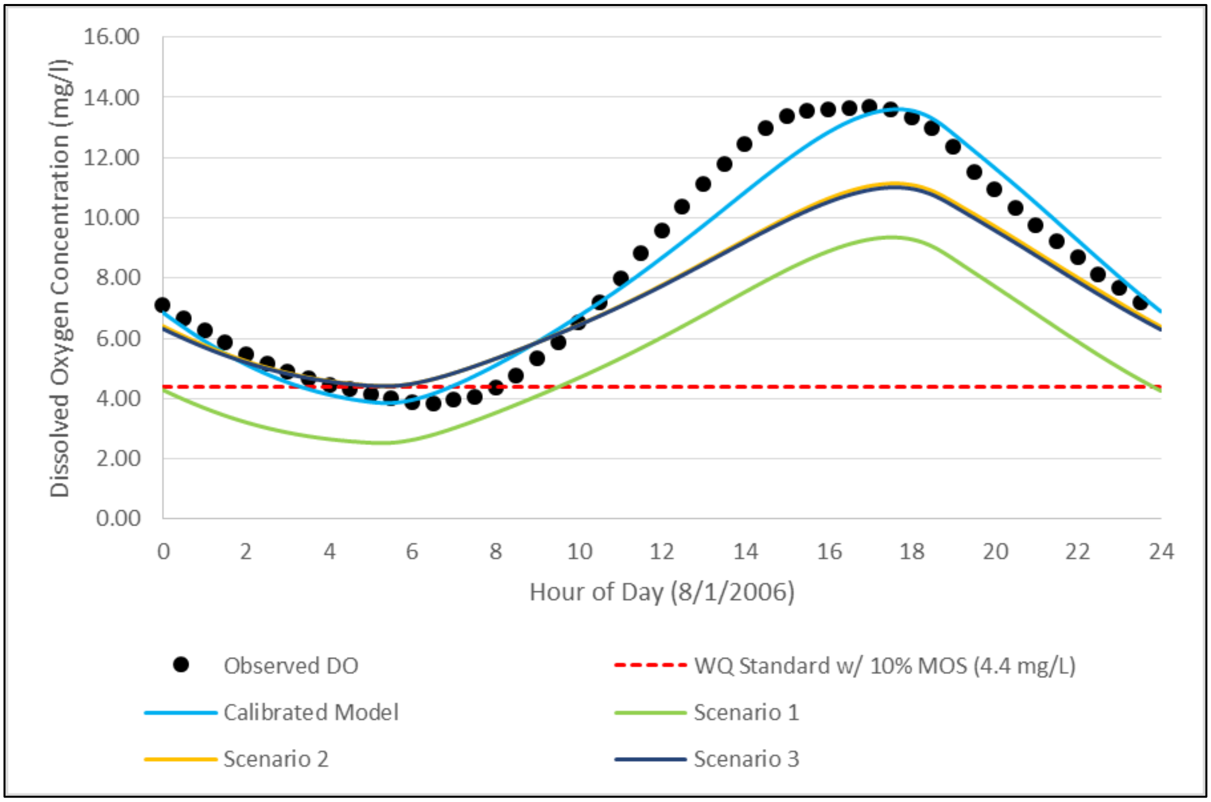

Figure 37. Model scenarios compared to observed data and calibrated model.

In GB-16, point sources discharging under their current permit limits are contributing to low DO conditions. In addition, the flow and chemistry of water flowing into this segment and SOD are also contributing to low DO conditions during critical conditions. Two allocation scenarios (Scenario 2 and Scenario 3) are provided in Table 34. For each of these scenarios, implementation targets are also provided that are required in combination with the pollutant load allocations to meet DO standards in GB-16.

A scenario that does not impact permit limits was not modeled as part of TMDL development, TMDL development requires an evaluation of the current permit limits, and assumes that facilities discharge at those limits during critical conditions. Additional scenarios will also likely meet the minimum DO conditions and Illinois EPA will consider alternative scenarios or solutions to meet the DO water quality standards. One such scenario could focus on the development and implementation of watershed-wide practices to reduce SOD inputs, increase rates of in-stream aeration, and decrease $CBOD_5$ inputs from nonpoint sources. As part of this alternative, stakeholders and point source dischargers would continue to implement their current adaptive management approaches. Stakeholders would collaborate to identify and implement solutions to meet DO water quality standards and associated aquatic life thresholds. Over the mid- to long-term, dischargers would need to identify and implement specific actions that reduce ambient SOD and SOD inputs, increase $CBOD_5$ assimilation and reduce $CBOD_5$ inputs, and improve aquatic ecology. Alternative scenarios, best management practices, and other waterway modifications would need to be itemized by the watershed group for inclusion as action items in the member agencies permits. This type of scenario was developed based on language provided by Illinois EPA's Permit Division[1] (A. Keller, personal communications).

[1] From Al Keller, IEPA, 4/28/2017:"The Agency has encouraged watershed groups to form to develop solutions to address impairments in streams and to benefit multiple communities or districts. The Agency has included specific action items from watershed groups in the group member's NPDES permits in order to address stream impairments. Alternative scenarios, BMPs, and other waterway modifications need to be itemized by the watershed group for inclusion as action items in the

Additional monitoring and further refinement of the QUAL2K model is recommended.

Illinois EPA expects that the USEPA will approve the most restrictive set of allocations as part of the formal approval process, however, Illinois EPA also expects that USEPA will consider the potential for other scenarios that could be used to meet the TMDLs as long as the allocations are consistent between the permits and the TMDLs. This approach allows flexibility on the part of Illinois EPA to consider alternate approaches to implementing the TMDLs.

permits. Please note that the TMDL would still need to have a final solution approved, such as lower effluent limits and a WLA, for meeting the DO standard. The Agency cannot guarantee to substitute using alternative solutions for 10 or 20 years but will review the progress made during each permit cycle. New regulations or new directives by USEPA will need to be addressed in each permit cycle. WLAs or lower effluent limits from an approved TMDL may need to be included in subsequent permits in addition to alternative solutions if the WQ standards are not met".

Table 34. CBOD$_5$, total phosphorus, and ammonia TMDLs to address dissolved oxygen summary (GB-16)

TMDL Parameter		Scenario 2				Scenario 3			
		CBOD$_5$ (lbs/day)	**Total Phosphorus (lbs/day)**	**Total Ammonia (lbs/day)**	**Implementation Targets**	**CBOD$_5$ (lbs/day)**	**Total Phosphorus (lbs/day)**	**Total Ammonia (lbs/day)**	**Implementation Targets**
Wasteload Allocation	CSOs	0 [b]	0 [b]	0 [b]	--	0 [b]	0 [b]	0 [b]	--
	Point Source: IL0034061 (Naperville WRC)	1,877	250	350	• Minimum DO increased to 6.5 mg/L in permit • Reduce CBOD$_5$ permit limit to 7.5 mg/L	2,503	250	350	• Minimum DO increased to 6.5 mg/L in permit
	Point Source: IL0069744 (Bolingbrook STP #3)	350	35	53	• Minimum DO increased to 6.5 mg/L in permit • Reduce CBOD$_5$ permit limit to 10 mg/L	350	35	53	• Minimum DO increased to 6.5 mg/L in permit • Reduce CBOD$_5$ permit limit to 10 mg/L
	Point Source: IL0074373 (Plainfield North STP)	626	63	94	• Minimum DO increased to 6.5 mg/L in permit • Reduce CBOD$_5$ permit limit to 10 mg/L	626	63	94	• Minimum DO increased to 6.5 mg/L in permit • Reduce CBOD$_5$ permit limit to 10 mg/L
	MS4	0 [b]	0 [b]	0 [b]	--	0 [b]	0 [b]	0 [b]	--
Load Allocation		512	326	34	• SOD rate reduced to 2.04 g/m^2/d • SOD coverage decreased by half to 7.5% • Headwater TP decreased to 1 mg/L • Headwater at 6 mg/L DO	511	326	34	• SOD rate reduced to 2.04 g/m^2/d • SOD coverage decreased to 5% • Headwater TP decreased to 1 mg/L • Headwater at 6 mg/L DO
MOS [a]		*Implicit*			--	*Implicit*			--
Loading Capacity		**3,366**	**674**	**531**	--	**3,990**	**674**	**531**	--
In-stream losses per QUAL2K model (see Appendix E)		-197	-91	-159	--	-260	-74	-160	--
In-stream load of pollutant at downstream point of segment meeting DO standards		3,169	583	372	--	3,730	600	371	--

a. A 10% MOS was applied to the standard during modeling; see Appendix E.
b. This TMDL is provided for critical conditions occurring during low flow summer months; CSO and stormwater discharges are not anticipated at this time.
c. Conversion units used in WLA calculations: 1.547 (MGD per cfs), 86,400 (seconds per day), 28.317 (liters per 1 cubic ft) and 453,592 (mg per lb)

7.3 West Branch DuPage River (IL_GBK-05)

7.3.1 Fecal Coliform TMDL

A fecal coliform bacteria TMDL has been developed for the West Branch DuPage River segment GBK-05. Figure 38 presents the fecal coliform load duration curve and Table 35 and Table 36 summarize the TMDL and required reductions for both the single sample maximum standard and the geomean standard, respectively. Pollutant reductions are needed for all flow conditions. Table 37 summarizes the individual WLAs.

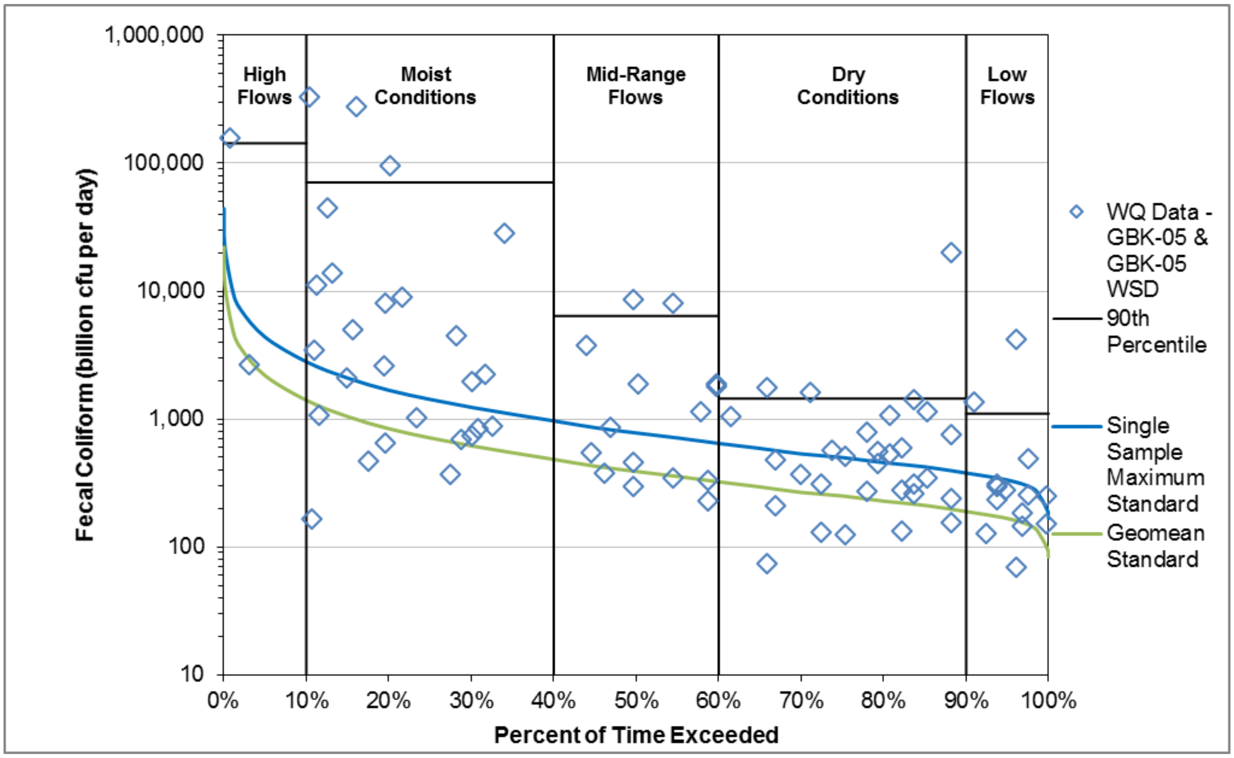

Figure 38. Fecal coliform load duration curve, West Branch DuPage River at GBK-05.

Table 35. Fecal coliform TMDL summary (single sample maximum standard; West Branch DuPage River at GBK-05)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facilities	1,405	642	642	b	b
	MS4 [c]	2,349	594	54	b	b
Load Allocation		177	45	4	b	b
MOS		437	142	78	50	33
Loading Capacity		**4,368**	**1,423**	**778**	**500**	**333**
Existing Load		143,396	70,781	6,387	1,444	1,102
Load Reduction [a]		97%	98%	88%	65%	70%

a. TMDL reduction is based on the observed 90th percentile load in each flow regime.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.
c. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 36. Fecal coliform TMDL summary (geomean standard; West Branch DuPage River at GBK-05)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facilities	704	320	320	b	b
	MS4 [c]	1,174	298	28	b	b
Load Allocation		88	22	2	b	b
MOS		218	71	39	25	17
Loading Capacity		**2,184**	**711**	**389**	**250**	**167**
Existing Load		143,396	70,781	6,387	1,444	1,102
Load Reduction [a]		Not calculated				

a. Insufficient data to calculate reduction based on the geomean standard.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.
c. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 37. Individual NPDES fecal coliform WLAs, West Branch DuPage River at GBK-05

Permit ID	Facility Name	Design Average Flow (MGD)	Design Maximum Flow (MGD)	Fecal Coliform WLA (billion cfu per day)	
				High Flows – Design Maximum Flow (single sample maximum/geomean standard)	Moist Conditions to Low Flows – Design Average Flow (single sample maximum/geomean standard)
IL0023469	WEST CHICAGO STP – B01[a]	7.64	20.3	307 / 154	116 / 58
IL0026352	CAROL STREAM STP – B01[a]	6.5	13.0	197 / 98	98 / 49
IL0027618	BARTLETT WWTP – B01[a]	3.679	5.151	78 / 39	56 / 28
IL0028428	DUPAGE COUNTY-CASCADE STP – 001	0.00585	0.0234	0.4 / 0.2	0.1 / 0.05
IL0031739	WHEATON S.D. – 001[a]	8.9	19.1	289 /145	135 / 67
IL0034479	HANOVER PARK STP #1 – B01[a]	2.42	8.68	131 / 66	37 / 18
IL0036137	MWRDGC HANOVER PARK WRP – 007	12	22	333 / 167	182 / 91
IL0048721	ROSELLE-BOTTERMAN WWTF – 001	1.22	4.60	70 / 35	18 / 9
			Total	**1,405 / 704**	**642 / 320**

a. NPDES-permitted facility with excess flow outfall – excess flows not included in WLAs.

7.4 West Branch DuPage River (IL_GBK-09)

7.4.1 Fecal Coliform TMDL

A fecal coliform bacteria TMDL has been developed for the West Branch DuPage River segment GBK-09. Figure 39 presents the fecal coliform load duration curve and Table 38 and Table 39 summarize the TMDL and required reductions for both the single sample maximum standard and the geomean standard, respectively. Pollutant reductions are needed for all flow conditions. Table 40 summarizes the individual WLAs.

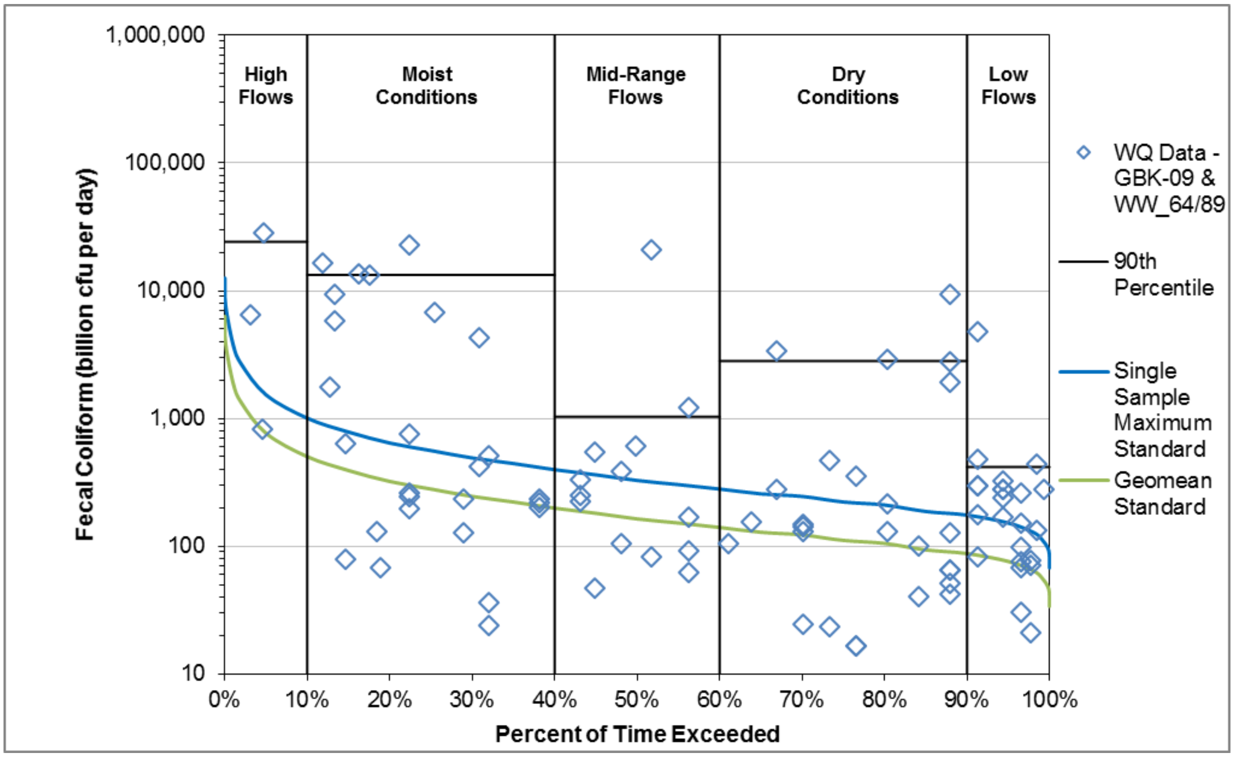

Figure 39. Fecal coliform load duration curve, West Branch DuPage River at GBK-09.

Table 38. Fecal coliform TMDL summary (single sample maximum standard; West Branch DuPage River at GBK-09)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facilities	612	293	293	b	b
	MS4 [c]	741	205	0.97	b	b
Load Allocation		23	6	0.03	b	b
MOS		153	56	33	22	15
Loading Capacity		**1,529**	**560**	**327**	**222**	**152**
Existing Load		24,165	13,295	1,030	2,822	416
Load Reduction [a]		94%	96%	68%	92%	64%

a. TMDL reduction is based on the observed 90th percentile load in each flow regime.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.
c. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 39. Fecal coliform TMDL summary (geomean standard; West Branch DuPage River at GBK-09)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facilities	307	146	146	b	b
	MS4 [c]	370	103	0.97	b	b
Load Allocation		11	3	0.03	b	b
MOS		77	28	16	11	8
Loading Capacity		**765**	**280**	**163**	**111**	**76**
Existing Load		24,165	13,295	1,030	2,822	416
Load Reduction [a]		Not calculated				

a. Insufficient data to calculate reduction based on the geomean standard.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.
c. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 40. Individual NPDES fecal coliform WLAs, West Branch DuPage River at GBK-09

Permit ID	Facility Name	Design Average Flow (MGD)	Design Maximum Flow (MGD)	Fecal Coliform WLA (billion cfu per day)	
				High Flows – Design Maximum Flow (single sample maximum/geomean standard)	Moist Conditions to Low Flows – Design Average Flow (single sample maximum/geomean standard)
IL0027618	BARTLETT WWTP – B01[a]	3.679	5.151	78 / 39	56 / 28
IL0028428	DUPAGE COUNTY-CASCADE STP – 001	0.00585	0.0234	0.4 / 0.2	0.1 / 0.05
IL0034479	HANOVER PARK STP #1 – B01[a]	2.42	8.68	131 / 66	37 / 18
IL0036137	MWRDGC HANOVER PARK WRP – 007	12	22	333 / 167	182 / 91
IL0048721	ROSELLE-BOTTERMAN WWTF – 001	1.22	4.60	70 / 35	18 / 9
			Total	**612 / 307**	**293 / 146**

a. NPDES-permitted facility with excess flow outfall – excess flows not included in WLAs.

7.5 West Branch DuPage River (IL_GBK-14)

7.5.1 Fecal Coliform TMDL

A fecal coliform bacteria TMDL has been developed for the West Branch DuPage River segment GBK-14. Figure 40 presents the fecal coliform load duration curve and Table 41 and Table 42 summarize the TMDL and required reductions for both the single sample maximum standard and the geomean standard, respectively. Pollutant reductions are needed for all flow conditions.

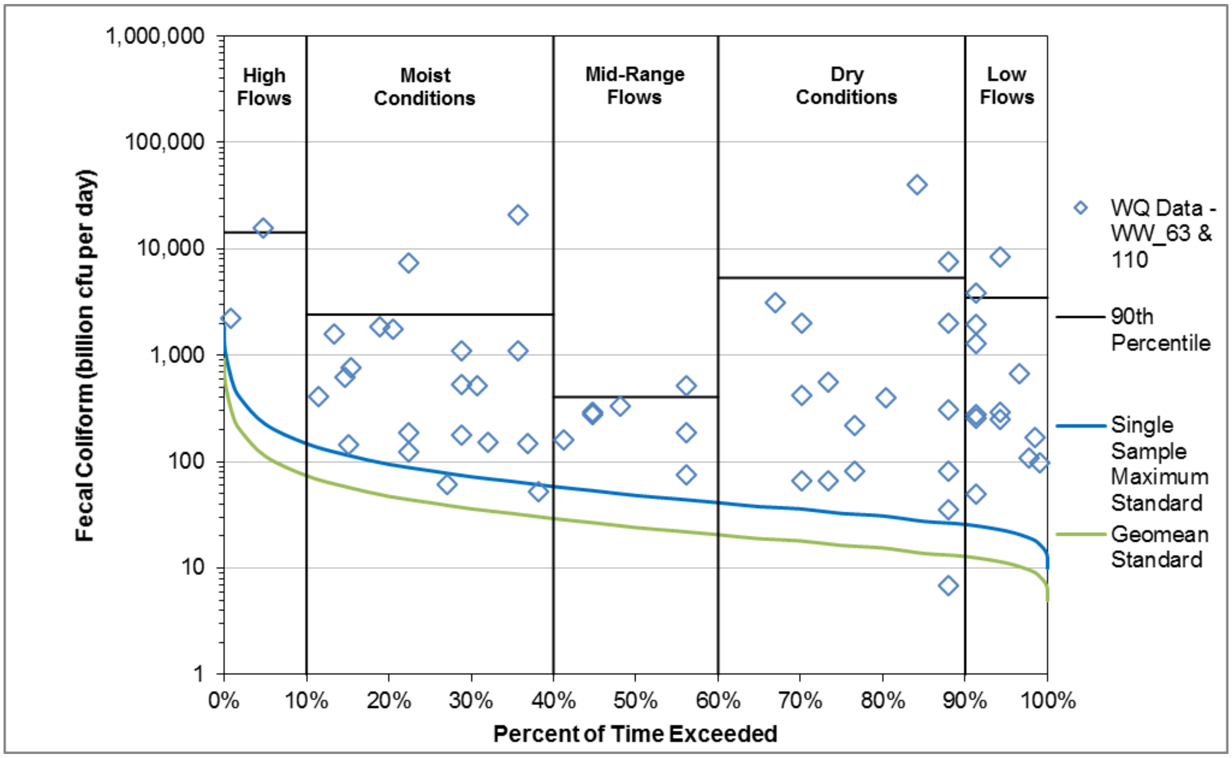

Figure 40. Fecal coliform load duration curve, West Branch DuPage River at GBK-14.

Table 41. Fecal coliform TMDL summary (single sample maximum; West Branch DuPage River at GBK-14)

TMDL Parameter	Flow Zones				
	High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
	Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation: MS4 [a]	200	73	42.6	29.7	19.8
Load Allocation	2	1	0.4	0.3	0.2
MOS	23	8	5	3	2
Loading Capacity	**225**	**82**	**48**	**33**	**22**
Existing Load	14,287	2,417	406	5,335	3,477
Load Reduction [b]	98%	97%	88%	99%	99%

a. The MS4 WLA is categorical, see section 6.3.1 for description.

b. TMDL reduction is based on the observed 90th percentile load in each flow regime.

Table 42. Fecal coliform TMDL summary (geomean standard; West Branch DuPage River at GBK-14)

TMDL Parameter	Flow Zones				
	High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
	Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation: MS4 [a]	100	36.6	21.8	13.9	9.9
Load Allocation	1	0.4	0.2	0.1	0.1
MOS	11	4	2	2	1
Loading Capacity	**112**	**41**	**24**	**16**	**11**
Existing Load	14,287	2,417	406	5,335	3,477
Load Reduction [b]	Not calculated				

a. The MS4 WLA is categorical, see section 6.3.1 for description.

b. Insufficient data to calculate reduction based on the geomean standard.

7.5.2 Dissolved Oxygen

A dissolved oxygen deficit (DOD) TMDL was developed to address low dissolved oxygen in GBK-14. DOD is a measure of the impacts of all DO-depleting sources and also has units of mg-DO/L. The loading capacity for DO is the difference between DO_{sat} (a function of temperature) and the water quality standard of 5.0 mg/L, expressed as DOD. An example TMDL is provided in Table 43 and is applicable to the following critical conditions:

- Flow of 1.33 cfs
- Water temperature of 19.4 °C
- DO_{sat} of 8.96 mg/l (derived from QUAL2K modeling for critical conditions)

A DOD TMDL can be calculated for any other combination of flow and water temperature using the following equation:

$$DOD\left[\frac{kg}{d}\right] = (DO_{sat} - DO)\,[mg/L]\;x\;Q\,[cfs]\;x\;2.447[conversion\ factor]$$

A calibrated QUAL2K model was developed to simulate critical summer conditions in GBK-14 and determine the implementation activities needed to meet the DOD TMDL (see Appendix E). The low DO in GBK-14 is estimated to be caused be a combination of low reaeration and the presence of SOD, along with exacerbation of existing conditions due to very low flow (only several inches of stream depth).

Table 43. Dissolved oxygen demand TMDL summary (GBK-14)

TMDL Parameter	DOD (kg/day)	DOD (lbs/day)
Wasteload Allocation: MS4 [a]	0 [b]	0 [b]
Load Allocation	11	24
MOS [c]	*implicit*	*implicit*
Loading Capacity (kg/day) [d]	**11**	**24**
Existing Load (kg/day)	19	42
Load Reduction	42%	

a. The MS4 WLA is categorical, see section 6.3.1 for description.
b. This TMDL is provided for critical conditions occurring during low flow summer months; CSO and stormwater discharges are not anticipated at this time.
c. A 10% MOS was applied to the standard during modeling; see Appendix E.
d. TMDL is provided for critical conditions: Flow = 1.33 cfs; Water temperature = 19.4 °C; DO_{sat} = 8.96 mg/l. TMDLs can be determined for any combination of flow and water temperature using the following equation:

$$DOD\left[\frac{kg}{d}\right] = (DO_{sat} - DO)\,[mg/L]\;x\;Q\,[cfs]\;x\;2.447[conversion\ factor]$$

In addition to the DOD loading capacity and allocations, implementation targets are provided that would lead to compliance with the TMDL. Any of these activities alone will result in meeting the DO standard, they can also be used in combination:

- Increased reaeration rate (increased from 1.1 to 2.1 per day)
- Reduced SOD (decreased by half from 2.04 to 1.02 $gO_2/m^2/d$)
- Combination of increased reaeration (increased 35%) and reduced SOD (decreased 35%)
- Increased streamflow (increased headwater streamflow from 0.038 to 0.110 m^3/s)

7.6 Spring Brook (IL_GBKA)

7.6.1 Fecal Coliform TMDL

A fecal coliform bacteria TMDL has been developed for the Spring Brook segment GBKA. Figure 41 presents the fecal coliform load duration curve and Table 44 and Table 45 summarize the TMDL and required reductions for both the single sample maximum standard and the geomean standard, respectively. Pollutant reductions are needed for all flow conditions.

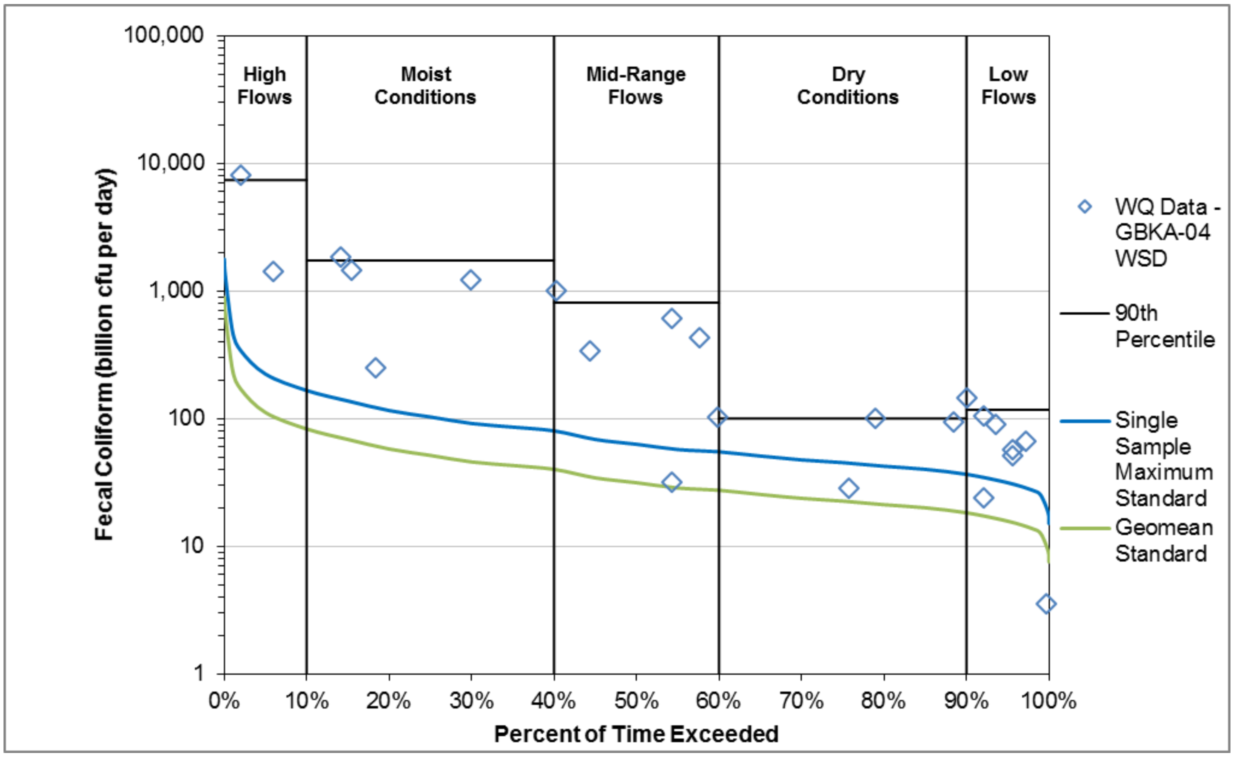

Figure 41. Fecal coliform load duration curve, Spring Brook at GBKA.

Table 44. Fecal coliform TMDL summary (single sample maximum standard; Spring Brook at GBKA)

TMDL Parameter	Flow Zones				
	High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
	Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation: MS4 [a]	202	93	57	40	29
Load Allocation [a]	0	0	0	0	0
MOS	22	10	6	5	3
Loading Capacity	**224**	**103**	**63**	**45**	**32**
Existing Load	7,380	1,737	809	100	117
Load Reduction [b]	97%	94%	92%	55%	73%

a. The MS4 WLA is categorical and accounts for 100% of the watershed, therefore the LA=0. See section 6.3.1 for description.

b. TMDL reduction is based on the observed 90th percentile load in each flow regime.

Table 45. Fecal coliform TMDL summary (geomean standard; Spring Brook at GBKA)

TMDL Parameter	Flow Zones				
	High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
	Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation: MS4 [a]	101	47	29	21	14
Load Allocation [a]	0	0	0	0	0
MOS	11	5	3	2	2
Loading Capacity	**112**	**52**	**32**	**23**	**16**
Existing Load	7,380	1,737	809	100	117
Load Reduction [b]	Not calculated				

a. The MS4 WLA is categorical and accounts for 100% of the watershed, therefore the LA=0. See section 6.3.1 for description.

b. Insufficient data to calculate reduction based on the geomean standard.

7.6.2 Dissolved Oxygen

A dissolved oxygen deficit (DOD) TMDL was developed to address low dissolved oxygen in Spring Brook. DOD is a measure of the impacts of all DO-depleting sources and also has units of mg-DO/L. The loading capacity for DO is the difference between DO_{sat} (a function of temperature) and the water quality standard of 5.0 mg/L, expressed as DOD. An example TMDL is provided in Table 46 and is applicable to the following critical conditions:

- Flow of 4.3 cfs
- Water temperature of 22.26 °C
- DO_{sat} of 8.76 mg/l (derived from QUAL2K modeling for critical conditions)

A DOD TMDL can be calculated for any other combination of flow and water temperature using the following equation:

$$DOD\left[\frac{kg}{d}\right] = (DO_{sat} - DO)\,[mg/L]\; x\; Q\;[cfs]\; x\; 2.447[conversion\ factor]$$

A calibrated QUAL2K model was developed to simulate critical summer conditions in Spring Brook and derive the DOD TMDL (see Appendix E). In the lowest part of the stream segment, SOD accounts for 36% of the DOD and inflow from upstream accounts for the remaining 64% of DOD. SOD and lack of reaeration were identified as the primary drivers of low dissolved oxygen in this impaired stream.

Table 46. Dissolved oxygen demand TMDL summary (Spring Brook at GBKA)

TMDL Parameter	DOD (kg/day)	DOD (lbs/day)
Wasteload Allocation: MS4 [a]	0 [b]	0 [b]
Load Allocation	39	86
MOS [c]	*implicit*	*implicit*
Loading Capacity [d]	**39**	**86**
Existing Load	59	130
Load Reduction	34%	

a. The MS4 WLA is categorical, see section 6.3.1 for description.
b. This TMDL is provided for critical conditions occurring during low flow summer months; stormwater discharges are not anticipated at this time.
c. A 10% MOS was applied to the standard during modeling; see Appendix E.
d. TMDL is provided for critical conditions: Flow = 4.3 cfs; Water temperature = 22.26 °C; DO_{sat} = 8.76 mg/l. TMDLs can be determined for any combination of flow and water temperature using the following equation:

$$DOD\left[\frac{kg}{d}\right] = (DO_{sat} - DO)\,[mg/L]\;x\;Q\;[cfs]\;x\;2.447[conversion\;factor]$$

In addition to the DOD loading capacity and allocations, implementation targets are provided that would lead to compliance with the TMDL:

- Increased reaeration (0.4 /d) and decreased SOD coverage and rate (50%, 1.05 gO2/m2/d) in the lower reach

It is also possible to achieve the DO criteria and the maximum allowable DOD by exclusively decreasing SOD in the lower reach or exclusively increased reaeration in the lower reach.

7.7 Spring Brook (IL_GBKA-01)

7.7.1 Fecal Coliform TMDL

A fecal coliform bacteria TMDL has been developed for the Spring Brook segment GBKA-01. Figure 42 presents the fecal coliform load duration curve and Table 47 and Table 48 summarize the TMDL and required reductions for both the single sample maximum standard and the geomean standard, respectively. Pollutant reductions are needed for all flow conditions.

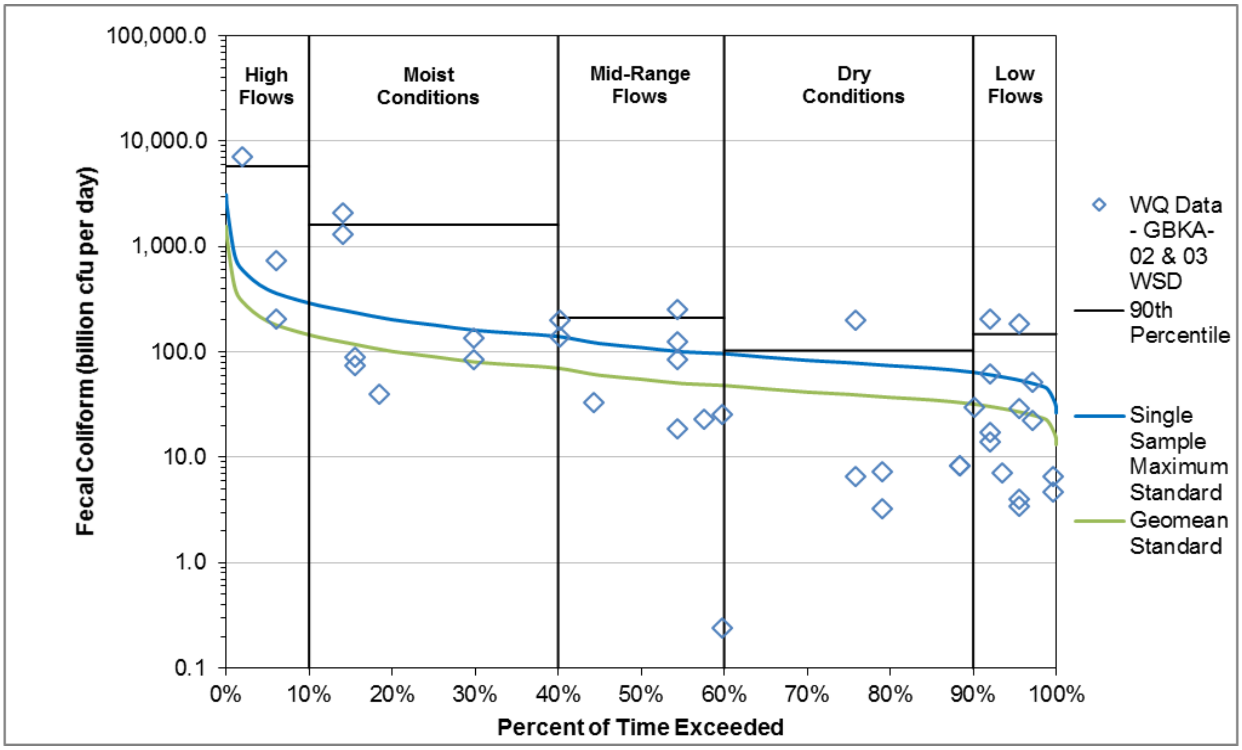

Figure 42. Fecal coliform load duration curve, Spring Brook at GBKA-01.

Table 47. Fecal coliform TMDL summary (single sample maximum standard; Spring Brook at GBKA-01)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facility: IL0031739 (Wheaton S.D.) [a]	289 (at DMF)	135 (at DAF)	b	b	b
	MS4 [c]	62	27	b	b	b
Load Allocation		1	1	b	b	b
MOS		39	18	11	8	6
Loading Capacity		**391**	**181**	**110**	**79**	**55**
Existing Load		5,777	1,610	211	103	148
Load Reduction [d]		93%	89%	48%	23%	63%

a. DMF = 19.1 MGD, DAF = 8.9 MGD

b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.

c. The MS4 WLA is categorical, see section 6.3.1 for description.

d. TMDL reduction is based on the observed 90th percentile load in each flow regime.

Table 48. Fecal coliform TMDL summary (geomean standard; Spring Brook at GBKA-01)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facility: IL0031739 (Wheaton S.D.) [a]	145 (at DMF)	67 (at DAF)	b	b	b
	MS4 [c]	30	13.7	b	b	b
Load Allocation		1	0.3	b	b	b
MOS		20	9	6	4	3
Loading Capacity		**196**	**90**	**55**	**40**	**28**
Existing Load		5,777	1,610	211	103	148
Load Reduction [d]		Not calculated				

a. DMF = 19.1 MGD, DAF = 8.9 MGD
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.
c. The MS4 WLA is categorical, see section 6.3.1 for description.
d. Insufficient data to calculate reduction based on the geomean standard.

7.8 East Branch DuPage River (IL_GBL-10)

7.8.1 Fecal Coliform TMDL

A fecal coliform bacteria TMDL has been developed for the East Branch DuPage River segment GBL-10. Figure 43 presents the fecal coliform load duration curve and Table 49 and Table 50 summarize the TMDL and required reductions for both the single sample maximum standard and the geomean standard, respectively. Pollutant reductions are needed for all flow conditions. Table 51 summarizes the individual wasteload allocations.

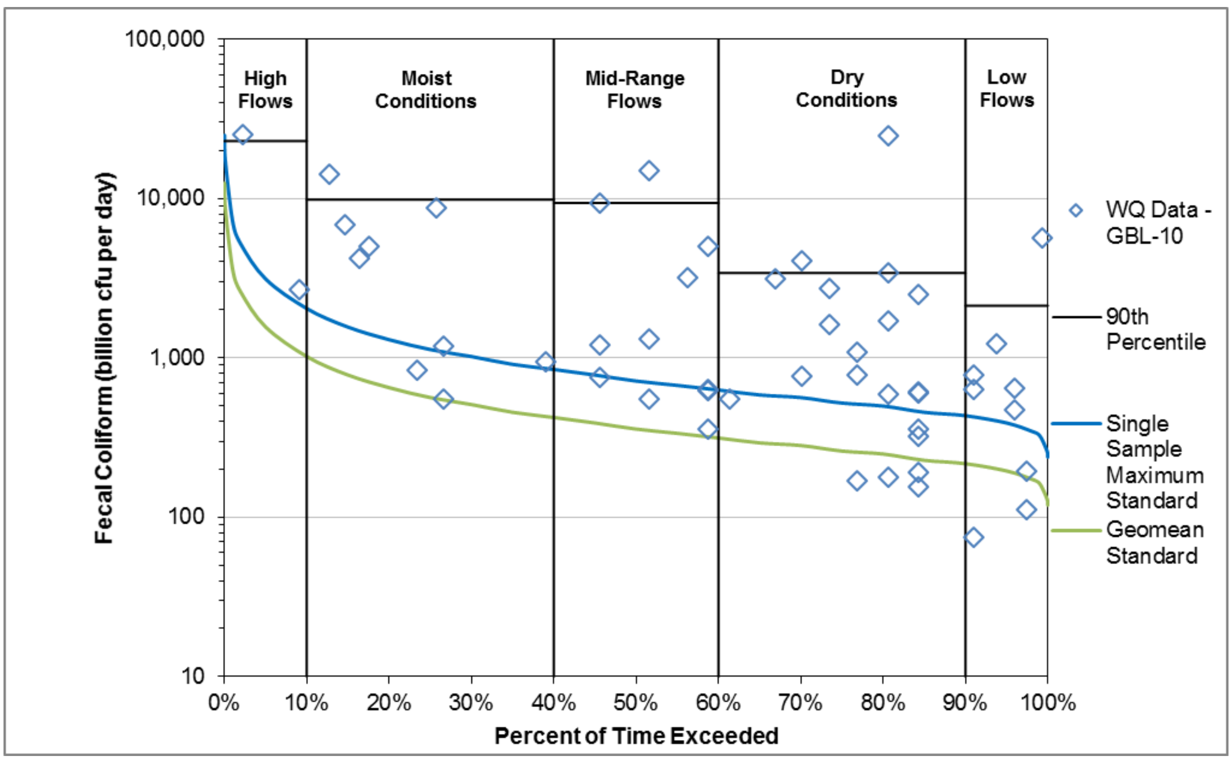

Figure 43. Fecal coliform load duration curve, East Branch DuPage River at GBL-10.

Table 49. Fecal coliform TMDL summary (single sample maximum standard; East Branch DuPage River at GBL-10)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [c]	372	-	-	-	-
	NPDES-permitted facilities	1,347	554	554	b	b
	MS4 [d]	1,086	457	89	b	b
Load Allocation		11	5	1	b	b
MOS		313	113	72	52	39
Loading Capacity		**3,129**	**1,129**	**716**	**521**	**391**
Existing Load		22,930	9,863	9,377	3,411	2,129
Load Reduction [a]		86%	89%	92%	85%	82%

a. TMDL reduction is based on the observed 90th percentile load in each flow regime.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.
c. CSO events are assumed to occur no more than 4 times per year.
d. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 50. Fecal coliform TMDL summary (geomean standard; East Branch DuPage River at GBL-10)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [c]	186	-	-	-	-
	NPDES-permitted facilities	674	276	276	b	b
	MS4 [d]	543	230	45.5	b	b
Load Allocation		5	2	0.5	b	b
MOS		156	56	36	26	20
Loading Capacity		**1,564**	**564**	**358**	**260**	**195**
Existing Load		22,930	9,863	9,377	3,411	2,129
Load Reduction [a]		Not calculated				

a. Insufficient data to calculate reduction based on the geomean standard.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.
c. CSO events are assumed to occur no more than 4 times per year.
d. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 51. Individual NPDES fecal coliform WLAs, East Branch DuPage River at GBL-10

Permit ID	Facility Name	Design Average Flow (MGD)	Design Maximum Flow (MGD)	Fecal Coliform WLA (billion cfu per day)	
				High Flows – Design Maximum Flow (single sample maximum/geomean standard)	Moist Conditions to Low Flows – Design Average Flow (single sample maximum/geomean standard)
IL0021130	BLOOMINGDALE-REEVES WRF – B01[a]	3.45	8.625	131 / 65	52 / 26
IL0021547	GLENBARD WW AUTH-GLENBARD – 001	16.02	47	712 / 356	243 / 121
IL0022471	GLENBARD WW AUTH-LOMBARD – 001	0.8[b]		12 / 6	12 / 6
IL0022471	GLENBARD WW AUTH-LOMBARD – 002/003 (CSOs)[c]	24.6 (maximum CSO volume, February 2014)[d]		372 / 186	--
IL0028380	DOWNERS GROVE SD WTC – B01[a]	11	22.0	333 / 167	167 / 83
IL0028967	GLENDALE HEIGHTS STP – B01[a]	5.26	10.52	159 / 80	80 / 40
Total (excluding CSO allocations)				**1,347 / 674**	**554 / 276**

a. NPDES-permitted facility with excess flow outfall – excess flows not included in WLAs.

b. 2013-2015 average DMR flows.

c. CSOs are only allowed to discharge 4 times per year at this level.

d. Maximum CSO volumes from 2013-2015 DMRs.

7.9 Salt Creek (IL_GL-09)

7.9.1 Fecal Coliform TMDL

A fecal coliform bacteria TMDL has been developed for Salt Creek segment GL-09. Figure 44 presents the fecal coliform load duration curve and Table 52 and Table 53 summarize the TMDL and required reductions for both the single sample maximum standard and the geomean standard, respectively. Pollutant reductions are needed for all flow conditions. Table 54 summarizes the wasteload allocations.

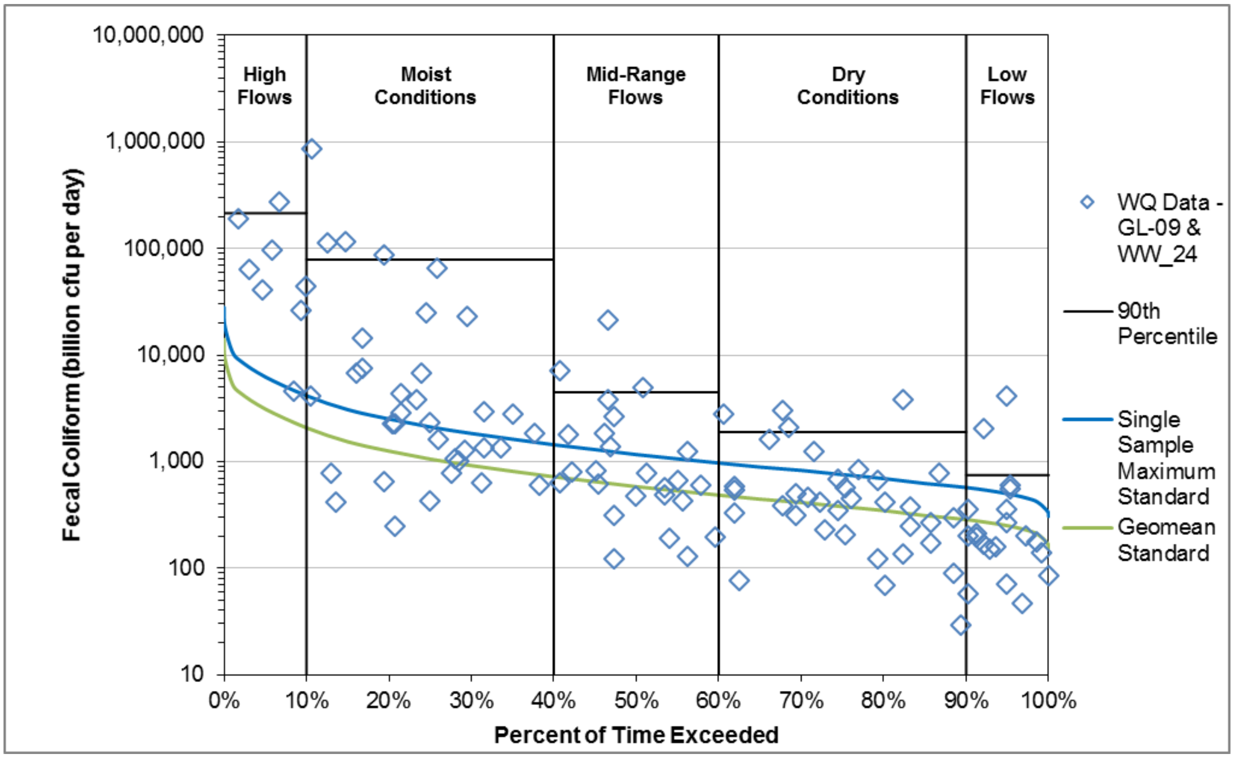

Figure 44. Fecal coliform load duration curve, Salt Creek at GL-09.

Table 52. Fecal coliform TMDL summary (single sample maximum; Salt Creek at GL-09)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [c]	2,719	-	-	-	-
	NPDES-permitted facilities	1,713	886	886	b	b
	MS4 [d]	1,176	1,007	160	b	b
Load Allocation		12	10	2	b	b
MOS		625	211	116	76	50
Loading Capacity		**6,245**	**2,114**	**1,164**	**756**	**500**
Existing Load		214,979	78,888	4,486	1,896	747
Load Reduction [a]		97%	97%	74%	60%	33%

a. TMDL reduction is based on the observed 90th percentile load in each flow regime.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.
c. CSO events are assumed to occur no more than 4 times per year.
d. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 53. Fecal coliform TMDL summary (geomean standard; Salt Creek at GL-09)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [c]	1,359	-	-	-	-
	NPDES-permitted facilities	859	444	444	b	b
	MS4 [d]	586	502	79	b	b
Load Allocation		6	5	1	b	b
MOS		312	106	58	38	25
Loading Capacity		**3,122**	**1,057**	**582**	**378**	**250**
Existing Load		214,979	78,888	4,486	1,896	747
Load Reduction [a]		Not calculated				

a. Insufficient data to calculate reduction based on the geomean standard.
b. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.
c. CSO events are assumed to occur no more than 4 times per year.
d. The MS4 WLA is categorical, see section 6.3.1 for description.

Table 54. Individual NPDES fecal coliform WLAs, Salt Creek at GL-09

Permit ID	Facility Name	Design Average Flow (MGD)	Design Maximum Flow (MGD)	Fecal Coliform WLA (billion cfu per day)	
				High Flows – Design Maximum Flow (single sample maximum/geomean standard)	Moist Conditions to Low Flows – Design Average Flow (single sample maximum/geomean standard)
IL0020061	WOOD DALE NORTH STP – 001[a]	1.97	3.93	60 / 30	30 / 15
IL0027367	ADDISON SOUTH-A.J. LAROCCA STP – B01[a]	3.2	8.0	121 / 61	48 / 24
IL0027367	ADDISON SOUTH-A.J. LAROCCA STP – 004 (CSO)[b]	24.6 (maximum CSO volume, February 2014)[c]		258 / 129	--
IL0028398	DUPAGE COUNTY-NORDIC PARK STP – 001	0.5	1.0	15 / 8	8 / 4
IL0028746	ELMHURST WWTP – 001[a]	8	20.0	303 / 151	121 / 61
IL0030813	ROSELLE STP – B01[a]	2	4	61 / 30	30 / 15
IL0030953	SALT CREEK SANITARY DISTRICT – 001/002	3.3	8.0	121 / 61	50 / 25
IL0033618	VILLA PARK WET WEATHER STP – 001/002/003/004 (CSOs)[a,b]	38.5 (maximum CSO volume, based on annual average discharge and 4 events per year)[c]		583 / 291	--
IL0033812	ADDISON NORTH STP – B01[a]	5.3	7.6	115 / 58	80 / 40
IL0034274	WOOD DALE SOUTH STP – 001[a]	1.13	2.33	35 / 18	17 / 9
IL0036340	MWRDGC EGAN WRP – 001[a]	30	50	757 / 379	454 / 227
IL0045039	VILLAGE OF WESTERN SPRINGS CSOS – 004[b]	No reported CSO volume		0 / 0	--
IL0052817	STONEWALL UTILITY COMPANY - STP	0.01	0.07	1.1 / 0.5	0.2 / 0.1

Permit ID	Facility Name	Design Average Flow (MGD)	Design Maximum Flow (MGD)	Fecal Coliform WLA (billion cfu per day)	
				High Flows – Design Maximum Flow (single sample maximum/geomean standard)	Moist Conditions to Low Flows – Design Average Flow (single sample maximum/geomean standard)
IL0079073	ITASCA STP – 001	3.2	8.2	124 / 62	48 / 24
ILM580008[d]	LAGRANGE PARK CSOS – 001/002/003/004/005/006[b]	124 (maximum CSO volume, April 2013)[c]		1,878 / 939	--
ILM580009[d]	VILLAGE OF LAGRANGE CSOS – 001/002/003[b]	No reported CSO volume			
Total (excluding CSO allocations)				1,713 / 859	886 / 444

a. NPDES-permitted facility with excess flow outfall – excess flows not included in WLAs.
b. CSOs are only allowed to discharge 4 times per year at this level.
c. Maximum CSO volumes from 2013-2015 DMRs.
d. MWRD-permitted facilities are combined into one categorical WLA.

7.10 Salt Creek (IL_GL-10)

7.10.1 Fecal Coliform TMDL

A fecal coliform bacteria TMDL has been developed for Salt Creek segment GL-10. Figure 45 presents the fecal coliform load duration curve and Table 55 and Table 56 summarize the TMDL and required reductions for both the single sample maximum standard and the geomean standard, respectively. Pollutant reductions are needed for all flow conditions.

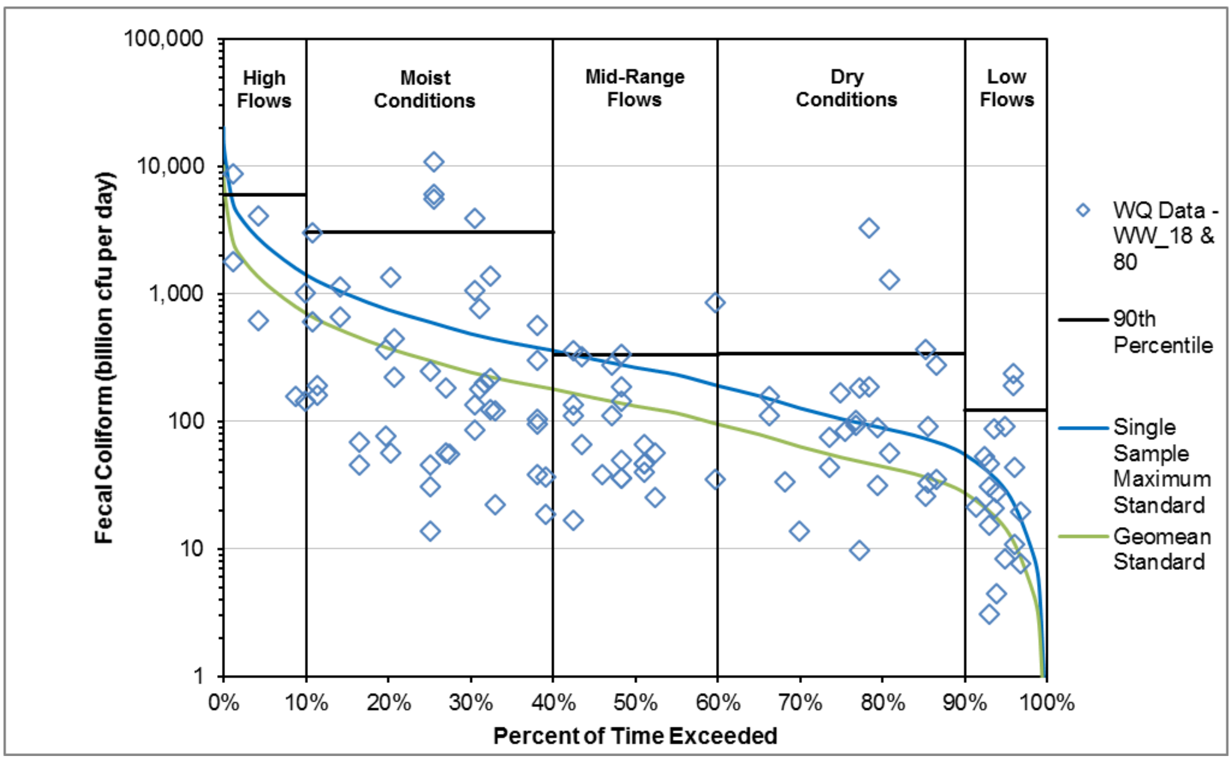

Figure 45. Fecal coliform load duration curve, Salt Creek at GL-10.

Table 55. Fecal coliform load duration curve (single sample maximum standard; Salt Creek at GL-10)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facility: IL0036340 (MWRDGC EGAN WRP – 001) [a]	757	454	c	c	c
	MS4 [b]	1,424	87	c	c	c
Load Allocation		14	1	c	c	c
MOS		244	60	26	11	3
Loading Capacity		**2,439**	**602**	**264**	**105**	**29**
Existing Load		5,938	3,027	332	342	121
Load Reduction [d]		59%	80%	20%	69%	76%

a. DMF = 50 MGD, DAF = 30 MGD. NPDES-permitted facility with excess flow outfall – excess flows not included in WLA.

b. The MS4 WLA is categorical, see section 6.3.1 for description.

c. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.

d. TMDL reduction is based on the observed 90th percentile load in each flow regime.

Table 56. Fecal coliform load duration curve (geomean standard; Salt Creek at GL-10)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	NPDES-permitted facility: IL0036340 (MWRDGC EGAN WRP – 001) [a]	379	227	c	c	c
	MS4 [b]	712	43.6	c	c	c
Load Allocation		7	0.4	c	c	c
MOS		122	30	13	5	1
Loading Capacity		**1,220**	**301**	**132**	**52**	**14**
Existing Load		5,938	3,027	332	342	121
Load Reduction [d]		Not calculated				

a. DMF = 50 MGD, DAF = 30 MGD. NPDES-permitted facility with excess flow outfall – excess flows not included in WLA.

b. The MS4 WLA is categorical, see section 6.3.1 for description.

c. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.

d. Insufficient data to calculate reduction based on the geomean standard.

7.11 Salt Creek (IL_GL-19)

7.11.1 Fecal Coliform TMDL

A fecal coliform bacteria TMDL has been developed for Salt Creek segment GL-19. Figure 46 presents the fecal coliform load duration curve and Table 57 and Table 58 summarize the TMDL and required reductions for both the single sample maximum standard and the geomean standard, respectively. Pollutant reductions are needed for all flow conditions. Table 59 summarizes the WLAs.

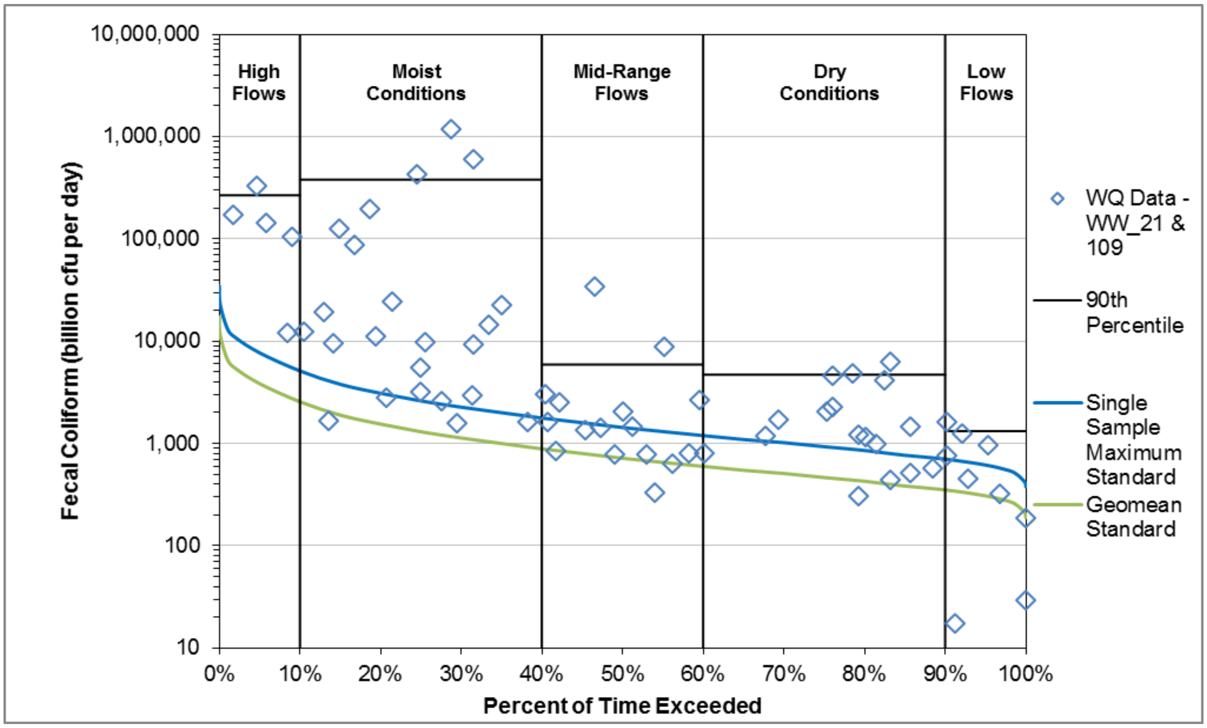

Figure 46. Fecal coliform load duration curve, Salt Creek at GL-19.

Table 57. Fecal coliform TMDL summary (single sample maximum; Salt Creek at GL-19)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [a]	b	-	-	-	-
	NPDES-permitted facilities	1,864	957	957	c	c
	MS4 [d]	5,017	1,375	332	c	c
Load Allocation		51	14	3	c	c
MOS		770	261	144	93	62
Loading Capacity		**7,702**	**2,607**	**1,436**	**932**	**617**
Existing Load		267,527	379,297	5,919	4,698	1,321
Load Reduction [e]		97%	99%	76%	80%	53%

a. CSO events are assumed to occur no more than 4 times per year.
b. Permitted CSO loads are estimated to be approximately 11,880 billion cfu/event. Permitted CSO facilities can discharge under high flow conditions if meeting permit conditions and long-term control plans.
c. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.
d. The MS4 WLA is categorical, see section 6.3.1 for description
e. TMDL reduction is based on the observed 90th percentile load in each flow regime.

Table 58. Fecal coliform TMDL summary (geomean standard; Salt Creek at GL-19)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSOs [a]	b	-	-	-	-
	NPDES-permitted facilities	935	480	480	c	c
	MS4 [d]	2,506	687	164	c	c
Load Allocation		25	7	2	c	c
MOS		385	130	72	47	31
Loading Capacity		**3,851**	**1,304**	**718**	**466**	**309**
Existing Load		267,527	379,297	5,919	4,698	1,321
Load Reduction [e]		Not calculated				

a. CSO events are assumed to occur no more than 4 times per year.
b. Permitted CSO loads are estimated to be approximately 5,940 billion cfu/event. Permitted CSO facilities can discharge under high flow conditions if meeting permit conditions and long-term control plans.
c. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.
d. The MS4 WLA is categorical, see section 6.3.1 for description.
e. Insufficient data to calculate reduction based on the geomean standard.

Table 59. Individual NPDES fecal coliform WLAs, Salt Creek at GL-19

Permit ID	Facility Name	Design Average Flow (MGD)	Design Maximum Flow (MGD)	Fecal Coliform WLA (billion cfu per day)	
				High Flows – Design Maximum Flow (single sample maximum/geomean standard)	Moist Conditions to Low Flows – Design Average Flow (single sample maximum/geomean standard)
IL0020061	WOOD DALE NORTH STP – 001[a]	1.97	3.93	60 / 30	30 / 15
IL0021849	BENSENVILLE STP – 001[a]	4.7	10.0	151 / 76	71 / 36
IL0027367	ADDISON SOUTH-A.J. LAROCCA STP – B01[a]	3.2	8.0	121 / 61	48 / 24
IL0027367	ADDISON SOUTH-A.J. LAROCCA STP – 004 (CSO)[b]	24.6 (maximum CSO volume, February 2014)[c]		258 / 129	--
IL0028398	DUPAGE COUNTY-NORDIC PARK STP – 001	0.5	1.0	15 / 8	8 / 4
IL0028746	ELMHURST WWTP – 001[a]	8	20.0	303 / 151	121 / 61
IL0030813	ROSELLE STP – B01[a]	2	4	61 / 30	30 / 15
IL0030953	SALT CREEK SANITARY DISTRICT – 001/002	3.3	8.0	121 / 61	50 / 25
IL0033618	VILLA PARK WET WEATHER STP – 001/002/003/004 (CSOs)[a,b]	38.5 (maximum CSO volume, based on annual average discharge and 4 events per year)[c]		583 / 291	--
IL0033812	ADDISON NORTH STP – B01[a]	5.3	7.6	115 / 58	80 / 40
IL0034274	WOOD DALE SOUTH STP – 001[a]	1.13	2.33	35 / 18	17 / 9

Permit ID	Facility Name	Design Average Flow (MGD)	Design Maximum Flow (MGD)	Fecal Coliform WLA (billion cfu per day)	
				High Flows – Design Maximum Flow (single sample maximum/geomean standard)	Moist Conditions to Low Flows – Design Average Flow (single sample maximum/geomean standard)
IL0036340	MWRDGC EGAN WRP – 001[a]	30	50	757 / 379	454 / 227
IL0045039	VILLAGE OF WESTERN SPRINGS CSOS – 004[b]	No reported CSO volume		0 / 0	--
IL0052817	STONEWALL UTILITY COMPANY - STP	0.01	0.07	1.1 / 0.5	0.2 / 0.1
IL0079073	ITASCA STP – 001	3.2	8.2	124 / 62	48 / 24
IL0028053	MWRDGC STICKNEY WRP CSOS – 150[b] (West Chester Pump Station)	389 (maximum CSO volume, October 2014)[c]		11,039 / 5,520	--
ILM580008[d]	LAGRANGE PARK CSOS – 001/002/003/004/005/006[b]	124 (maximum CSO volume, April 2013)[c]			
ILM580009[d]	VILLAGE OF LAGRANGE CSOS – 001/002/003[b]	No reported CSO volume			
ILM580032[d]	BROOKFIELD CSOS – 001/002/003/005/006/007[b]	341 (maximum CSO volume, April 2013)[c]			
Total (excluding CSO allocations)				**1,864 / 935**	**957 / 480**

a. NPDES-permitted facility with excess flow outfall – excess flows not included in WLAs.
b. CSOs are only allowed to discharge 4 times per year at this level.
c. Maximum CSO volumes from 2013-2015 DMRs.
d. MWRD-permitted facilities are combined into one categorical WLA.

7.12 Addison Creek (IL_GLA-02)

7.12.1 Fecal Coliform TMDL

A fecal coliform bacteria TMDL has been developed for Addison Creek segment GLA-02. Figure 46 presents the fecal coliform load duration curve and Table 60 and Table 61 summarize the TMDL and required reductions for both the single sample maximum standard and the geomean standard, respectively. Pollutant reductions are needed for all flow conditions.

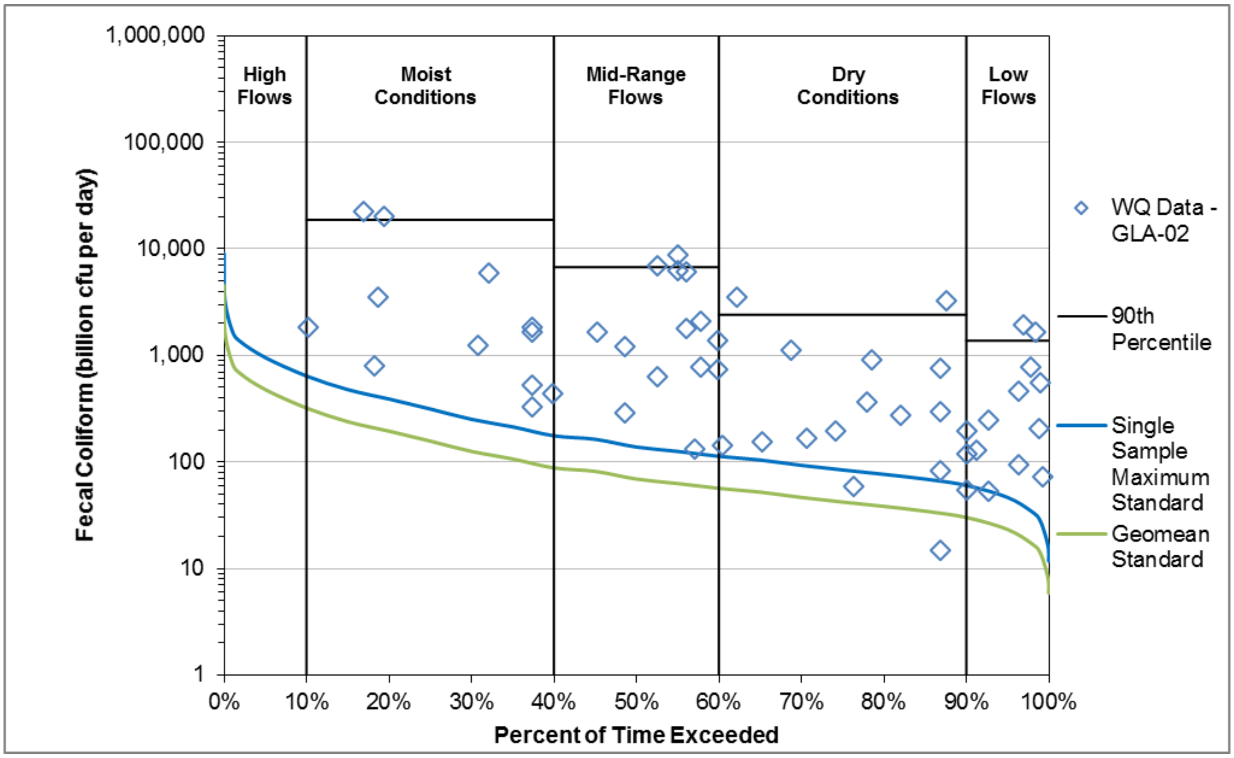

Figure 47. Fecal coliform load duration curve, Addison Creek at GLA-02.

Table 60. Fecal coliform TMDL summary (single sample maximum standard; Addison Creek at GLA-02)

TMDL Parameter		Flow Zones				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSO: IL0020853 (MWRDGC STICKNEY WRP CSOS – 150) [a]	b	-	-	-	-
	NPDES-permitted facility: IL0021849 (BENSENVILLE STP – 001) [c]	151	71	71	d	d
	MS4 [e]	702	210	52	d	d
Load Allocation		7	2	0.5	d	d
MOS		96	31	14	8	5
Loading Capacity		**956**	**314**	**138**	**84**	**47**
Existing Load		-	18,705	6,727	2,407	1,377
Load Reduction [f]		-	98%	98%	97%	97%

a. CSO events are assumed to occur no more than 4 times per year.

b. Permitted CSO loads are estimated to be approximately 5,891 billion cfu/event. Permitted CSO facilities can discharge under high flow conditions if meeting permit conditions and long-term control plans.

c. DMF = 10 MGD, DAF = 4.7 MGD. NPDES-permitted facility with excess flow outfall – excess flows not included in WLA.
d. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (400 counts per 100 mL). The allowable concentration is based on water quality standards.
e. The MS4 WLA is categorical, see section 6.3.1 for description.
f. TMDL reduction is based on the observed 90th percentile load in each flow regime.

Table 61. Fecal coliform TMDL summary (geomean standard; Addison Creek at GLA-02)

TMDL Parameter		Flow Zones				
		High Flows	**Moist Conditions**	**Mid-Range Flows**	**Dry Conditions**	**Low Flows**
		Fecal Coliform Load (billion cfu/day)				
Wasteload Allocation	CSO: IL0020853 (MWRDGC STICKNEY WRP CSOS – 150) [a]	b	-	-	-	-
	NPDES-permitted facility: IL0021849 (BENSENVILLE STP – 001) [c]	76	36	36	d	d
	MS4 [e]	350	104	26	d	d
Load Allocation		3	1	0.3	d	d
MOS		48	16	7	4	2
Loading Capacity		**478**	**157**	**69**	**42**	**23**
Existing Load		-	18,705	6,727	2,407	1,377
Load Reduction [f]		Not calculated				

a. CSO events are assumed to occur no more than 4 times per year.
b. Permitted CSO loads are estimated to be approximately 2,945 billion cfu/event. Permitted CSO facilities can discharge under high flow conditions if meeting permit conditions and long-term control plans.
c. DMF = 10 MGD, DAF = 4.7 MGD. NPDES-permitted facility with excess flow outfall – excess flows not included in WLA.
d. The permitted wastewater treatment facility design flows exceed the long-term monitored stream flow in the dry and low flow zones. NPDES-permitted facilities can discharge under these flow conditions if meeting permit conditions. To account for these unique situations only, the WLAs and LA are expressed as an equation rather than an absolute number: Wasteload Allocation or Load Allocation = (flow contribution from a given source) x (200 counts per 100 mL). The allowable concentration is based on water quality standards.
e. The MS4 WLA is categorical, see section 6.3.1 for description.
f. Insufficient data to calculate reduction based on the geomean standard.

8.0 Implementation Plan and Reasonable Assurance

The implementation plan identifies activities that stakeholders could consider to reduce pollutant loads and improve the conditions of the impaired waterbody segments in the watershed, and provides reasonable assurance that required load reductions will be achieved. These implementation activities will help to achieve pollutant load reductions and attain water quality standards and also result in a cleaner, healthier watershed for the people who depend on the resources of the watershed for their livelihood now and in the future.

8.1 Introduction

This implementation plan is a framework that watershed stakeholders may use to guide implementation of best management practices (BMPs) to address TMDLs in the DuPage River and Salt Creek watersheds. This framework is flexible and incorporates adaptive management to allow watershed stakeholders to adjust the implementation plan to align with their priorities and limitations. This flexibility is necessary because the implementation of nonpoint source controls is voluntary. For example, an implementation plan that specifies a parking lot location for permeable pavement installation would be of little use to watershed stakeholders if the property owners at the specified locations are unwilling or unable to implement. Adaptive management is also necessary because factors unique to specific localities may yield better or worse results for a certain BMP (or suite of BMPs) and the implementation plan will need to be modified to account for such results.

An important factor for implementation of the recommended BMPs is access to technical and financial resources. One potential source of funding is the Clean Water Act Section 319 Nonpoint Source Management grants. Section 319 grant funding supports implementation activities including technical and financial assistance, education, training, demonstration projects, and monitoring to assess the success of nonpoint source implementation projects. To be eligible for these funds, watershed management plans must address nine elements identified by U.S. EPA (2008, revised 2014) as critical for achieving improvements in water quality. These nine elements include:

- Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve load reductions estimated within the plan
- Estimate of the load reductions expected from management measures
- Description of the nonpoint source management measures that will need to be implemented to achieve load reductions estimated in element 2; and identification of critical areas
- Estimate of the amounts of technical and financial assistance needed, associated costs, and the sources and authorities (e.g., ordinances) that will be relied upon to implement the plan
- An information and public education component; early and continued encouragement of public involvement in the design and implementation of the plan
- Implementation schedule
- A description of interim, measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented
- Criteria to measure success and reevaluate the plan
- Monitoring component to evaluate the effectiveness of the implementation efforts over time

Although 319 plans are created to address nonpoint source pollution specifically, improvements to point source pollution control may also have great impacts on ambient water quality in the watershed. Due to the urban nature of the watershed as well as the active work of many point source facilities in water quality improvements in the area, the implementation plan also addresses point sources.

The DuPage River and Salt Creek watershed TMDLs, including this implementation plan, is considered a watershed plan that meets U.S. EPA's nine elements. Table 62 illustrates which sections of the document contain information that fulfills U.S. EPA's nine elements.

Table 62. Comparison of TMDL Study and Implementation Plan to U.S. EPA's Nine Elements

Section 319 Nine Elements	Applicable Section of the TMDL/Implementation Plan
1. Identification of **causes of impairment and pollutant sources** or groups of similar sources that need to be controlled to achieve **load reductions** estimated within the plan.	Section 5.2, 5.4, 7, 8.1
2. Estimate of the **load reductions expected from management measures**	Section 8.4, 8.5
3. Description of the **nonpoint source management measures** that will need to be implemented to **achieve load reductions** estimated in element 2; and identification of **critical areas**	Section 8.3, 8.4
4. Estimate of the amounts of **technical and financial assistance needed**, associated **costs**, and the **sources and authorities** (e.g., ordinances) that will be relied upon to implement the plan.	Section 8.5, 8.10
5. An **information and public education component**; early and continued encouragement of public involvement in the design and implementation of the plan.	Section 8.8
6. **Implementation schedule**	Section 8.6
7. A description of **interim, measurable milestones** for determining whether nonpoint source management measures or other control actions are being implemented.	Section 8.6
8. Criteria to **measure success** and **reevaluate** the plan	Section 8.6, 8.7
9. **Monitoring component** to evaluate the effectiveness of the implementation efforts over time	Section 8.9

8.1.1 Pollutants of Concern

This implementation plan addresses impairments (see Section 1.2) due to fecal coliform, chloride, and low dissolved oxygen. TMDLs have been developed to address these impairments and are provided in Section 7 (Figure 48 and Figure 49). Additional impairments in the watershed include nutrients and sediment (Figure 50). TMDLs are not provided for these impairments and needed reductions to meet water quality standards are unknown, however, activities to reduce nutrient and sediment loading are also included in this plan.

Needed fecal coliform pollutant reductions are summarized in Table 63. Note that pollutant load reductions for river and stream TMDLs are dependent upon flow regime and are provided for waters meeting the single sample maximum standard of 400 counts/100 ml (see Section 4 for a description of these standards). There were insufficient data to evaluate needed reductions to meet the geometric mean standard of 200 counts/100 ml.

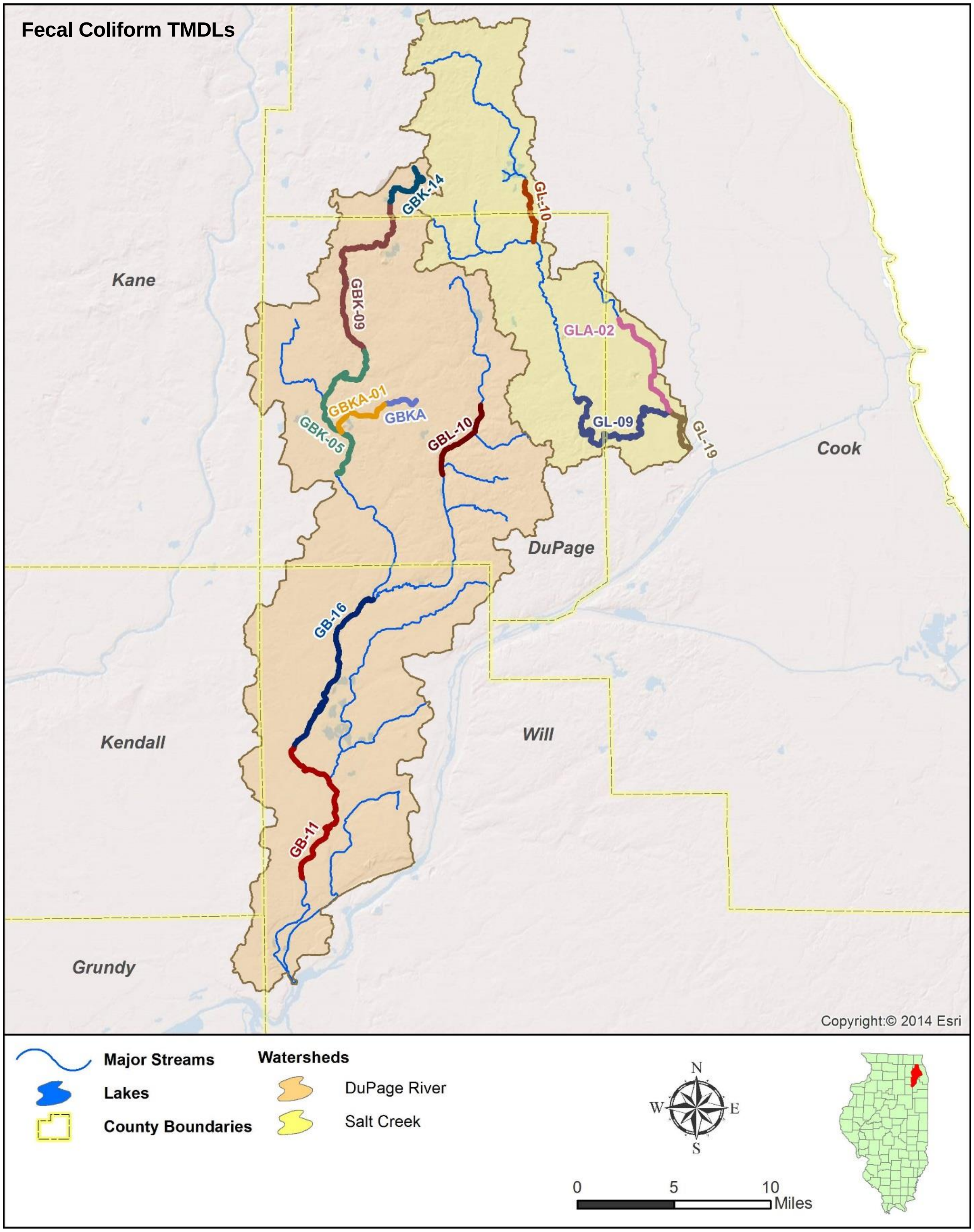

Figure 48. Fecal Coliform TMDL stream segments within the DuPage River and Salt Creek watersheds.

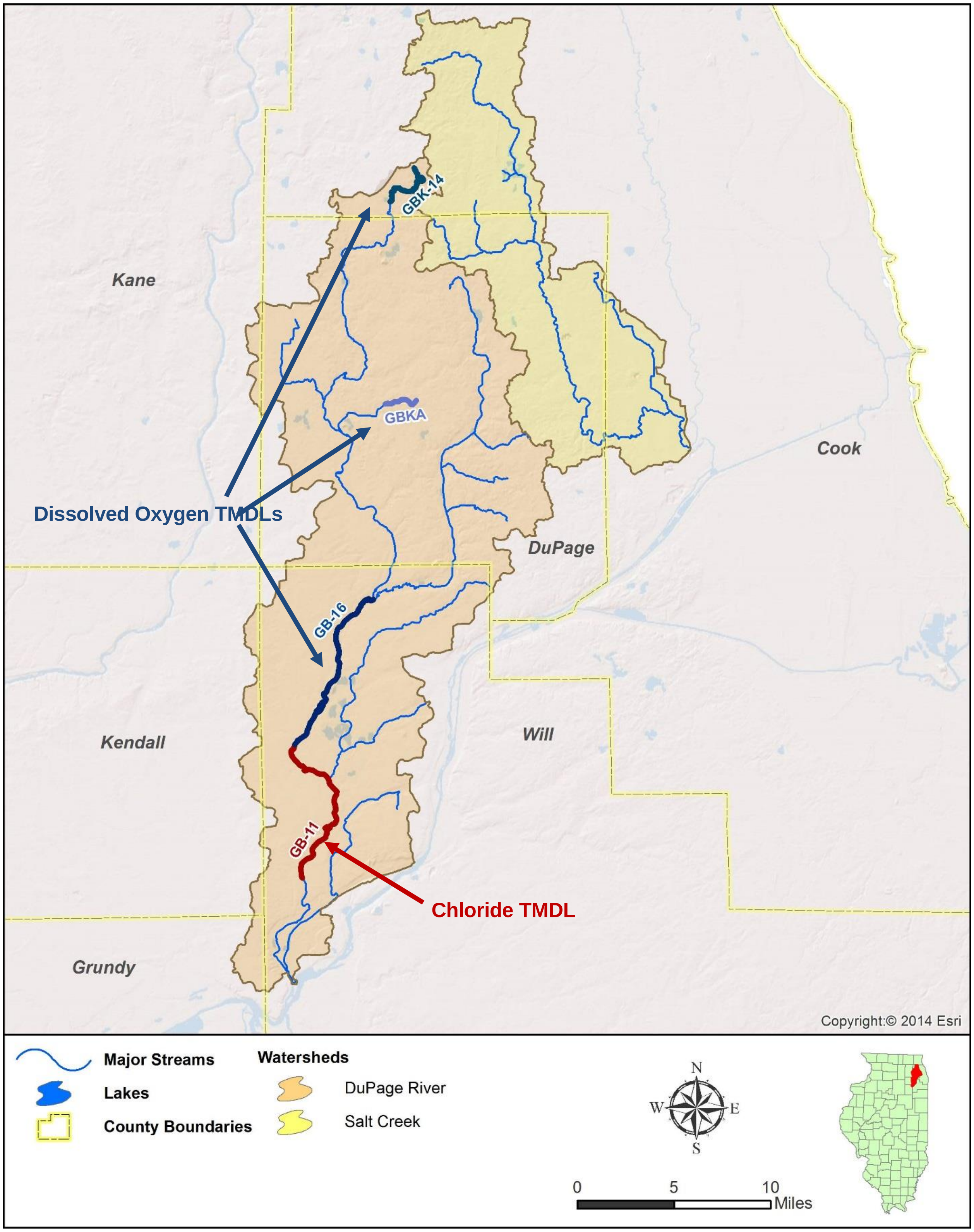

Figure 49. Dissolved oxygen and chloride TMDL stream segments within the DuPage River and Salt Creek watersheds.

Additional TMDLs have been developed previously and are not addressed in this plan, see Section 2.2.

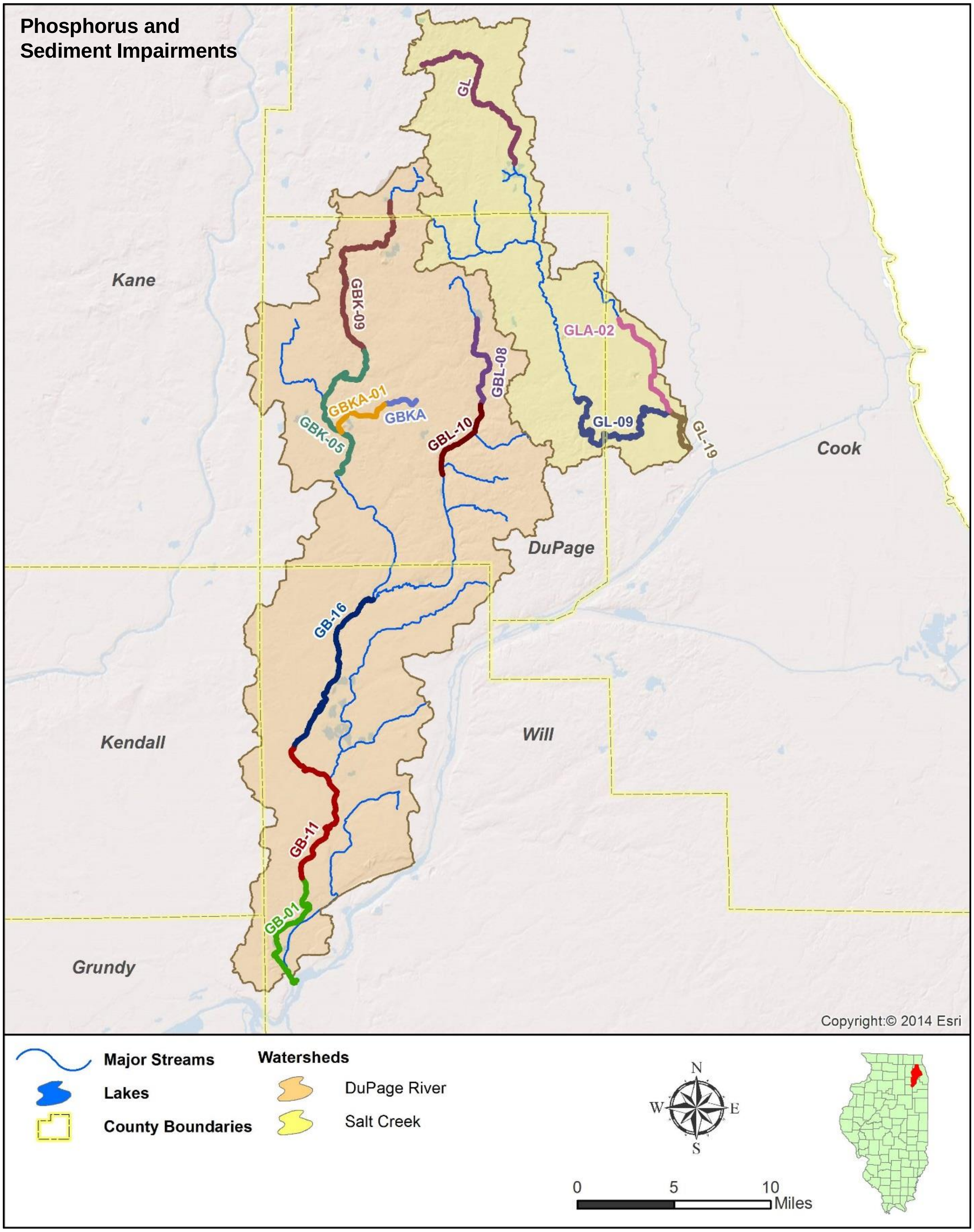

Figure 50. Phosphorus and sediment impaired streams (no TMDLs developed) within the DuPage River and Salt Creek watersheds.

Table 63. Fecal coliform reductions needed in watershed to meet the single sample maximum standard

Waterbody ID	Waterbody Name	Needed Fecal Coliform Reductions by Flow Zone				
		High Flows	Moist Conditions	Mid-Range Flows	Dry Conditions	Low Flows
GB-11	DuPage River	63%	60%	47%	0%	29%
GB-16	DuPage River	92%	90%	0%	0%	0%
GBK-05	West Branch DuPage River	97%	98%	88%	65%	70%
GBK-09	West Branch DuPage River	94%	96%	68%	92%	64%
GBK-14	West Branch DuPage River	98%	97%	88%	99%	99%
GBKA	Spring Brook	97%	94%	92%	55%	73%
GBKA-01	Spring Brook	93%	89%	48%	23%	63%
GBL-10	East Branch DuPage River	86%	89%	92%	85%	82%
GL-09	Salt Creek	97%	97%	74%	60%	33%
GL-10	Salt Creek	59%	80%	20%	69%	76%
GL-19	Salt Creek	97%	99%	76%	80%	53%
GLA-02	Addison Creek	No data	98%	98%	97%	97%

In the case of chloride, TMDLs have been developed previously for portions of the West Branch DuPage River, East Branch DuPage River, and Salt Creek. A new TMDL has been developed for GB-11 as part of this study. This stream segment is located at the downstream end of the Lower DuPage River. Reductions in chloride in GB-11 range from 47-74% and are needed during both winter and non-winter seasons. Existing TMDLs were developed to address chloride in the East Branch and West Branch DuPage Rivers; implementation of the GB-11 TMDL relies on meeting water quality standards in these upstream reaches per their respective TMDLs which require a 33-35% reduction in chloride loading.

TMDLs that address low dissolved oxygen conditions have also been previously developed for portions of the East Branch DuPage River and Salt Creek. Three additional TMDLs that address low dissolved oxygen conditions were developed for this study: GB-16 (segment on Lower DuPage River), GBKA (Spring Brook, tributary to West Branch DuPage River), and GBK-14 (headwaters to West Branch DuPage River). Implementation targets have been provided for each of these impaired stream segments that include a mix of point source permit compliance or point source reductions along with reductions to nonpoint sources such as SOD.

In addition to the TMDL pollutants described above, other nonpoint sources of pollutants exist in the watershed resulting in sediment and nutrient loading. While no TMDLs are provided for these pollutants, nonpoint sources of these pollutants are important to overall watershed health and are addressed within this plan.

8.1.2 Planning Area

The DuPage River and Salt Creek watersheds are comprised of four main subwatersheds including the East Branch DuPage River, West Branch DuPage River, Lower DuPage River, and Salt Creek (Figure 51), however, the planning area for this document only covers the East Branch, West Branch and Lower DuPage rivers. An implementation planning effort is underway for Salt Creek by the Chicago Metropolitan Agency for Planning (CMAP). This plan is anticipated to be competed in 2018 and will address both the impaired waters in the Salt

Creek watershed as well as other water quality concerns. In addition to the Salt Creek watershed planning effort, other smaller planning efforts have been completed or are underway (see Table 64). In these areas, the local watershed plans will take precedence. Portions of this implementation plan are divided into the main subwatersheds: East Branch, West Branch, and the Lower DuPage. This format allows analysis and recommendations at the appropriate scale for each subwatershed, highlights the unique characteristics of the subwatershed, and addresses the specific concerns and objectives of local stakeholders and organizations as described in existing plans.

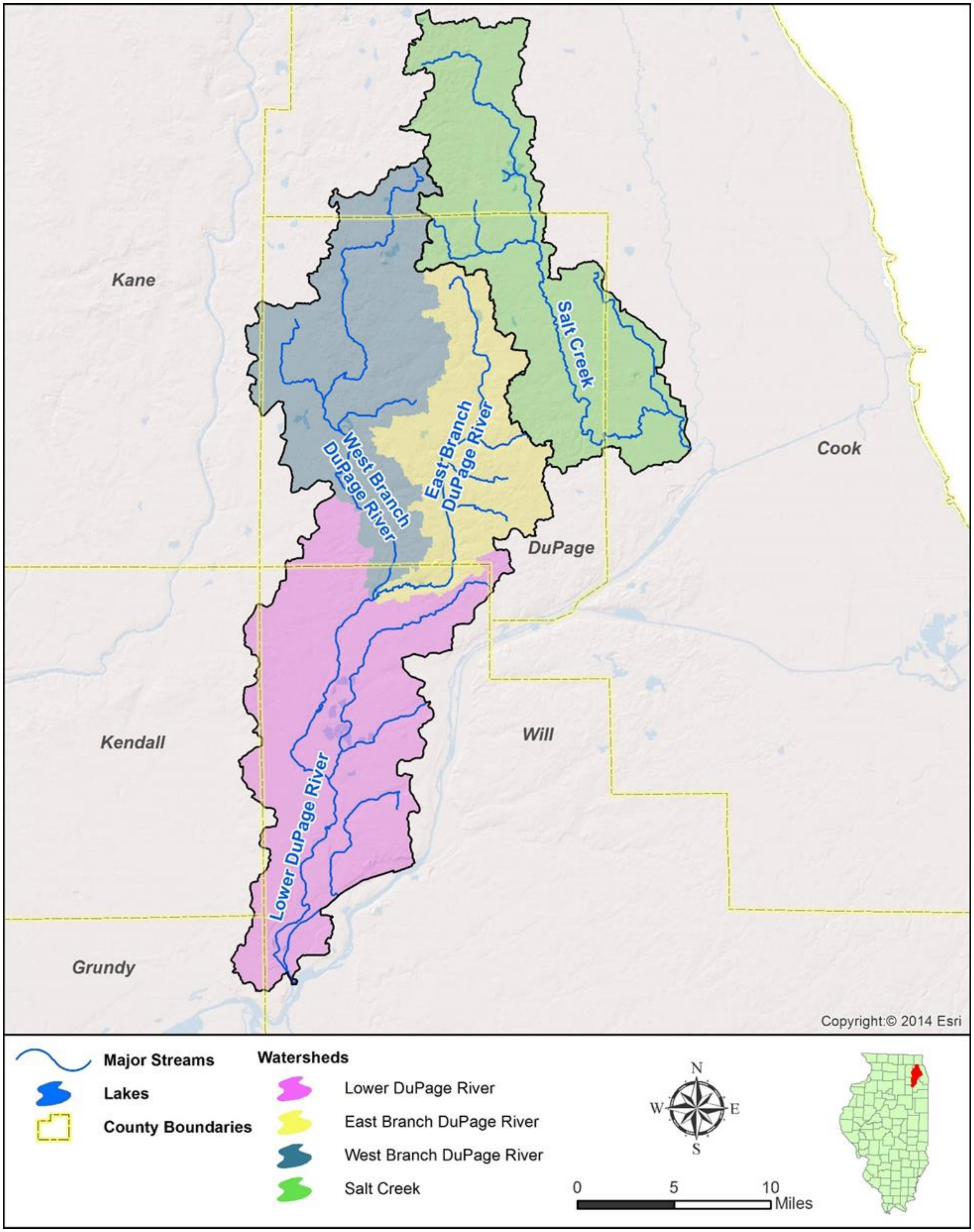

Figure 51. DuPage River and Salt Creek subwatersheds.

East Branch DuPage River Watershed

The East Branch DuPage River subwatershed covers approximately 81 square miles in the east central portion of the DuPage River and Salt Creek watersheds (Figure 52). The headwaters begin in the Village of Bloomingdale and flow south until the confluence with the West Branch DuPage and start of the Lower DuPage River. The subwatershed lies mainly in DuPage County but includes portions of Will County in the south. Pollutants of concern include fecal coliform, nutrients, and sediment.

The watershed is highly urbanized and developed with many channelized streams. Land use is predominantly residential. Riparian buffers are generally in poor condition with little vegetation and tree cover (Midwest Biodiversity Institute 2014). During the summer-fall season, the mainstem is dominated by effluent discharge from communities' wastewater treatment plants (WWTPs) (Hey and Associates et al. 2015). The watershed contains several unique natural areas including the Morton Arboretum, a 1,700 acre property that contains more than 222,000 live plants and eight Illinois Natural Areas Inventory sites that include high quality natural community or restoration, suitable habitat for listed species, and nature preserves, reserves or landmarks. The Churchill Woods Dam was modified in 2011 by watershed partners (DuPage County Stormwater Management, Forest Preserve District of DuPage County, and DRSCW) and restoration activities took place in the impoundment footprint upstream of the dam in an effort to improve water quality and promote fish passage.

West Branch DuPage River

The West Branch DuPage River subwatershed covers 128 square miles in the northwestern portion of the DuPage River and Salt Creek watersheds (Figure 53). The West Branch DuPage River begins near Schaumburg flowing south until its confluence with the East Branch DuPage River and start of the Lower DuPage River between Naperville and Bolingbrook. The main stem of the West Branch DuPage River measures 34 miles in length and is fed by 10 major tributaries. Land use is predominantly residential and urban with some agricultural land use in the western portions of the watershed. The watershed lies mainly within DuPage County, but encompasses portions of Kane, Cook, and Will counties. Pollutants of concern include fecal coliform, nutrients, and sediment. In addition, low dissolved oxygen conditions are present in two headwater reaches. The subwatershed contains several Forest Preserves including two that border the mainstem: West Branch and Blackwell. In 2008, the McDowell Grove dam was removed through a NRCS funded project in an effort to improve water quality and fish passage. DuPage County Stormwater Management has conducted multiple water quality and flood control projects along the West Branch since 2005. These projects have resulted in the removal of the Warrenville Grove Dam, 13 acres of floodplain restoration, stabilization of 7,625 linear feet of streambank, restoration of more than 58 acres of wetland and riparian vegetation, amongst other improvements.

Lower DuPage River

The Lower DuPage River subwatershed covers 168 square miles in the southern most portion of the DuPage River and Salt Creek watersheds (Figure 54). The Lower DuPage River begins at the confluence of the East and West Branches of the DuPage River within the DuPage River Confluence Preserve and flows south until its confluence with the Des Plaines River. The watershed is unique as it includes portions of the Illinois and Michigan Canal, a manmade canal which connects the river system to Lake Michigan located at its confluence with the Des Plains River (The Conservation Foundation 2011). In addition, the Lower DuPage River contains the 829 acre Lake Renwick Nature Preserve and the Heron Rookery Nature Preserve that provide refuge for several species of bird including, herons, egrets, cormorants, bald eagles, American white pelicans and several other winter water fowl (Forest Preserve District of Will County).

The subwatershed mostly lies within Will County but also includes small portions of DuPage, Grundy, and Kendall counties. The watershed contains 166 miles of streams and eight major tributaries. Land use is predominantly residential with portions of agricultural and commercial land. Agricultural land use, however, is expected to decrease in the near future as development pressure increases, in some cases, up to 400% from 2000-2030 (see Section 3 of the TMDL). Pollutants of concern include fecal coliform, nutrients, sediment, and chloride. Low dissolved oxygen conditions are also present in one reach.

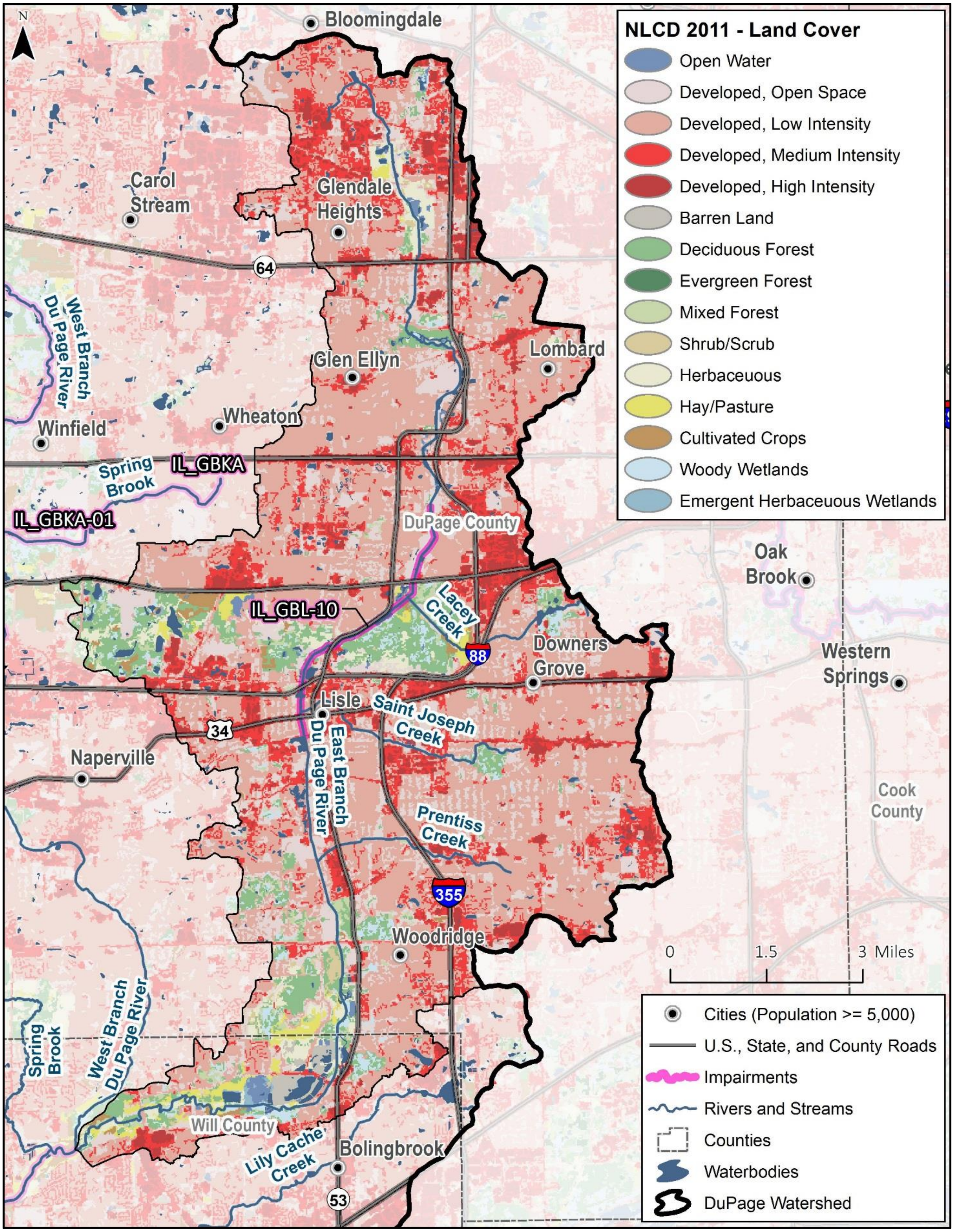

Figure 52. East Branch DuPage River subwatershed land use.

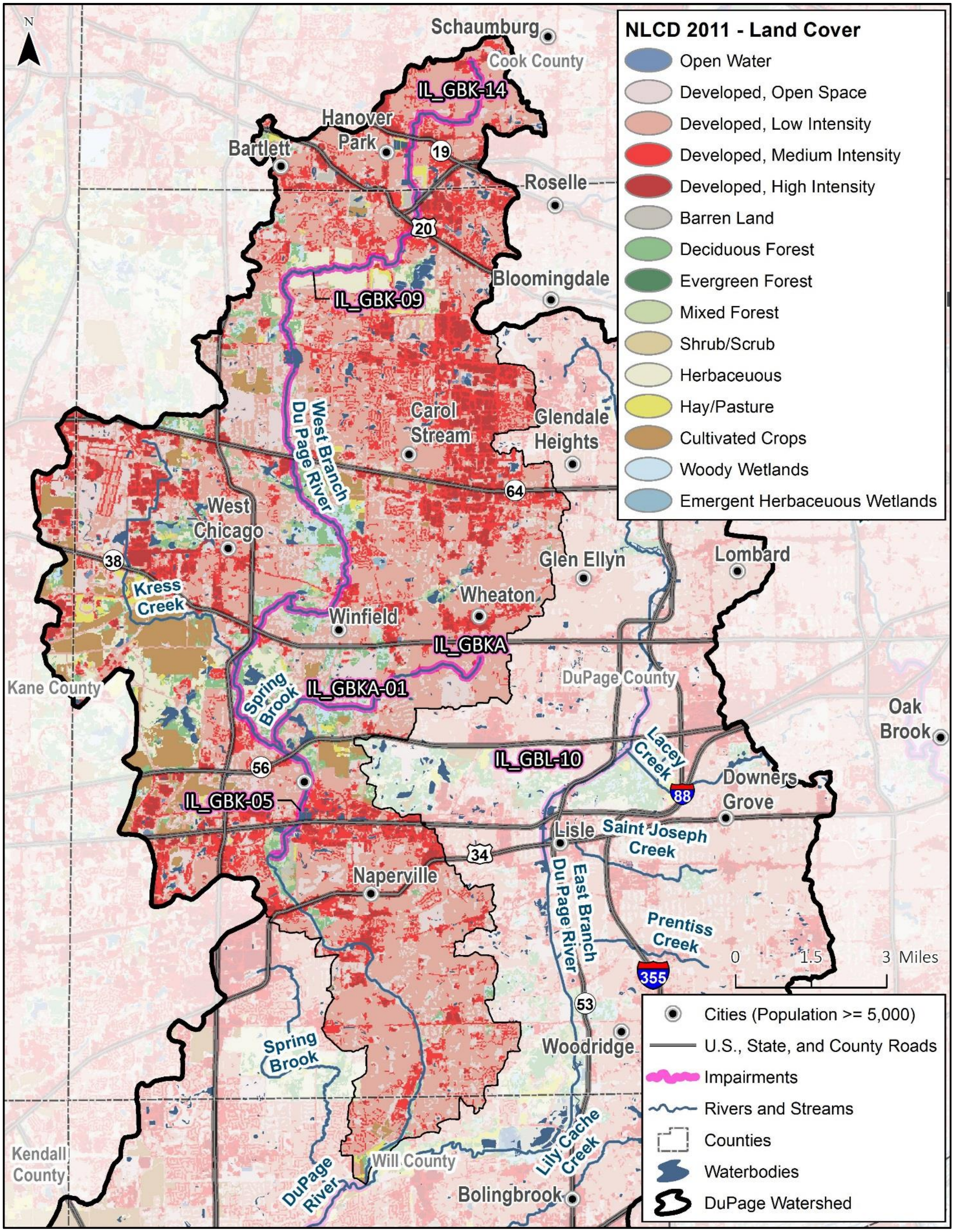

Figure 53. West Branch DuPage River subwatershed land use.

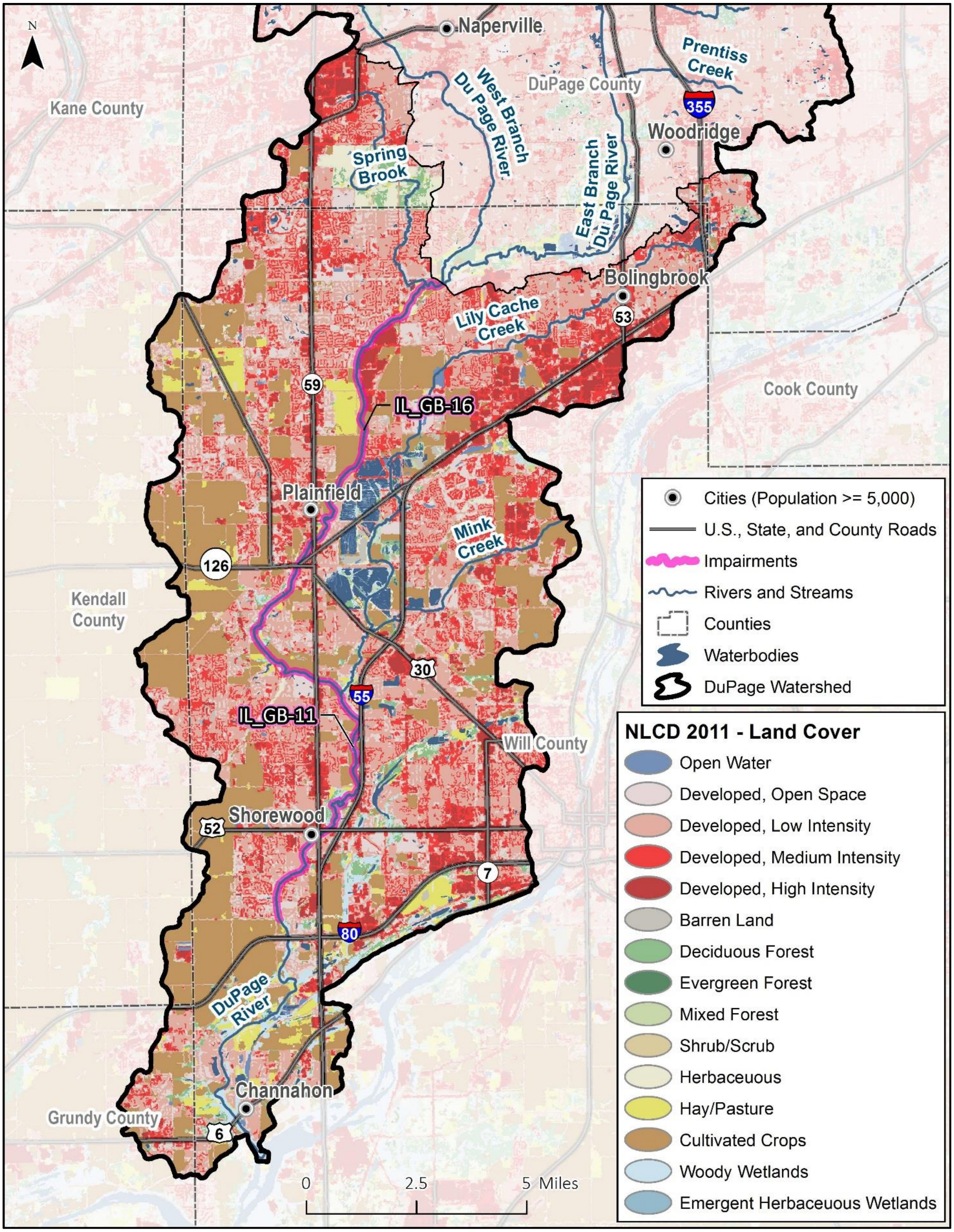

Figure 54. Lower DuPage River subwatershed land use.

8.1.3 Existing and On-Going Planning Efforts

Portions of the DuPage River and Salt Creek watersheds have been the subject of watershed planning efforts developed on smaller, HUC12 watershed scales. Existing watershed plans such as these provide important local and regional stakeholder knowledge in addition to reasonable assurance that water quality improvement work will continue in the DuPage River watershed. This implementation plan incorporates and builds upon the concerns, priorities, recommendations, and data from these past planning efforts. Elements from exiting plans were incorporated, as appropriate. Table 64 provides a summary of existing watershed plans in the watershed including planned BMPs and involved parties.

In addition to watershed plan development, the DRSCW has developed an Implementation Plan (DRSCW 2015) to guide implementation activities that will result in attainment of aquatic life uses. The DRSCW uses statistical techniques to evaluate the relationship between observed aquatic communities and possible stressors. Possible stressors include landscape scale stressors (such as road density and basin size), ambient chemistry (such as chloride and phosphorous concentrations) and physical (using sub components of the QHEI such as measures of buffer width and stream sinuosity). The Identification and Prioritization System or IPS uses these and other data to identify and prioritize restoration opportunities in an adaptive management framework. The IPS prioritizes projects based on their ability to:

- Address the most limiting stressors at a reach level
- Prioritize reaches for intervention
- Establish restoration endpoints
- Provide a level of confidence in the likelihood of success
- Have measurable outcomes

The highest priority projects have already been placed within the permit special conditions (see Table 69), and additional projects have also been identified (see Section 8.5).

Table 64. Existing and on-going planning efforts

Plan (Year)	Involved Parties	Purpose/Objectives	319 Status	Example BMPs in Plan
East Branch DuPage River Watershed				
St. Joseph Creek Watershed Plan (2017)	• DCSM • St. Joseph Creek Watershed Steering Committee: TCF, FPDDC, DRSCW, ComEd, ISTHA, municipalities, park districts, school districts, townships, sanitary districts • East Branch Watershed Protection Workgroup	Mission: To improve the quality of St. Joseph Creek and the surrounding watershed to meet federal, statewide and regional water quality initiatives for BOD, total phosphorus, total nitrogen, total suspended solids and oil and grease Driven by stakeholder input, long-term monitoring and regional, statewide and federal water quality goals	Approved 2017	• Bioretention • Wetland restoration • Stream stabilization • Stream daylighting • Detention basin retrofits • Riparian buffer enhancements • Permeable pavers
East Branch DuPage River Watershed & Resiliency Plan (2015)	• DCSM	Identify opportunities to enhance water quality, flood risk, and community well-being through coordinated actions, investments, and public engagement Enhance resilience, environmental quality, and community cohesion throughout the East Branch subwatershed	Not eligible	• Native vegetation • Residential stormwater BMPs • Permeable pavers • Bioretention • Green infrastructure • Wetland restoration • Native riparian buffers • Review regulatory regulations
West Branch DuPage River Watershed				
Kress Creek Watershed-Based Plan	• DCSM • FPDDC • TCF • DRSCW • ComEd • IDOT • DuPage Airport Authority • Local authorities • Sanitary districts	Develop recommendations to improve the quality of Klein Creek and its surrounding areas	Approved 2017	• Bioretention • Bioswale • Oil and grit separators • Permeable pavers
Winfield Creek Watershed Plan (2017)	• DCSM • FPDDC • TCF • DRSCW • IDOT • ComEd • Local municipalities • Park districts • Townships • Sanitary districts	Develop recommendations to improve water quality in Winfield Creek and its surrounding areas	Approved 2017	• Infiltration practices • Permeable pavers • Detention basins retrofits • Riparian buffers • Wetland restoration • Daylighting

Plan (Year)	Involved Parties	Purpose/Objectives	319 Status	Example BMPs in Plan
Klein Creek Watershed-Based Plan	• DCSM • FPDDC • TCF • DRSCW • ComEd • IDOT • Local municipalities • Sanitary districts • West Branch Watershed Protection Workgroup	Develop recommendations to improve the quality of Klein Creek and its surrounding areas	Approved 2017	• Bioretention • Bioswale • Oil and grit separators • Permeable pavers
Spring Brook No.1 Watershed Plan	• DCSM • ACOE • CMAP • DuPage County Health Department • DRSCW • FPDDC • TCF • Wheaton Park District	Improve water quality and stream geomorphology within the watershed Update County and local ordinances to protect watershed resources Incorporate green infrastructure into the watershed, whenever possible Manage and mitigate for existing and future flood problems Implement additional outreach throughout the watershed	Approved 2015	• Pre-wetting/anti-icing techniques and better salt storage/handling • Streambank stabilization with bioengineering • Riparian buffer work • Naturalize ponds • Pool and riffles, sinuosity, dam modification, habitat/refuge for aquatic life • Green infrastructure and bioretention • Protect natural areas around city
Lower DuPage River Watershed				
Lower DuPage River Watershed Plan	• TCF	Address water quality impairments and prevent further degradation Identify stakeholders, problems, solutions and funding sources Protect natural resources Restore stream health Establish and protect buffers and greenway corridors through the creation of a prioritized map Protect and restore streambanks and floodplain Identify areas for restoration and protection Reduce nutrient enrichment Attain data necessary to assess and monitor stream quality Improve recreational opportunities, access and awareness Reduce flooding and flood damage Reduce erosion	Approved 2011	• Buffer/filter strips • Cover crops • Conservation tillage • Grassed waterways • Nutrient/waste management • Wetland restoration • Bioretention • Constructed wetland • Filtration basin • Green roofs • Naturalized stream buffer • Porous pavement • Rain barrels/cisterns • Road salt application calibration and Storage • Stream restoration • Vegetated swale/bioswale

Plan (Year)	Involved Parties	Purpose/Objectives	319 Status	Example BMPs in Plan
		Enhance stewardship in the watershed through education, outreach, and communication		
DuPage County				
Natural Treasures of DuPage County: Open Space and Natural Areas Plan	• TCF • FPDDC • Local municipalities	Coordinate the efforts of all local and regional open space organizations in the acquisition or protection of property that will benefit and improve the quality of life for the residents of DuPage County Protect forests, woodlands, prairies, wetlands, watersheds, streams and river corridors	NA	• Riparian buffer and habitat improvements • Daylight and re-meander streams • Green infrastructure • Detention basin retrofits • Permeable pavers • Wetland restoration

Notes:
ACOE: Army Corps of Engineers
CMAP: Chicago Metropolitan Agency for Planning
ComED: Commonwealth Edison Electric Company
DCSM: DuPage County Stormwater Management
DRSCW: DuPage River Salt Creek Workgroup
FPDDC: Forest Preserve District DuPage County
IDOT: Illinois Department of Transportation
ISTHA: Illinois State Toll Highway Authority
TCF: The Conservation Foundation

8.2 Nonpoint Source Assessment

Nonpoint sources of pollutants in the watershed are primarily related to runoff from agricultural land uses. However, in order to more fully assess the impacts of runoff in the watershed, all land covers were evaluated. The *Spreadsheet Tool for the Estimation of Pollutant Load* (STEPL) model is used to quantify watershed loadings in the East Branch DuPage River, West Branch DuPage River, and Lower DuPage River watersheds. STEPL modeling is being conducted by CMAP for the Salt Creek watershed and nonpoint sources for the Salt Creek watershed will be described in CMAP's Salt Creek Watershed Plan when completed. STEPL provides a simplified simulation of precipitation-driven runoff and sediment and nutrient delivery. STEPL has been used extensively in U.S. EPA Region 5 for watershed plan development and in support of watershed studies.

Model catchments were developed using existing catchment delineations provided by DuPage and Will counties and range from approximately 2,000 to 14,000 acres. Land cover data for the STEPL analysis were provided by CMAP. Appendix H includes a summary of CMAP land use classifications as used in the STEPL model. Existing BMPs and point sources are not included in the STEPL model setup. Annual pollutant loads of phosphorus, sediment, and BOD were calculated; results are provided below by subwatershed and in Appendix I.

At the time of this work, STEPL did not estimate fecal coliform nor chloride loading and reductions, therefore a qualitative approach was used to identify potential sources for each pollutant. For the purposes of this implementation plan, developed land cover is used as an indicator of both chloride and fecal coliform due to its imperviousness nature and likely presence of storms sewers.

East Branch DuPage River Subwatershed

The East Branch DuPage River watershed is heavily urbanized and urban sources contribute the vast majority of pollutants to the subwatershed. Cropland and other undeveloped land uses contribute less than 1% to phosphorus and BOD loading in the watershed and less than 3% of the total sediment loading. Additionally, as part of implementation development, a coarse analysis using air photos was conducted to identify potential areas of erosion; none were found. This analysis, combined with STEPL results, indicates that sediment loading is most likely coming from urban watershed sources such as stormwater runoff from impervious areas. Figure 55 provides a breakdown of the percent of annual runoff attributed to the various urban land uses. Transportation, or roads, contribute the highest level of runoff on an average annual basis. Pollutant loading from STEPL by model catchment are provided in Figure 56 through Figure 58 and the percent of developed land cover per model catchment is provided in Figure 59.

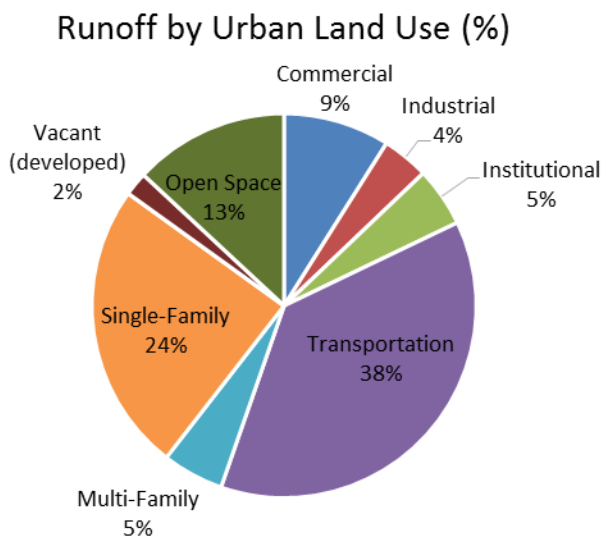

Figure 55. Percent total runoff from STEPL by urban land uses in the East Branch DuPage River subwatershed.

The East Branch DuPage River includes one fecal coliform impaired segment. There are no identified impairments upstream and therefore this implementation plan assumes that sources of fecal coliform are found in the direct drainage area of the impaired segment. Wastewater and stormwater runoff are the most likely source of fecal coliform to this impaired segment, although potential cross connections between sanitary sewers and storm sewers could also be present.

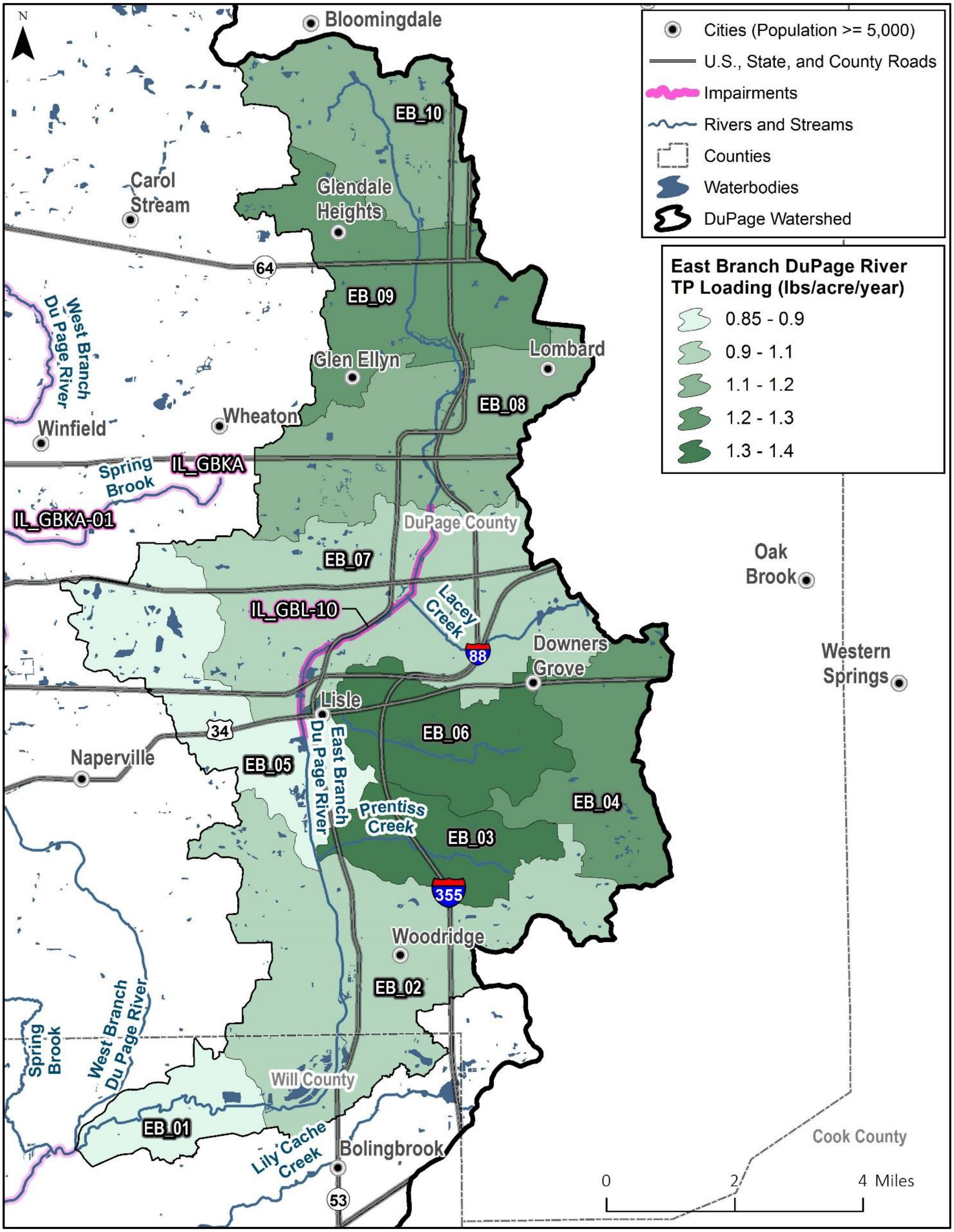

Figure 56. Annual phosphorus loading from STEPL in the East Branch DuPage River subwatershed.

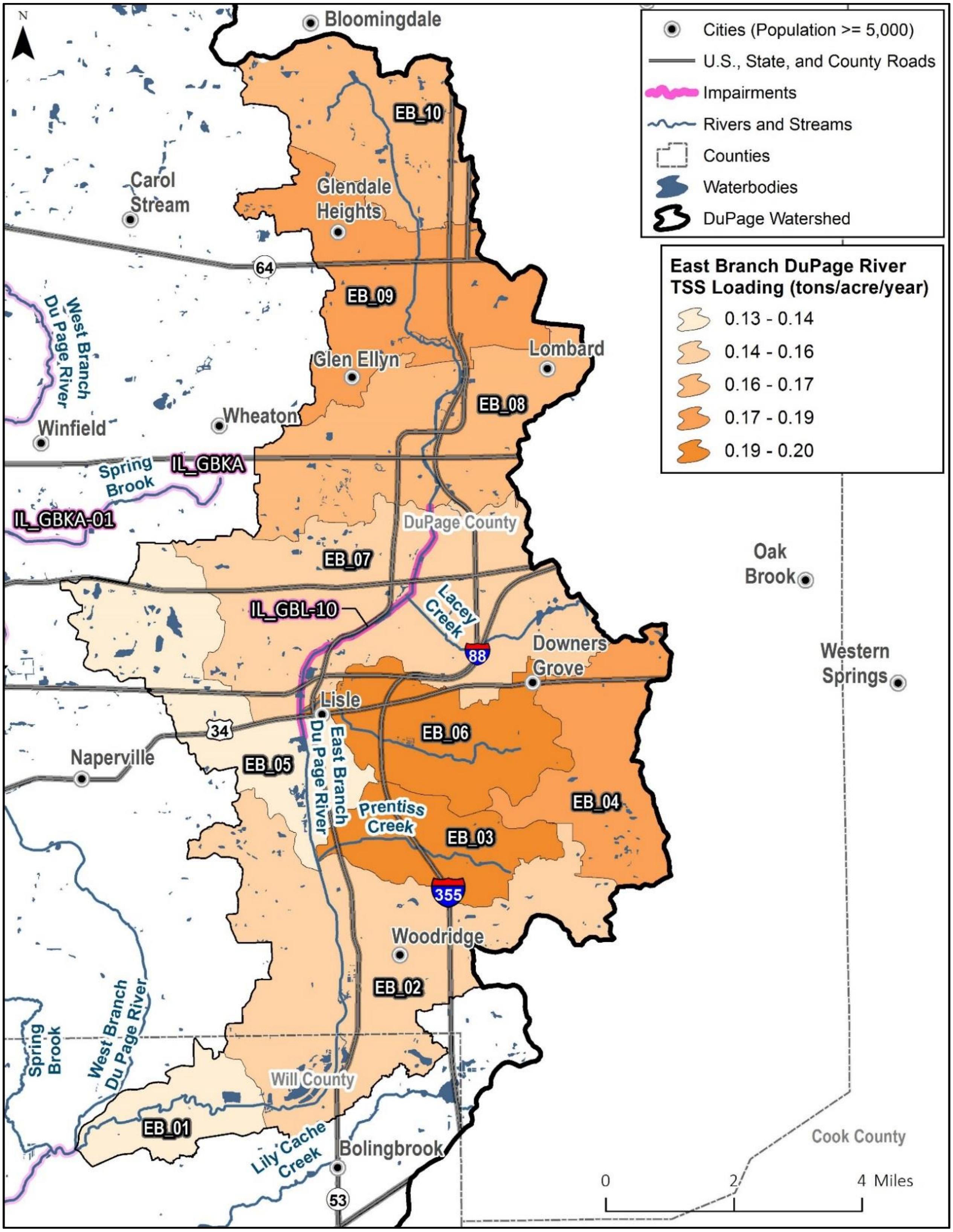

Figure 57. Annual sediment loading from STEPL in the East Branch DuPage River subwatershed.

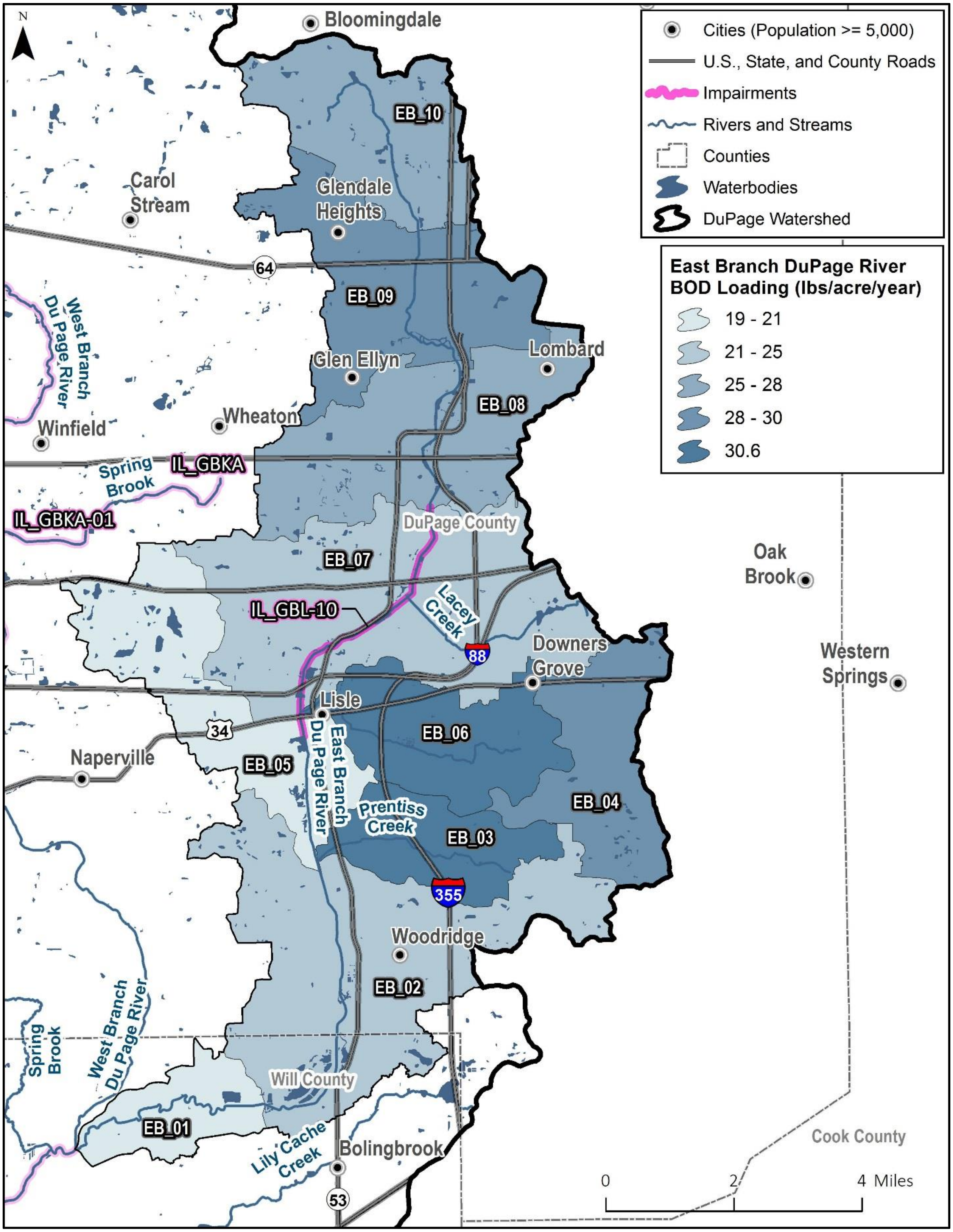

Figure 58. Annual BOD loading from STEPL in the East Branch DuPage River subwatershed.

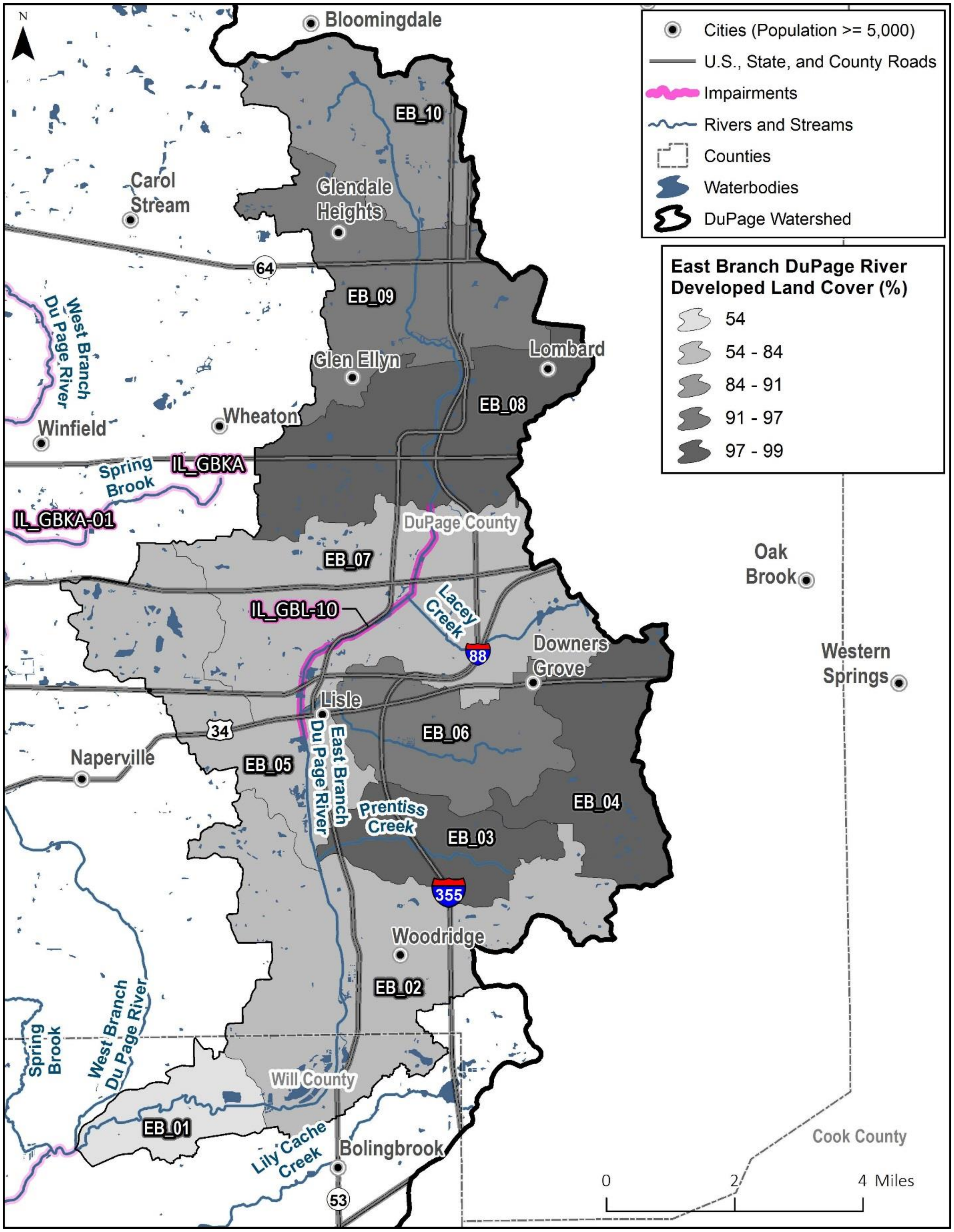

Figure 59. Developed land cover in the East Branch DuPage River subwatershed (NLCD 2011).

West Branch DuPage River Subwatershed

Similar to the East Branch DuPage River, urban land uses contribute the majority of watershed pollutant loads in the West Branch DuPage River subwatershed. Cropland and other undeveloped land uses contribute between two and 18% of the total pollutant load. The streambank erosion analysis found no major areas of erosion within the watershed, therefore the majority of sediment loading is most likely coming from urban watershed sources such as stormwater runoff from impervious areas. A breakdown of urban runoff sources in the watershed is provided in Figure 60. Transportation, or roads, contribute the highest level of runoff on an average annual basis. Pollutant loading from STEPL by model catchment are provided in Figure 61 through Figure 63, and the percent of developed land cover per model catchment is provided in Figure 64.

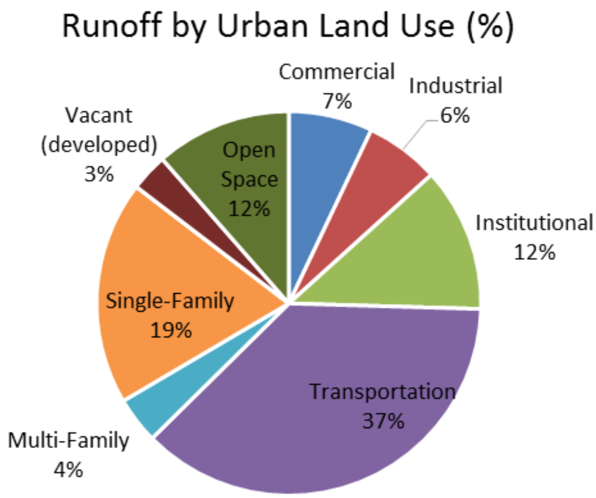

Figure 60. Total runoff from STEPL by urban land use in the West Branch DuPage River watershed.

The West Branch DuPage River is impaired for fecal coliform along five segments starting in the headwaters. Stormwater and wastewater are the primary sources of fecal coliform in this subwatershed. Two fecal coliform-impaired reaches do not have any wastewater (GBK-14 and GBKA). These two reaches demonstrate the potential for stormwater only to cause impairments, although there is the possibility of cross connections between sanitary sewers and storm sewers. The same two headwater reaches are also impaired for low dissolved oxygen. Low dissolved oxygen conditions are primarily due to habitat/channel geometry and sediment oxygen demand (SOD). SOD is in part a result of organic matter decomposing within the stream channel. Reduction in watershed loading of phosphorus, sediment, and BOD will work towards reductions in SOD over time. In the case of GBK-14, additional evaluation of conditions contributing to low dissolved oxygen is needed. Specifically, sampling along the length of the segment is needed as well as monitoring of the outflow from the large retention pond in the upper reaches.

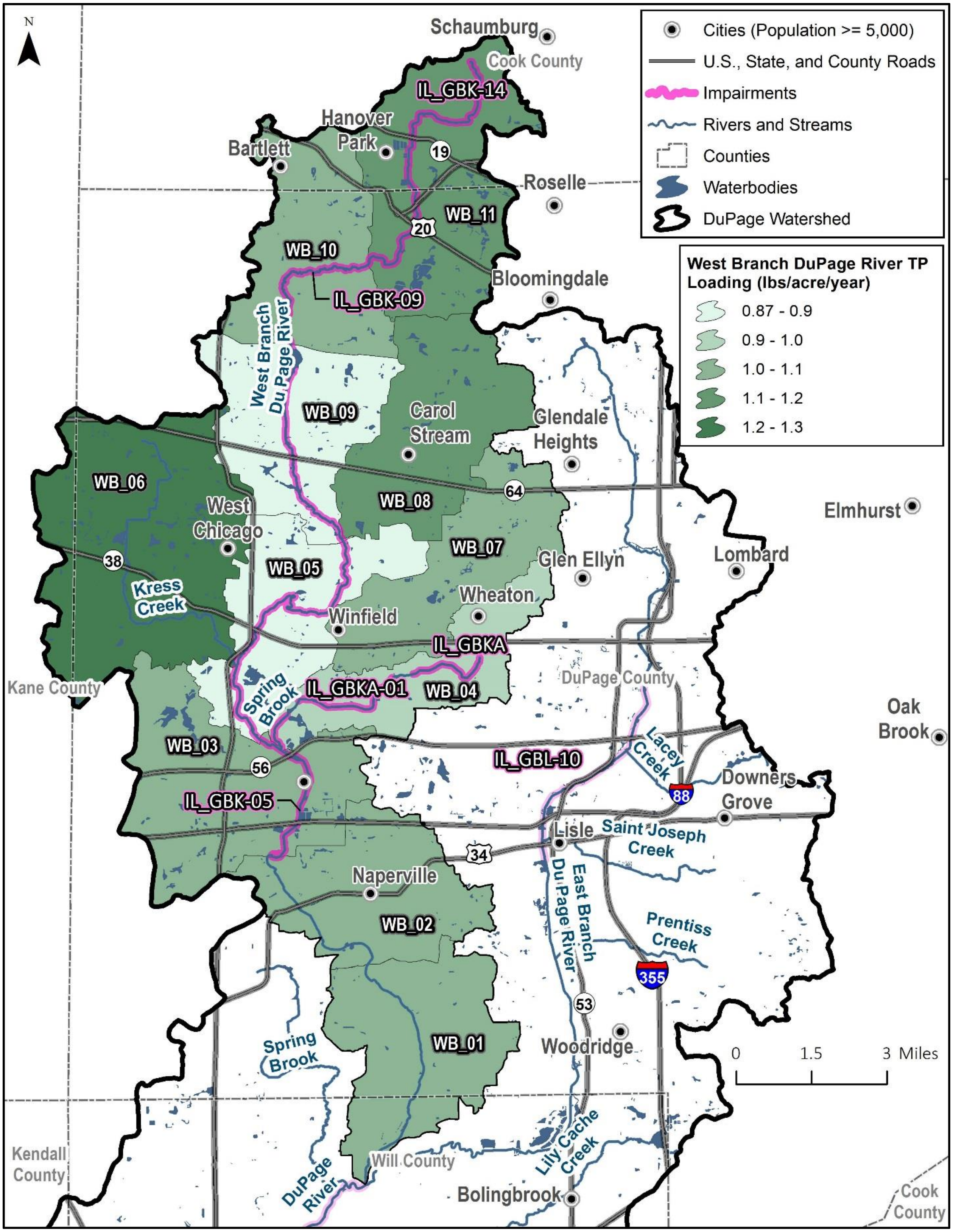

Figure 61. Annual phosphorus loading from STEPL in the West Branch DuPage River subwatershed.

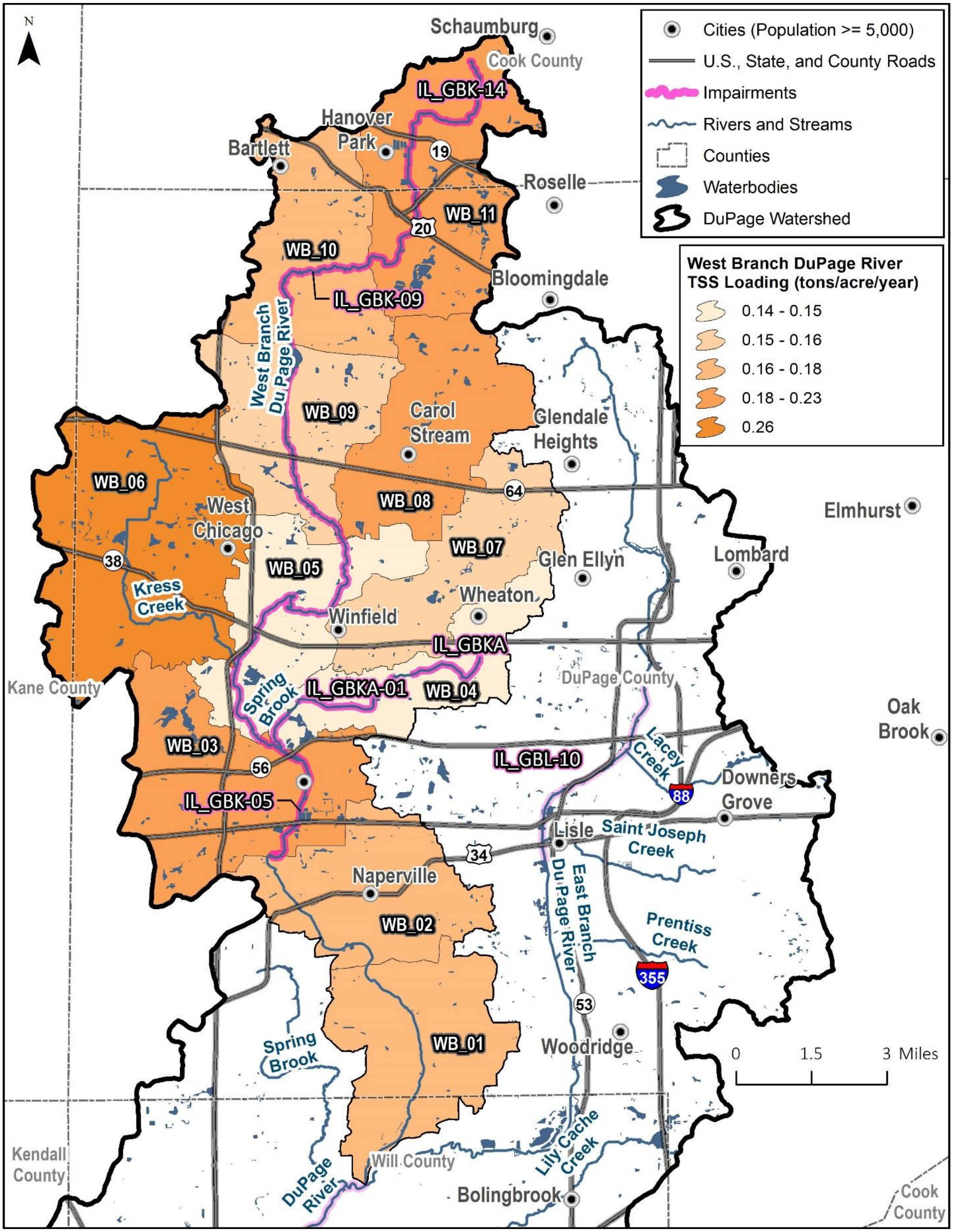

Figure 62. Annual sediment loading from STEPL in the West Branch DuPage River subwatershed.

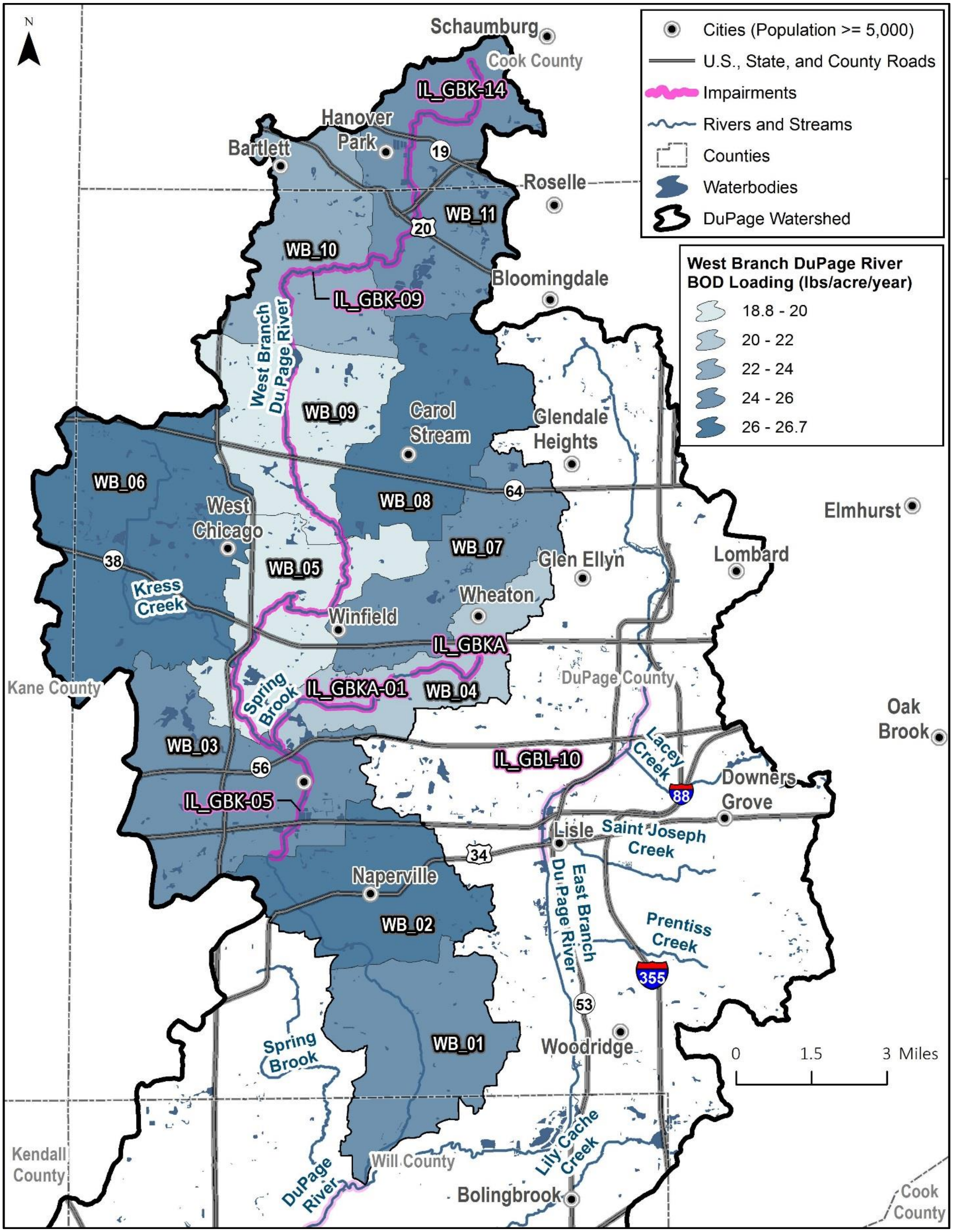

Figure 63. Annual BOD loading from STEPL in the West Branch DuPage River subwatershed.

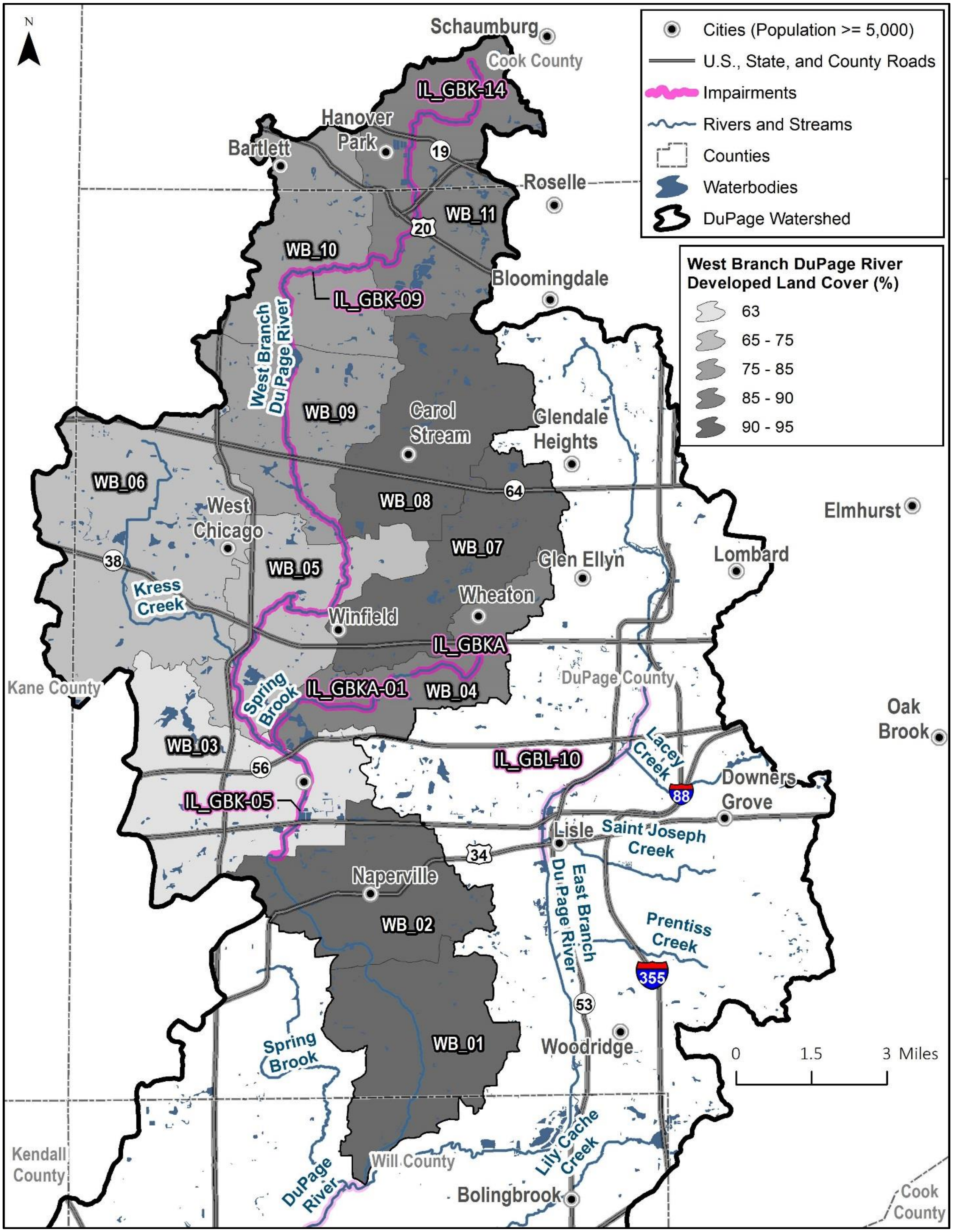

Figure 64. Developed land cover in the West Branch DuPage River subwatershed (NLCD 2011).

Lower DuPage River Subwatershed

The Lower DuPage River subwatershed is influenced by contributions from the East Branch and West Branch of the DuPage River. Two segments along the Lower DuPage River are impaired for fecal coliform and either low dissolved oxygen or chloride. There are no fecal coliform impairments identified for the reaches that are directly upstream of the Lower DuPage River. In addition, there is no identified chloride impairment immediately upstream. Therefore, this implementation plan assumes that sources of pollutants affecting these impairments are located in the direct drainage areas to the impaired segments. Stormwater, wastewater, and agricultural runoff are the primary sources of fecal coliform and chloride in the subwatershed.

The low dissolved oxygen impairment (GB-16) is the result of point source discharges, SOD, and upstream contributions. In addition, loads from the East Branch and West Branch are influencing the headwater of GB-16 with high phosphorus concentrations and lower dissolved oxygen. The cause of low dissolved oxygen conditions within the watershed is not yet clearly understood. It is likely a combination of stormwater, wastewater, SOD, and in-channel habitat. Permitted facilities in the watershed are being required to reduce point source nutrient loading as part of a basin-wide permit; they are also funding several habitat improvement projects. Loading of biochemical oxygen demand (BOD) and potential reductions is provided in this implementation plan to help inform implementation activities.

Annual loads by source category are summarized in Figure 65, Figure 66, and Figure 67 for total phosphorus and total BOD (pounds per year) and sediment (tons per year), respectively. While urban sources of pollutants are dominant in the East and West Branch DuPage River subwatersheds, cropland contributes much more of the total phosphorus and BOD loading, and is the dominant source of sediment in the Lower DuPage River subwatershed. The streambank erosion analysis found no major areas of erosion within the watershed. This, combined with STEPL results indicate that sediment loading is most likely coming from cropland areas in the Lower DuPage River watershed. A further break down of runoff being generated in urban areas is provided in Figure 68. Urban runoff in the Lower DuPage River subwatershed is predominantly from transportation, or roads. Pollutant loading from STEPL by model catchment are provided in Figure 69, through Figure 71, and the percent of developed land cover per model catchment is provided in Figure 72.

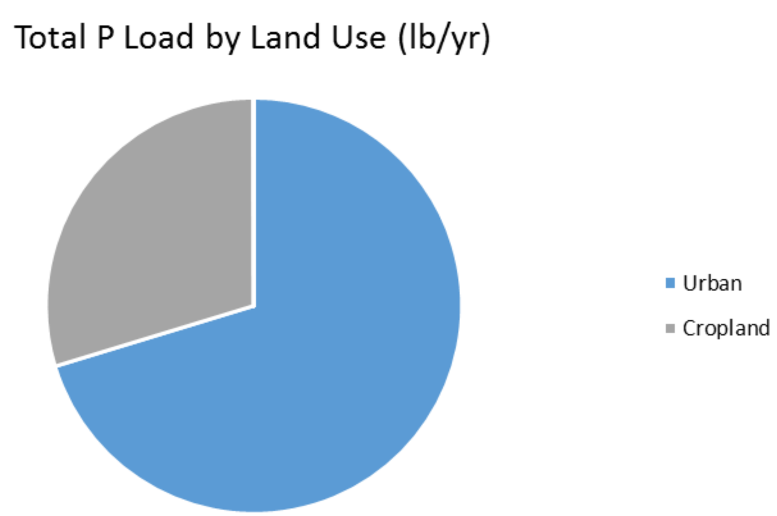

Figure 65. Total phosphorus loading from STEPL to the Lower DuPage River subwatershed by land use.

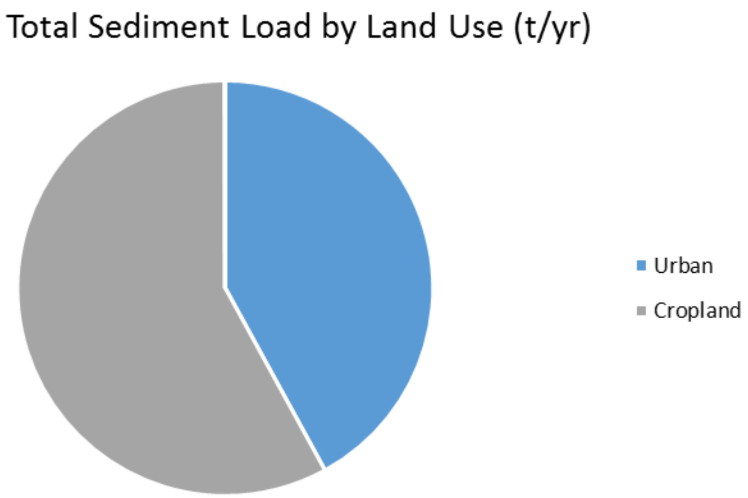

Figure 66. Total sediment loading from STEPL to the Lower DuPage River subwatershed by land use.

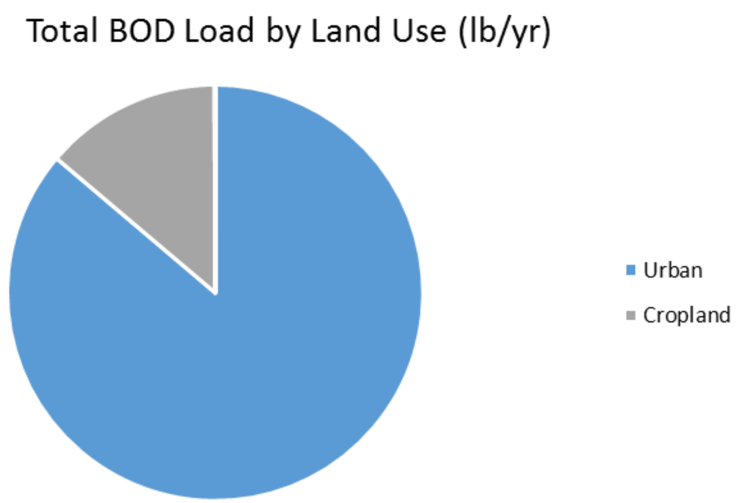

Figure 67. Total BOD loading from STEPL to the Lower DuPage River subwatershed by land use.

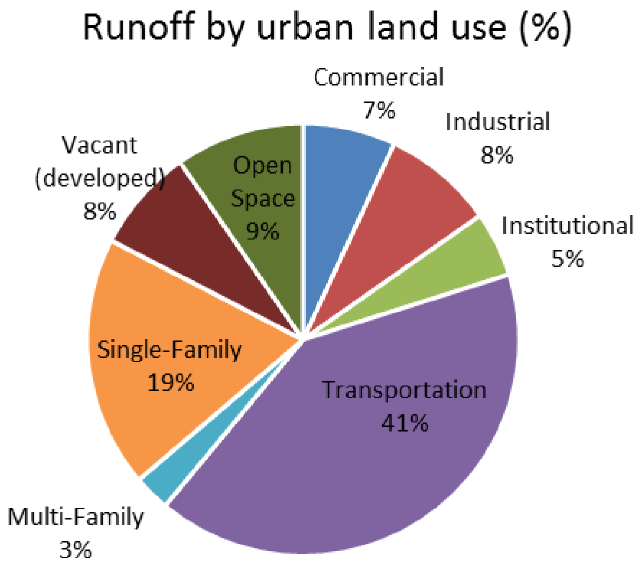

Figure 68. Total runoff from STEPL by urban land use in the Lower DuPage River subwatershed.

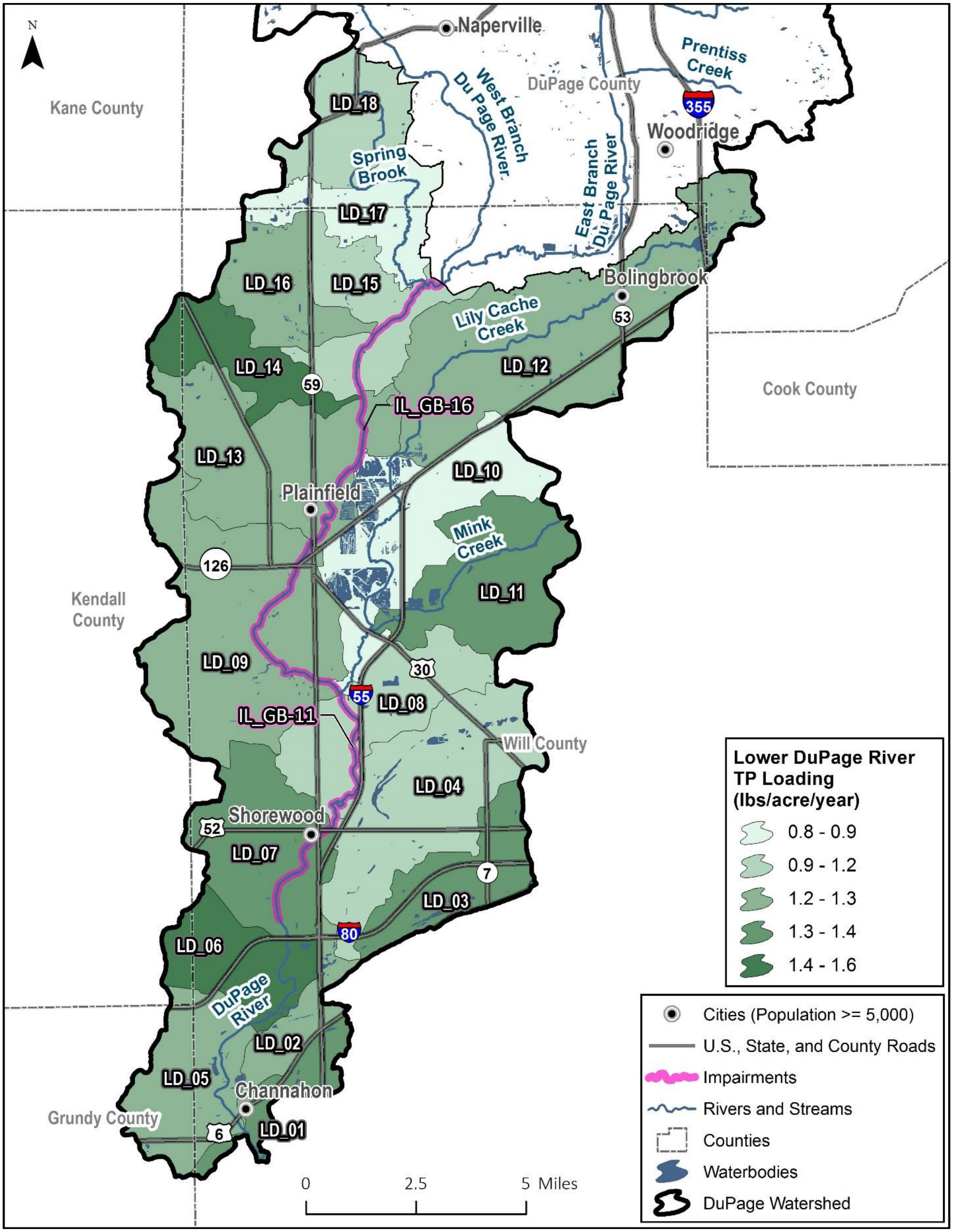

Figure 69. Annual phosphorus loading from STEPL in the Lower DuPage River subwatershed.

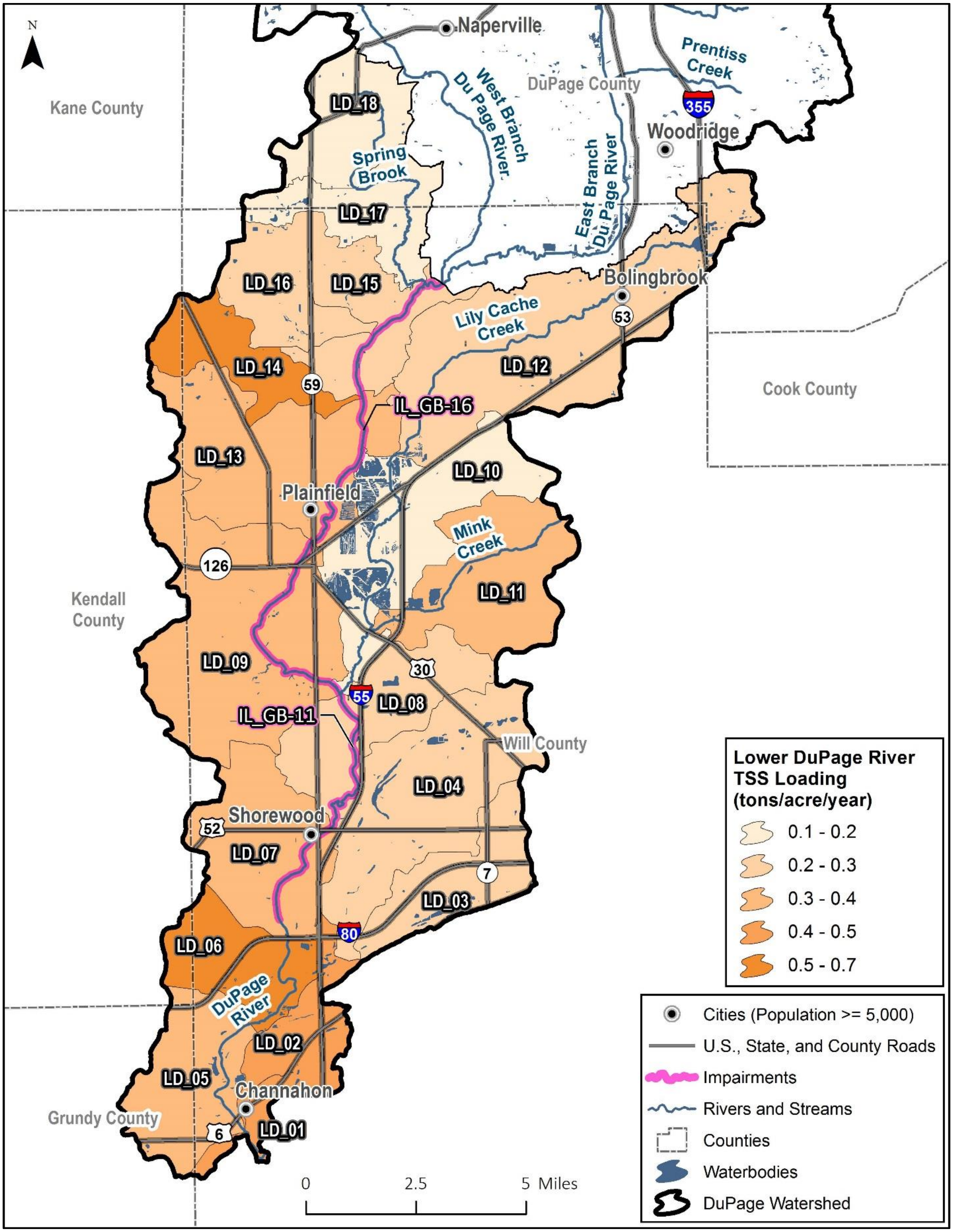

Figure 70. Annual sediment loading from STEPL in the Lower DuPage River subwatershed.

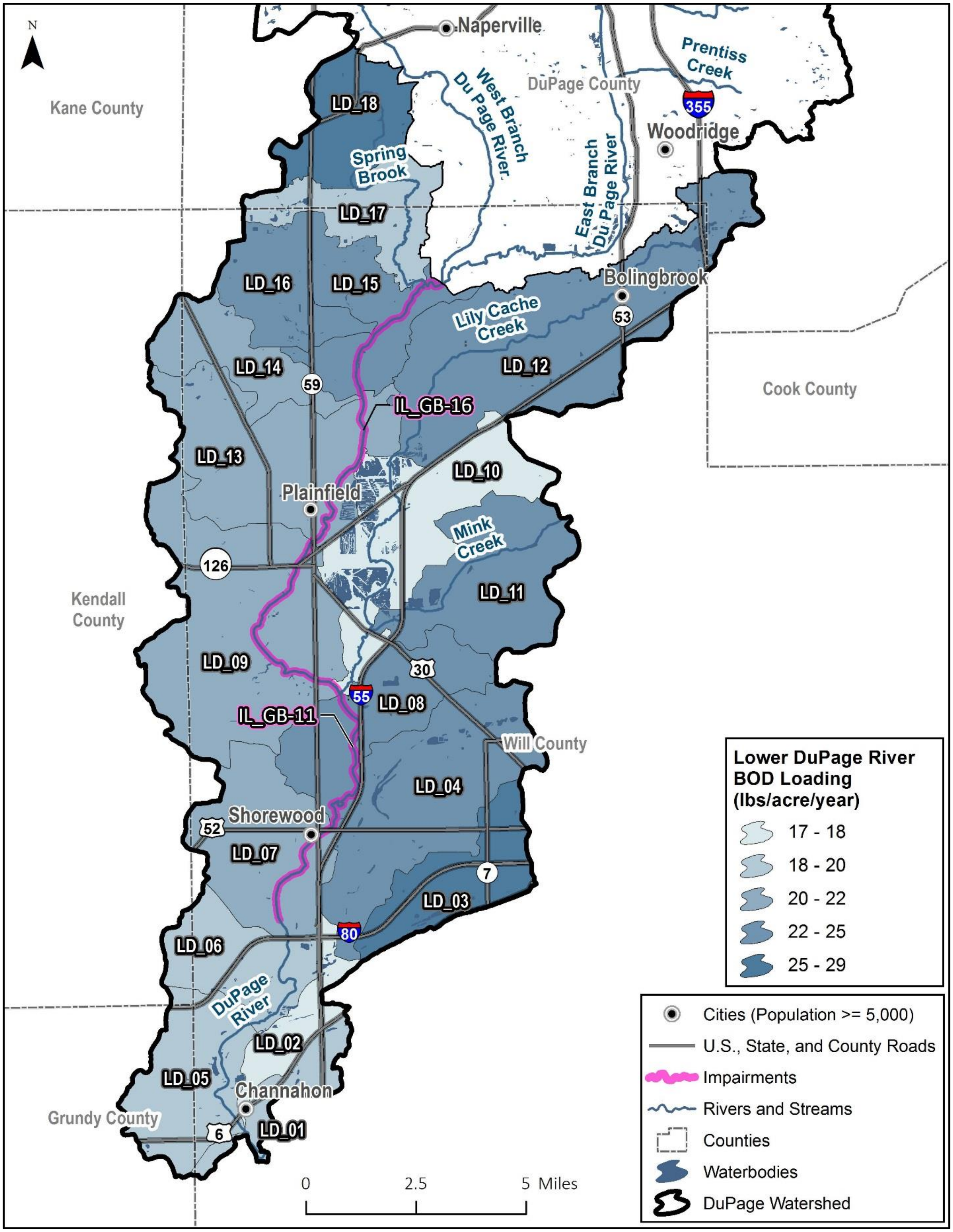

Figure 71. Annual BOD loading from STEPL in the Lower DuPage River subwatershed.

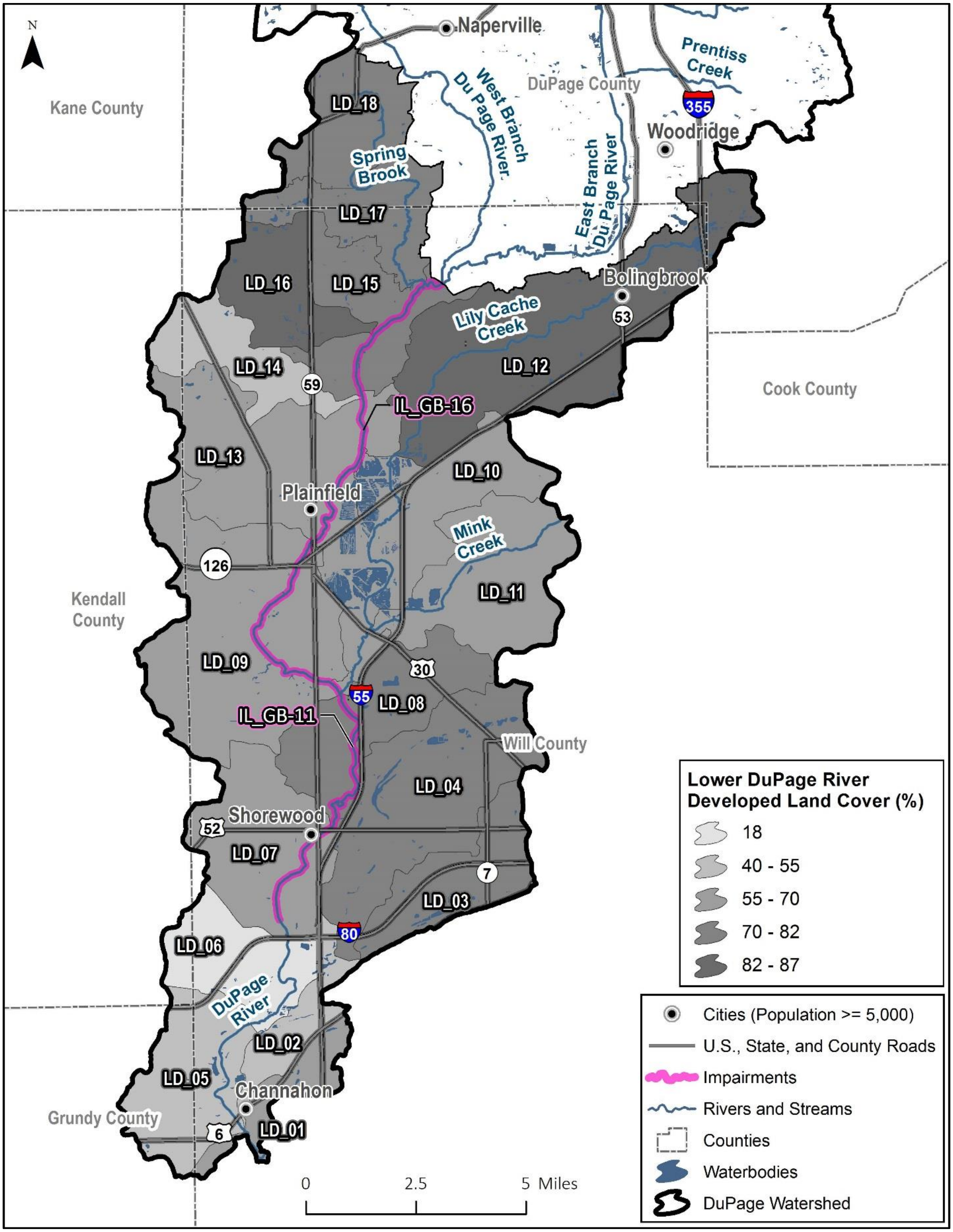

Figure 72. Developed land use in the Lower DuPage River subwatershed (NLCD 2011).

Salt Creek Subwatershed

A separate planning study is being completed by CMAP for the Salt Creek watershed. Please see http://www.cmap.illinois.gov/programs/lta/lower-salt-creek for more information.

8.3 Critical Areas

Successful implementation begins with identifying and focusing resources in critical areas. Critical areas are the focus of outcome-based plans because they represent those areas where project funding will provide the greatest environmental benefit. In this case, critical areas are those areas where there is a high risk for delivery of pollutant loads. The critical area analysis recognizes that achieving water quality improvements requires a mix of practices across multiple landscapes.

Critical areas for implementation of nutrient and sediment reductions were determined on a model catchment scale; each of the catchments within a subwatershed (East Branch, West Branch, Lower) were rank ordered from high to low based on phosphorus, BOD, and sediment yields (see Appendix I). Salt Creek critical areas are being identified in a separate planning study by CMAP. A score was assigned to each catchment based on the rank order for each pollutant. Each pollutant score was totaled for a final critical area score in each catchment (Figure 73 through Figure 75). High scores represent high pollutant loadings per acre of watershed and are therefore considered primary critical areas for implementation. Critical areas present opportunities to develop smaller-scale implementation plans that can include field-based observations and landowner involvement. These smaller-scale implementation plans will help to refine implementation activities and focus resources.

Critical areas for chloride reductions are not specifically identified in the GB-11 catchment. Since application of road salt and de-icing chemicals is the primary contributor of chloride loading (CDM 2007), all impervious areas that are treated with de-icing chemicals are considered critical source areas for chloride reduction and management in the GB-11 catchment.

Critical areas that address sources of fecal coliform require additional monitoring to define. Sources of fecal coliform are widespread and often intermittent. Some sources pose a greater risk to human health than others. Understanding the different source contributions and their potential risk to human health is important to overall TMDL implementation and prioritizing implementation activities that address the recreational use impairments due to fecal coliform. Monitoring that will help define critical areas include synoptic sampling, sanitary surveys, and microbial source tracking, described below.

Synoptic Sampling

Sampling for fecal coliform along the length of the impaired segment as well as upstream can be used to identify fecal coliform hotspots in the contributing drainage area. Synoptic sampling is recommended along each reach under different flow conditions. Results of this sampling will guide the geographic area where sanitary surveys should be completed.

Sanitary Survey

A sanitary survey is often used to identify fecal coliform sources in a watershed. For the purpose of fecal coliform source identification, sanitary surveys consist of observational data collection of potential sources of fecal coliform in a watershed. Data collected may include: number of pets and wildlife; distance and condition of public restrooms from impaired waters; location, number and condition of waste collection facilities (e.g., trash cans, pet waste stations, dumpsters); identification of improperly placed or failing infrastructure; septic system evaluation in unsewered communities; quantity of pet and wildlife excrement in open areas; and other potential sources and/or conveyance systems. Surveys should be conducted on a regular frequency under varying weather conditions.

Microbial Source Tracking

Microbial source tracking (MST) is a useful tool to help differentiate sources of fecal contamination. Fecal bacteroidetes, or fecal indicator bacteria, are used in MST. The use of fecal indicator bacteria is advantageous as they are abundant in the intestinal tract of warm blooded animals and various strains are known to be associated with specific hosts (human, bird, dog, deer, etc.), allowing test results to determine the likely source of contamination. While human sources of fecal pollution are critical to eliminate, it is also important to minimize other sources that can cause illness in humans, although the actual risk associated with these other sources may fall within “acceptable” levels. MST is not able to determine exact source location. Best professional judgement from sanitary surveys and local knowledge can provide an initial assessment of source and location.

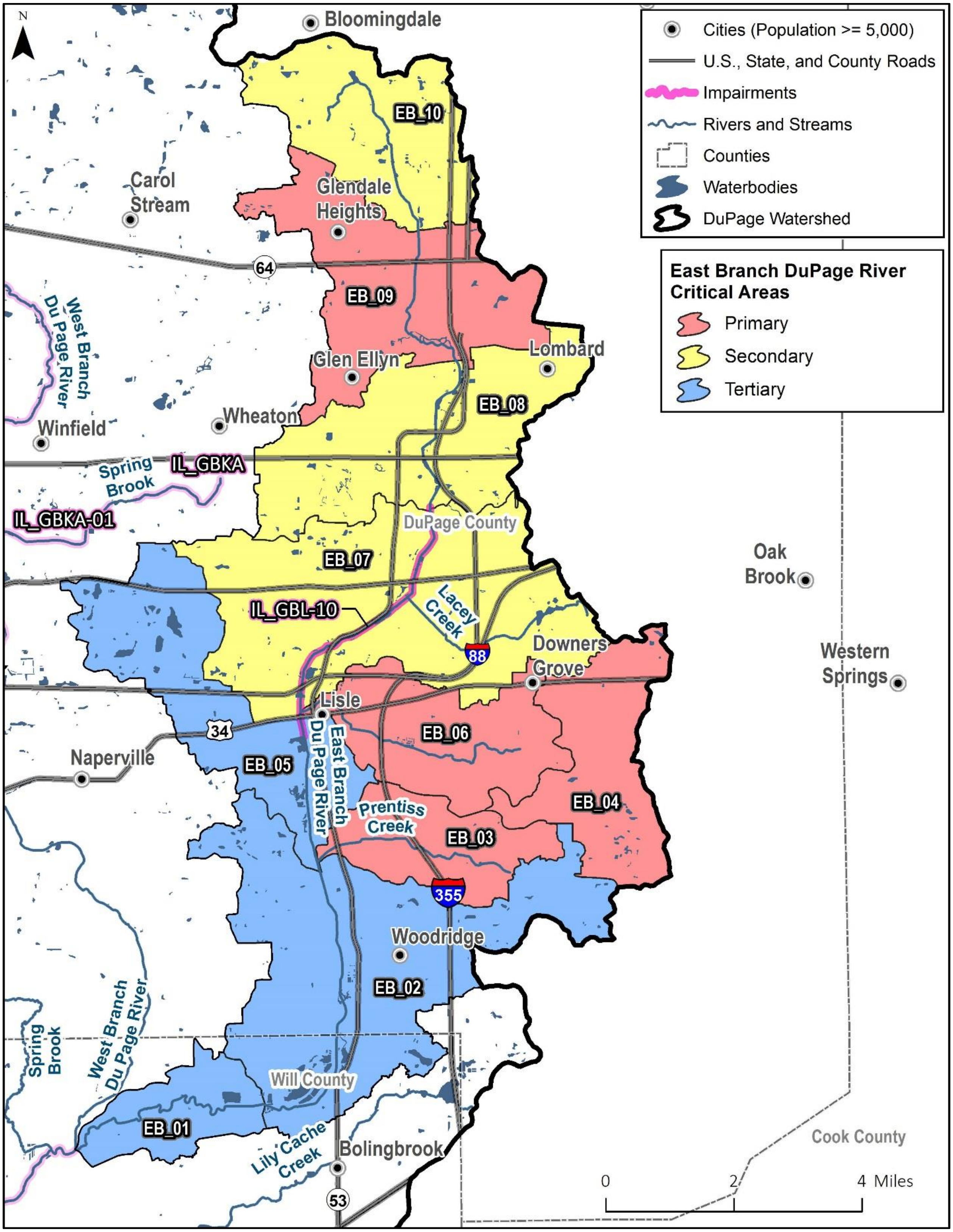

Figure 73. Critical areas for implementation in the East Branch DuPage River subwatershed.

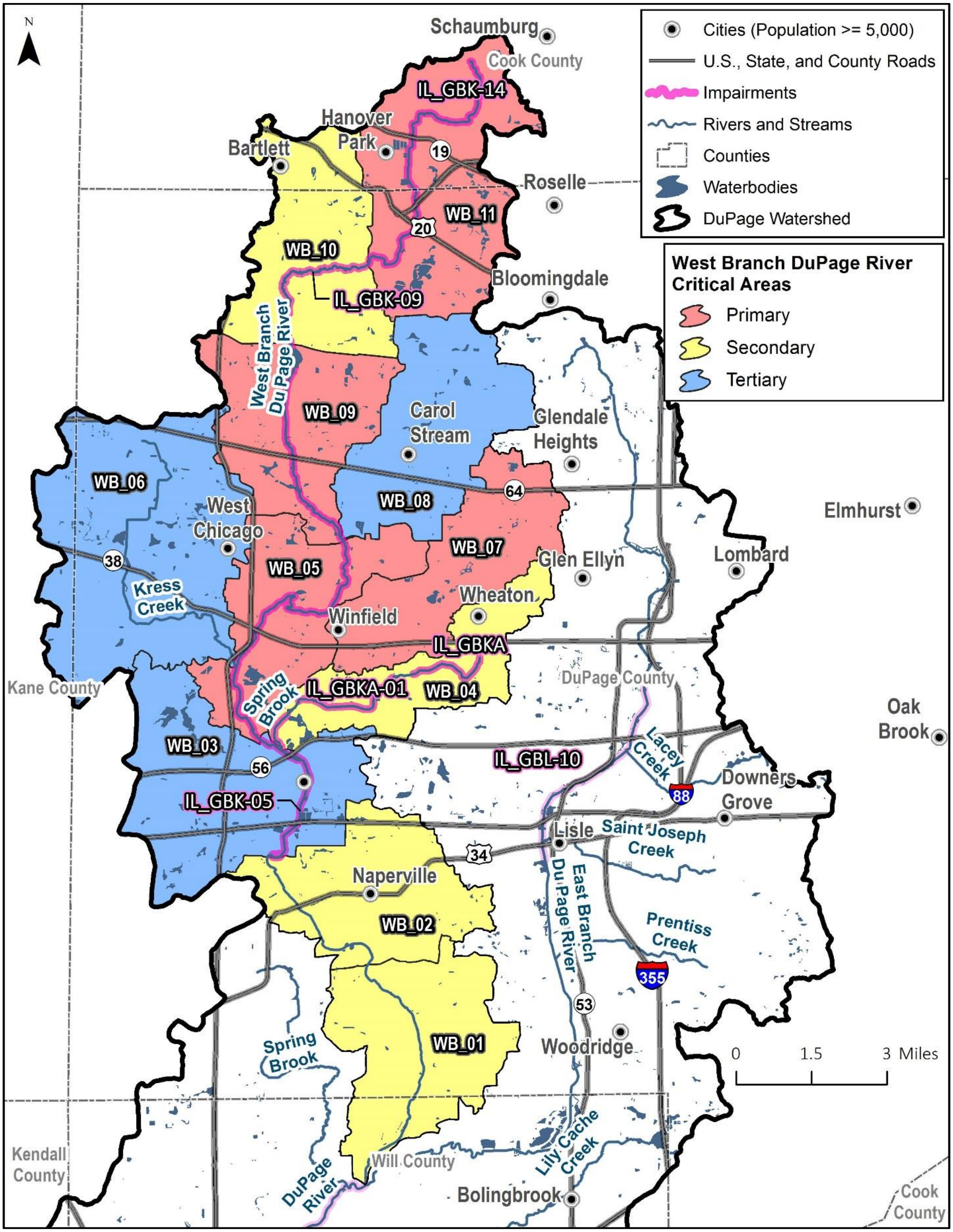

Figure 74. Critical areas for implementation in the West Branch DuPage River subwatershed.

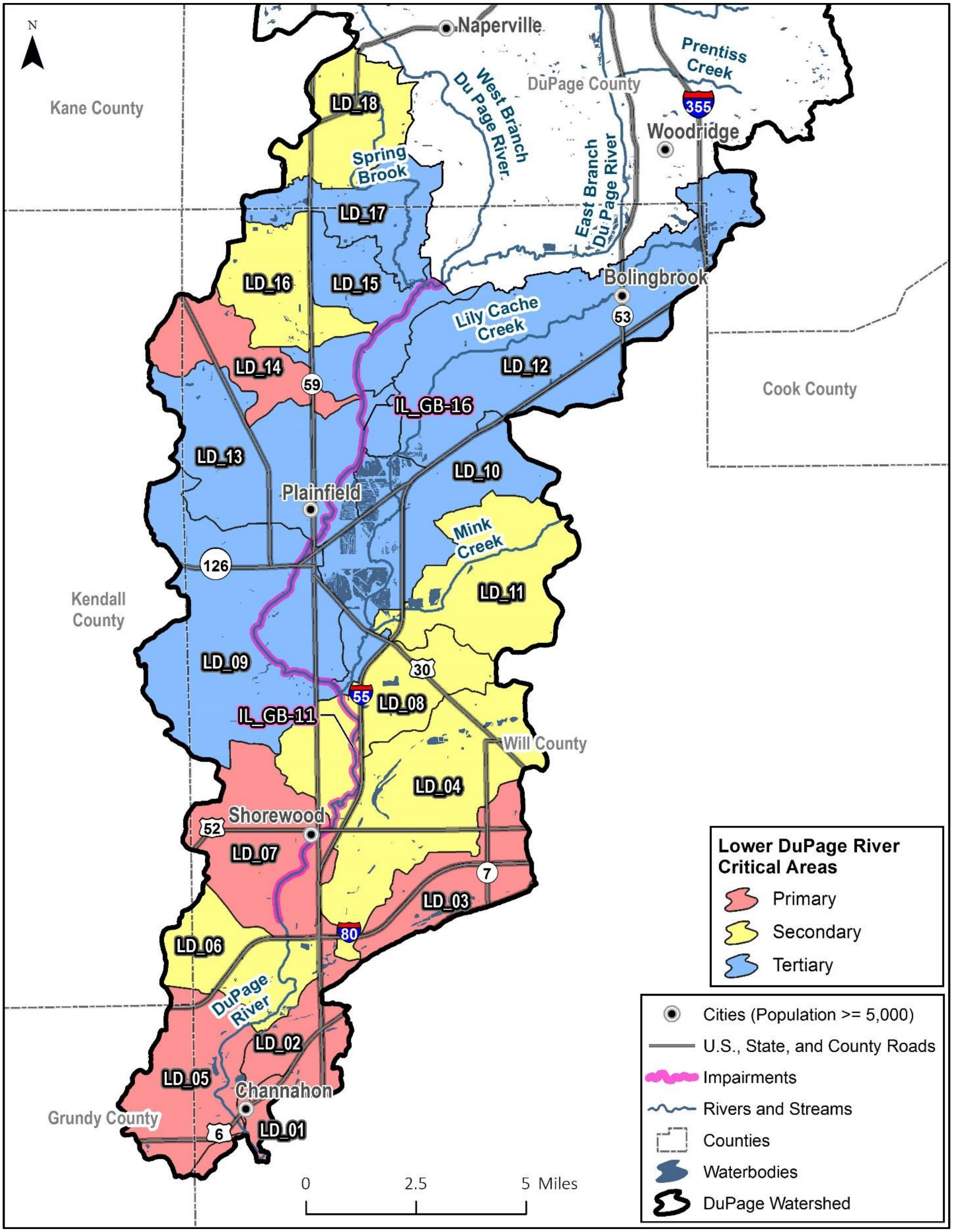

Figure 75. Critical areas for implementation in the Lower DuPage River subwatershed.

8.4 Best Management Practices

Both point and nonpoint sources of pollution will need to be addressed in order to achieve long-term, successful improvements to water quality, however only nonpoint source controls and BMPs are eligible for Section 319 funding. A suite of both structural and nonstructural BMPs will be needed to address sources contributing to impairments in the watershed. BMPs are included to address TMDL pollutants (i.e., fecal coliform, chloride, and low dissolved oxygen conditions) as well as other sources of pollutants contributing to nutrient and sediment loading in the watershed.

8.4.1 Nonstructural Management Opportunities

Nonstructural management opportunities are often classified as pollution prevention or source control BMPs since they aim to prevent runoff from a site. Source control BMPs reduce the exposure of materials to runoff, and thereby reduce the amount of pollutants picked up by runoff. It is typically more cost-effective to prevent pollution from entering runoff rather than treat either the collected runoff flow or waterbodies affected by stormwater discharges (UDFCD 2010). Traditional source control methods include land use or site planning practices, as well as ordinances that aim to prevent runoff. During the early stages of implementation, efforts should first focus on the refinement of existing programs to verify that the existing programs target sources effectively. Nonstructural management opportunities include:

- Ordinance development
- Street and parking lot sweeping
- Pet waste education and outreach
- Wildlife implementation practices
- Chloride reduction management planning and education
- Septic system maintenance and inspection

Ordinance Development

Many communities are undertaking efforts to improve current development ordinances, stormwater regulations, and environmental protection ordinances. Most developed areas within the DuPage River watershed already have ordinances in place to protect water quality. For example, the Will County watershed management ordinance (WMO) states:

> "developers must provide the District with the boundaries, extent, function, value, and quality of all wetlands on site. Development that impacts wetlands is discouraged by the WMO, but mitigation is allowed in some cases. The District's preferred method for wetland mitigation, as written in the WMO, is payment to a wetland mitigation bank. The WMO encourages existing riparian functions to be protected. Mitigation practices such as streambank stabilization and native vegetation planting are required."

Local land use planning requirements and stormwater regulations could be strengthened to more fully address the activities that are causing impairments. Many of the components of the DuPage County countywide stormwater and flood plain ordinance (2012) could be incorporated to strengthen existing requirements and regulations including:

- Buffer requirements
- Stormwater quality treatment requirements
- Stormwater volume control
- Stronger new development ordinances

Additional components may include provisions that encourage green infrastructure as a method of meeting runoff, volume control and stormwater detention requirements, ordinances on private salt piles, and the formation of a formal pet waste program. Areas of existing agricultural use are likely to become developed during implementation of this plan, and therefore ordinances that address new imperviousness and retrofitting existing untreated sites are important.

Street and Parking Lot Sweeping

Streets and parking lots accumulate significant amounts of pollutants, including sediment, road salt, trash, organic material, and debris. Street sweeping can decrease the accumulation of pollutants in catch basins while improving curb appeal and controlling dust. Municipal street sweeping programs can target regulatory requirements and minimize pollutants from roadways, a primary source of sediment and organic material in the watershed.

An effective street sweeping program can remove several tons of debris per year while minimizing pollutants in stormwater runoff. Studies have shown that street sweeping programs can reduce sediment and nutrients, depending on the frequency and timing of sweeping and the sweeping technology used. Sweeper type and frequency will dictate the expected removal efficiency depending on the timing, frequency, and the sweeping technology used. There are three types of sweepers: the mechanical broom, regenerative-air, and vacuum-assist. The frequency of sweeping affects the pollutant removal efficiency. Weekly sweeping can remove up to 31% of solids and 8% total phosphorus (CWP 2008).

Pet Waste Education and Outreach

Pet waste management can reduce nutrient and bacteria loadings in developed areas. Successful pet waste programs are often composed of (1) codified ordinance to penalize illicit deposition of pet feces, (2) public outreach, and (3) pet waste stations in public parks and recreation areas. Some pet waste programs also include municipal pet registries that are typically created for public health concerns. Recommended implementation activities are intended to create a comprehensive, coordinated, and robust pet waste education and outreach program. Priority areas for domestic waste implementation practices are areas with lots of pets and a high degree of impervious cover such as highly developed areas. Recommendations for developing a pet waste program include the following:

- **City code that penalizes pet feces deposition in public areas.** City code should be developed to prohibit deposition of pet feces in public areas, if not already in place. Code should target public areas (e.g., municipal parks) and areas served by storm sewers. In the counties, which are rural, ordinance should focus on public recreation areas, especially those adjacent to waterways. City code or county ordinance, along with civil and monetary penalties, should be cited on signage at public recreation areas and at pet waste stations. Monetary penalties may serve as a disincentive from pet waste mismanagement. For example, the City of Geneva's local ordinance states:

  > "It shall be unlawful for an owner to fail to immediately remove excrement deposited by [his/her] pet upon the public ways, or within the public places of the city, or upon the property of any other person without that person's consent. When accompanying an animal off of [his/her] property, the owner or [his/her] agent shall have on [his/her] person a plastic or paper bag or container suitable for the removal of such excrement. Any person violating any provisions of this chapter shall be guilty of a petty offense and may be fined not less than twenty five dollars ($25.00) nor more than five hundred dollars ($500.00) for each separate and distinct violation."

  The Forest Preserve of DuPage County also regulates pet waste pickup in forest preserves and have enforcement mechanisms that include a fine up to $120 and court costs for improperly disposing of dog waste. Enforcement is critical to a successful pet waste management program.

- **Establish a network of pet waste stations in public recreation areas.** Pet waste stations should be established in all parks and other recreation areas. The stations should include signs to identify the stations and how to use the stations; if code or ordinance is enacted to prohibit pet waste mismanagement, the code or ordinance should also be cited on signage.
- **Develop an education campaign.** A campaign refers to a coordinated, comprehensive outreach effort that integrates a variety of education and outreach techniques. Campaign development starts with a baseline survey to understand existing dog owner behaviors and perceptions, uses survey information to craft effective messages delivered using formats tailored to target audiences, and follows up with a

post-campaign survey to determine effectiveness. This campaign can support any regional or local stormwater management programs.

Because pet waste programs are a popular component of stormwater management programs, there are a great deal of materials available for use. DuPage County Stormwater Management, for example, has developed an educational brochure on proper pet care (https://www.dupageco.org/EDP/Stormwater_Management/Docs/Brochures_and_Applications/53390/). There are not a lot of data available about the effectiveness of these programs with changing behavior and improving water quality conditions, however. Assumptions related to the amount of dog waste diverted from the stream can be made based on bag usage from pet waste stations. Another evaluation mechanism used by these programs is changes in awareness, although a more aware target audience does not always translate into an audience that exhibits behavior changes.

Wildlife Implementation Practices

Wildlife such as raccoons, deer, and birds are a source of fecal bacteria in urban areas. Priority areas for implementation include high-density wildlife populations near or in riparian areas with unstable banks or poor riparian vegetation and recreational areas where food/dumping might attract wildlife. Recommended implementation activities include outreach and education on impacts of feeding wildlife near riparian areas and riparian buffers to reduce wildlife access.

Chloride Reduction Management Planning and Education

Road salt for snow removal was the primary contributor to chloride water quality standard exceedances in the watershed. Therefore, it is incumbent that those who use road salt use it as efficiently as possible, applying the right amount at the right time as required for any given winter storm (e.g., frost events, snow fall, freezing rain, and sleet) situation. In 2007, DRSCW completed the *Chloride Usage Education and Reduction Program Study*. The study compiled information on chloride usage within the watershed to calculate an estimated annual chloride load. The following activities were recommended for chloride reduction in the watershed:

- Public education, staff training, and improved salt storage and handling practices
- Watershed-wide implementation of pre-wetting and anti-icing programs
- Consideration of alternative non-chloride products such as acetate deicers and beet and corn derivatives
- Chloride monitoring in streams to demonstrate program effectiveness

The DRSCW also provides the following guidance for both salt storage, to minimize any loss of road salt, and in application, to apply the correct amount of salt and to ensure that the salt stays on the pavement surface until it has served its purpose. In addition, the DRSCW has model ordinance language for private section salt storage.

- **Salt storage best management practices** minimize the loss of road salt due to precipitation onto stockpiles, or water running into the storage area and to protect the ground upon which the salt is stored. The following best practices will be required for all class four, five and six dischargers in the watershed but are recommended for all facilities that store road salt:
    1. Road salt must be stored on an impermeable pad at all times. Temporary storage on permeable surfaces is not acceptable. All pads must be under cover to eliminate exposure to precipitation.
    2. Pads must be constructed so that rain water or other precipitation does not drain onto the pad. Any rain that drains onto the pad must be drained to a collection point, preferably a specially designed sump area.
    3. Salt that is temporally not stored under a permanent structure must be covered by tarping, for example, except when the stockpile is in active use.
    4. If the agency regularly stores smaller salt piles (5,000 tons or less) outside of a permanent structure the agency with such stockpiles should develop a plan to construct covered storage capable of containing an average year's use of salt.
    5. All salt storage facilities must have policies in place for "good housekeeping" when salt is being placed into storage, and moved from storage into trucks (either for winter maintenance

purposes or for movement to other storage facilities). These policies must reflect the particular conditions on site, but should be aimed at ensuring that as little salt as possible is spilled during these trans-shipment processes, and that any salt which is spilled should be swept up and returned to storage in a timely manner to minimize any loss of salt.

6. All employees involved in salt storage must undergo training annually on best practices for road salt storage.
7. Additional information on salt storage is available in the Salt Institute "Safe and Sustainable Salt Storage Handbook" which may be accessed at: http://www.saltinstitute.org/wp-content/uploads/2013/09/Salt-Storage-Handbook-2015.pdf (accessed on 5/10/17).
8. Local units of government are recommended to adopt a storage ordinance covering private salt piles. Examples of such ordinances can be found at http://drscw.org/wp/model-ordinances/.

- **Salt application best management practices** help to ensure that only as much salt as needed is placed upon the road during winter maintenance operations. The purpose of road salt in such operations is not to melt snow or ice, but rather to prevent the bond of snow or ice to the pavement. If snow or ice has already bonded to the pavement the purpose of the salt is to break the bond.

  The best practice for efficient salt application during winter maintenance is to anti-ice, or to place road salt (in either liquid or solid form, but more often as a liquid brine) on the road surface prior to the start of a winter event, thus providing a protective layer that prevents snow and ice from bonding to the road surface. However, experience has shown that it takes several years for an agency to transition from more traditional winter maintenance operational strategies to anti-icing, so a series of actions leading toward anti-icing could be implemented. The following best practices will be required or recommended for dischargers who run snow fighting operations – these best practices are not pertinent to those dischargers that are simply and solely salt storage facilities. They are, however, somewhat applicable to all classes of dischargers, to the extent that all of these classes clear snow and ice from their own facilities.

1. All salt spreading equipment, whether designed to spread dry road salt, pre-wet road salt or salt brine, must be calibrated at least annually. Whenever the hydraulics on a truck are adjusted or repaired, the spreader equipment will need recalibration. Records of the calibration results must be maintained for each piece of spreading equipment. Proper calibration of equipment can reduce salt application by 50% or more, depending upon how far out of calibration the equipment was originally.
2. Using pre-wet road salt allows an agency to reduce salt application rates by 30%. Pre-wetting can be accomplished in two ways – by applying liquids to the salt stockpile, or by applying liquids by way of the spreading equipment as the salt is deposited on the road. It is generally accepted that the second method is more efficient, but requires modification to spreading equipment, and that an agency have storage capacity for liquid chemicals (most typically salt brine, but other chemicals can also be used). Agencies must make use of pre-wetting, either using treated salt in the stockpile, or preferably by use of liquids applied on the truck during the spreading process.
3. The quantity of salt applied to the road should vary according to the pavement temperature. Accordingly, agencies must have equipment that allows them to measure the pavement temperature. While it may take some time to equip the complete winter maintenance fleet with temperature measuring devices, agencies must, at the start of the variance period, have pavement temperature sensors on enough vehicles to provide operational information during storms that allow salt application rates to be adjusted to the most efficient levels. In addition, agencies must have a plan developed at the start of the variance period to equip the whole winter maintenance fleet with such sensors, and this plan must be completed by the end of the variance period. This requirement is a pre-requisite for the requirement detailed in item 4 below.
4. Agencies should adopt or develop a chart with suggested application rates that are a function of storm type and pavement temperature. An example of such a chart is available in the *"Manual of Best Management Practices for Road Salt in Winter Maintenance"* referenced above. Additionally, agencies should develop a methodology whereby they can determine

whether each truck in their fleet applied salt at the recommended rate, and if not, why the variation from the recommended rate occurred and what needs to be changed in their procedures to be sure that the variation only occurs when strictly necessary. Varying application rates according to pavement temperature allows for reductions in total applications of as much as 50% or more.

5. As pavement temperatures decline, salt takes longer to go into solution and thus to become effective. Practice has shown that once pavement temperatures drop below 15° F the time for salt to go into solution is such that it is often plowed off the road by subsequent operations before it can be effective. Clearly, this is not an optimal use of road salt. Agencies must develop procedures for those rare situations when pavement temperatures drop below 15° F, including methods to track when these situations occur and what actions were taken under these extreme conditions. Avoiding application of salt in conditions where pavement temperatures are too low obviously results in a 100% reduction in salt usage for those conditions.
6. Agencies must have in place a methodology to track how much road salt was applied during each storm, together with some measure of how operationally severe the storm was. While this methodology does not result in a reduced application rate *per se*, it does address the issue that “if you do not measure it you cannot manage it.”
7. Anti-icing has been shown to allow agencies to achieve their desired levels of service using about a quarter of the salt that a more traditional de-icing operational strategy requires to achieve the same levels of service (i.e., as much as a 75% reduction in salt application totals). Accordingly, agencies must develop a plan with clearly delineated milestones for the implementation of anti-icing in their agency.
8. All employees involved in winter maintenance operations must undergo annual training in best practices in the use of road salt in such operations.

DuPage County has a website designated to winter snow and ice removal that includes additional information on municipal BMPs. DRSCW has also led chloride reduction workshops for many years in the watershed and provides technical resources and educational materials. Workshops on chloride management are also held in Will County.

Septic System Maintenance and Inspection

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

BMPs to reduce fecal coliform loads from septic systems include system upgrades/replacement, maintenance, inspection programs, and public education. The most cost-effective BMP for managing pollutant loading from septic systems is regular maintenance. U.S. EPA recommends that septic tanks be pumped every 3 to 5 years depending on the tank size and number of residents in the household (U.S. EPA 2002). When not maintained properly, septic systems can cause the release of pathogens, as well as excess nutrients, into surface water. Annual inspections, in addition to regular maintenance, ensure that systems are functioning properly. An inspection program would help identify those systems that are currently connected to tile drain systems or storm sewers and those that may be failing. Inspections would also help determine if systems discharge directly to a waterbody (“straight pipe”). Additional point of sale inspections, or inspections when a property is sold and purchased, can improve the baseline understanding of septic conditions and decrease occurrences of leaks potentially contributing to fecal loading in the watershed. These may include a soil boring to determine if the soil has adequate separation, and an examination of the inside of the tank after it has been pumped.

Education is a crucial component of reducing pollution from septic systems. Education can occur through public meetings, mass mailings, and radio and television advertisements. An inspection program can also help with public education because inspectors can educate owners about proper operation and maintenance during inspections.

8.4.2 Structural Management Opportunities

Structural BMPs can be incorporated in urban landscapes to capture, infiltrate, filter, and treat stormwater runoff. These BMPs can be integrated into redevelopment projects, implemented as part of a stormwater retrofit strategy, or required for new developments. In addition, significant areas in agricultural production are present and contributing to sediment and nutrient loading in the Lower DuPage River watershed. Agricultural BMPs are included for these land uses.

Green Infrastructure Retrofitting

The use of green infrastructure, especially those practices that reduce the volume of runoff from urban areas, can address pollutant loads from existing developed areas and prevent or mitigate stormwater runoff volume. A number of green infrastructure practices may be appropriate, considering land use constraints, and are likely to be effective for reducing watershed loadings of bacteria, nutrients, sediment, and organic matter.

Offering considerable versatility with design and implementation, green infrastructure concepts can be incorporated into new and existing developments and can be less cost intensive than traditional, structural stormwater management systems (U.S. EPA 2007b). Furthermore, green infrastructure practices offer an innovative way to integrate stormwater management into natural landscapes, minimizing alterations to the natural hydrologic regime and reducing site runoff. Implementation of green infrastructure practices can also encourage groundwater recharge, and decreases surface erosion and pollutant transport. Additional benefits of green infrastructure include improved greenways and enrichment of natural environmental aesthetics within the urban setting.

Figure 76. Green infrastructure examples: top - residential rain garden; bottom - permeable pavement.

When selecting the most appropriate BMPs for a specific site or drainage area, site-specific conditions (e.g., land availability, slope, soil characteristics, climate condition, utilities, and characterization of contributing drainage including imperviousness) must be taken into consideration. Care must also be given to ensure the proper treatment identifies any site concerns or hazards. For example, infiltration should not be encouraged in areas surrounding stormwater hot spots, such as automotive repair shops, gasoline stations, or industrial areas where groundwater contamination or pollutant transfer is a possibility.

The use of green infrastructure is quickly advancing and new research is supporting the use of varying BMPs for pollutant removal, provided the systems are constructed and maintained. Examples of green infrastructure BMPs include rain gardens, bioretention/biofiltration, permeable pavement, and green roofs.

The Illinois Urban Manual includes design information and practice standards for use throughout the state for these and other stormwater management practices. The most recent summary of BMP removal efficiencies provided by the International Stormwater BMP Database (Clary et al. 2017) shows on average that many BMPs are able to remove fecal bacteria from stormwater to some degree (Figure 77). Those practices that include infiltration or filtration such as biofiltration, and traditional practices such as sand filters, have the best opportunity to reduce fecal coliform loads. Practices such as wetlands and ponds can also remove fecal coliform, however practices must be designed and maintained to deter wildlife.

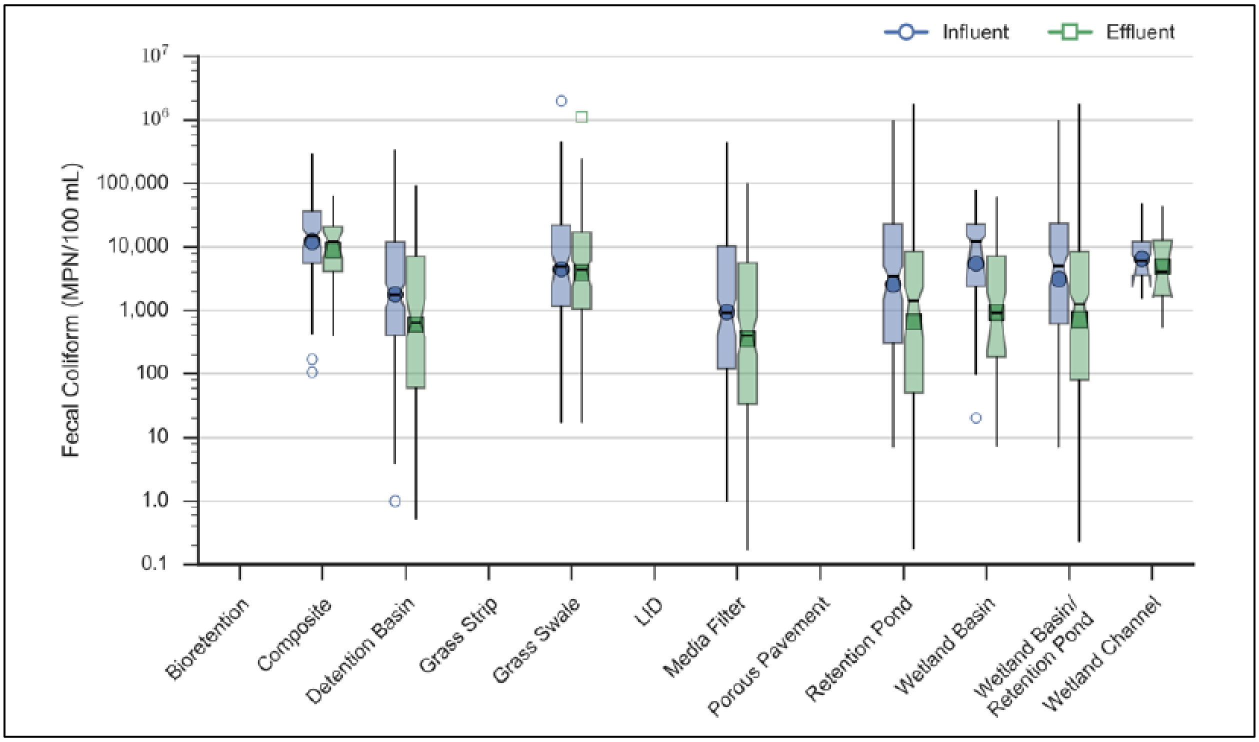

Figure 77. Fecal coliform concentrations in influent and effluent for various BMPs.
Figure from Clary et al. 2017.

Stormwater Ponds and Detention Basins

Stormwater ponds have traditionally been constructed to provide rate control and flood protection. Depending on the pond design, additional water quality benefits can also be realized. Ponds rely on physical, biological, and chemical processes to remove pollutants from incoming stormwater runoff, in particular nutrients and sediment. Ponds designed to hold back water for longer periods of time will reduce pollutants to higher levels. Different types of ponds exist including dry and wet ponds; these ponds can include pretreatment cells where sediment is allowed to settle out. Fecal coliform removal has been documented (see Figure 77), however ponds have also been shown to be sources of fecal bacteria. Design, maintenance, and monitoring is needed to determine a pond's ability to reduce fecal coliform loading.

A naturalized detention basin is similar to a conventional pond but is enhanced with relatively flat side slopes and diverse plant communities along aquatic benches and within buffers. These basins are intended to provide multiple benefits including pollutant removal, flood prevention, hydrologic stability, and creation of habitat. In addition, naturalized detention basins can prevent shoreline erosion, increase water clarity, reduce water temperatures, and discourage congregation of geese. They are also generally thought to be safer than conventional wet ponds without benches and require less long-term maintenance.

Wetland Creation and Restoration

Wetland are a natural storage feature that slows and filters water, increasing flood resiliency. They have the ability to reduce fecal bacteria, nutrient and sediment loading to nearby waterways, moderate water temperature, and provide habitat for plants and wildlife. Wetland soils and plants provide carbon storage, helping to moderate levels of carbon dioxide in the atmosphere. Wetland restoration is the renewal of natural and historical wetlands that have been lost or degraded. When selecting wetland restoration projects and locations, diversity of wetland and long term maintenance should be considered. Special consideration should be given to increasing the diversity of wetlands and their functions as relate to water quality. Wetlands restoration projects can also be combined with regional greenways and trail networks to increase public access and education potential. Long term maintenance cost for wetlands may include invasive species control, burning, herbicide application, and mowing (The Conservation Foundation 2011).

Riparian Area Management

Preserving the natural vegetation along a stream corridor can mitigate pollutant loading associated with human disturbances. The root structure of the vegetation in a buffer enhances infiltration and subsequent trapping of pollutants. However, the buffers are only effective in this manner 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 they provide to streambanks and steep slopes. The rooting systems of the vegetation serve as reinforcements in soils, which help to hold material in place and minimize erosion. Due to the increase in stormwater runoff volume and peak rates of runoff associated with 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 and enhances the pollutant removal of sheet flow runoff from developed areas that pass through the buffer.

Riparian buffers/filter strips should consist of native species and may include grasses, forbs, shrubs, and trees. Higher removal rates are provided with greater buffer widths. Maintenance of a riparian buffer should be minimal, but may include items inspection, minor grading to prevent short circuiting, and replanting/reseeding dead vegetation following premature death or heavy storms. The following activities could take place as part of a riparian area management program:

- Adopt and/or implement buffer ordinances for new development or redevelopment
- Document the presence of gullies or invasive species that could contribute to water quality concerns

Stream Restoration

Restoration of channelized streams and rivers and daylighting streams that have been buried in storm sewers or tunnels can greatly enhance the stream function, habitat, and water quality. A natural channel design is typically meandering with connection to a floodplain. In urban areas, this type of channel is challenging due to space constraints and the need to protect private property and infrastructure. In these cases, identifying opportunities to daylight a portion of the streamflow and creating habitat can be successful strategies.

One key method to restoring a stream is dam removal. Dams can contribute to stagnant pools where dissolved oxygen is low. Additionally, many of the impoundments caused by dams in the DuPage River watershed resulted in large amounts of sediment to settle out of the water column and cover natural habitat (Hammer et al. 2003). For example, the Churchill Woods dam was lowered in 2011 to improve dissolved oxygen and water quality conditions in the East Branch DuPage River as well as provide for fish passage.

Streambank erosion from unstable or channelized streambanks can also be addressed by many different BMPs including:

- **Engineering controls** such as armoring with materials that straighten the banks and deflection of the water course with rock or log structures.
- **Vegetative stabilization** and **restoration of riparian areas** can reduce peak flows from runoff areas and channel velocities directing runoff. Using vegetative controls also enhance infiltration, which reduces high flows that cause erosion.
- **Natural channel restoration** that establishes meanders and natural flow complexity and connects the stream channel with the floodplain.

Agricultural BMPs

Agricultural runoff is an important source of sediment and nutrients loading in portions of the watershed. Various agricultural practices can be used to reduce pollutant loading associated with crop production including:

- **Conservation tillage** is identified as a primary BMP for nutrient reduction in the Illinois Nutrient Loss Reduction Strategy (NLRS). Conservation tillage is any tillage practice that results in at least 30% coverage of the soil surface by crop residuals after planting.
- **Fertilizer and nutrient management** addressed application rates, methods, and timing as described in the NRLS and according to the 4Rs – Right Source, Right Rate, at the Right Time, and in the Right Place nutrient stewardship program. Additional information on the 4Rs can be found at http://www.nutrientstewardship.com/4rs/.
- **Cover crops** (winter) are identified in the NRLS as an important management practice to reduce erosion and phosphorus loading. Grasses and legumes may be used as winter cover crops to reduce soil erosion and improve soil quality.
- **Filter strips** include perennial vegetation and trees that can filter runoff from adjacent cropland, provide shade and habitat for wildlife, and reinforce streambanks to minimize erosion.

8.4.3 BMP Removal Efficiencies and Costs

Table 65 summarizes the removal efficiency and costs of various BMPs that could be used to achieve necessary load reductions in the watershed.

Table 65. BMP removal efficiencies

BMP	Removal Efficiency (%) [a]				Cost [b]
	Phosphorus	BOD	Sediment	Fecal Coliform	
Green Infrastructure					
Bioretention	80	ND	80		$10,000-25,000 per acre
Permeable Pavement	65	ND	90	Varies	$12-14 per sq ft
Infiltration Basin	65	ND	75		$15,000-30,000 per acre
Stormwater Ponds and Detention Basins					
Wet Pond	45	ND	60		
Extended Wet Detention	69	72	86	Varies	
Dry Detention	26	27	58		$10,000-25,000 per acre
Riparian Area Management					
Filter or Buffer Strip	30	40	60	34-74% [c]	$60-400 /acre (herbaceous) $600-4,000 /acre (forested)
Wetland Creation and Restoration					
Wetland Detention	20	44	63	Varies	$10,000-25,000 per acre
Stream Restoration					
Streambank Stabilization	75	ND	75	Varies	$75-350 per linear foot
Agricultural BMPs [d]					
Conservation tillage	50	ND	50		$10-15 per acre
Cover crops	30	ND	50	Varies	$40-75 per acre
Buffers/filter strips	25-50	ND	25		$60-400 per acre (herbaceous) $600-4,000 per acre (forested)

ND: No data available
a. Source: EPA STEPL unless noted otherwise
b. Cost ranges developed from review of existing watershed plans in DuPage and surrounding counties unless otherwise noted
c. Source: Wenger 1999
d. Removal efficiencies estimated from the Illinois NLRS; cost data from 2017 EQIP schedule

8.5 BMP Implementation

As summarized in Section 8.2, stormwater sources contribute the vast majority of pollutant loading to the East and West Branch DuPage River subwatersheds. Much of the pollutant loading to the Lower DuPage River is from urban sources with the exception of sediment, which is mostly coming from cropland (Figure 66). The potential impacts of several BMPs were evaluated across a range of implementation levels.

Reductions in TP, sediment, and BOD associated with treatment of runoff from various land uses were quantified using STEPL. No specific load reductions targets are available for these pollutants, therefore multiple implementation scenarios to treat runoff were simulated to present a range of possible reductions in each subwatershed. There are many different BMP scenarios that could be used to achieve pollutant load reductions, this plan provides a framework and example scenarios.

The extent of BMP implementation to meet load reductions needed for fecal coliform and chloride are not quantified. BMP removal efficiencies for fecal coliform is extremely variable, with filtration practices being the most promising. Point source reductions from WWTPs and programmatic activities will also be needed to meet fecal coliform load reductions. Chloride reductions will be the result of source control; there are no practical BMPs that can remove chloride once it is dissolved into water. Addressing the conditions that are contributing to low dissolved oxygen will be a combination of programmatic activities, point source reductions, in-stream restoration, and reductions in phosphorus and loading of organic material that are contributing to sediment oxygen demand. Lastly, DRSCW members provided planned site-specific projects that will help to reduce and assimilate pollutant loads in the East and West Branch DuPage River subwatersheds addressed in this TMDL.

8.5.1 East Branch DuPage River Subwatershed

BMPs are needed in the East Branch DuPage River to address fecal coliform, sediment, and nutrient impairments. In addition, as the East Branch DuPage River discharges into the Lower DuPage River, phosphorus reductions and compliance with dissolved oxygen standards are needed to comply with the GB-16 low dissolved oxygen TMDL.

Fecal Coliform Load Reductions

There is one fecal coliform-impaired segment in the East Branch DuPage River, GBL-10. There are several point sources that discharge to this segment including one CSO. Permit compliance and elimination of the CSO is needed to meet required load reductions. In addition, a sanitary survey (described in Section 8.3) is needed to identify potential sources of fecal coliform in the direct drainage area. This survey, along with additional monitoring, can be used to identify hotspots and focus implementation activities. Disconnecting impervious areas using green infrastructure and other stormwater management practices that utilize filtration can be used to reduce stormwater runoff and associated fecal coliform loading. Programmatic activities described in Section 8.4.1 are also needed.

Nutrient and Sediment Load Reduction Scenarios

In the East Branch, urban sources contribute the vast majority of pollutant loading to the subwatershed (between 97 and 100%). Of these sources, commercial, single family residential, open space, and transportation land use categories contribute the greatest amount. Therefore, for each of these land uses, BMPs were assigned to treat 20, 40, and 60% of the urban runoff being generated (Figure 78). BMPs were selected from STEPL that best aligned with the planned and implemented BMPs in the watershed gathered through a review of existing and current planning efforts and include:

- Permeable pavement – applied to commercial land uses
- Bioretention – applied to single family residential land uses
- Wetland detention – applied to open space land uses
- Extended wet detention ponds – applied to transportation land uses

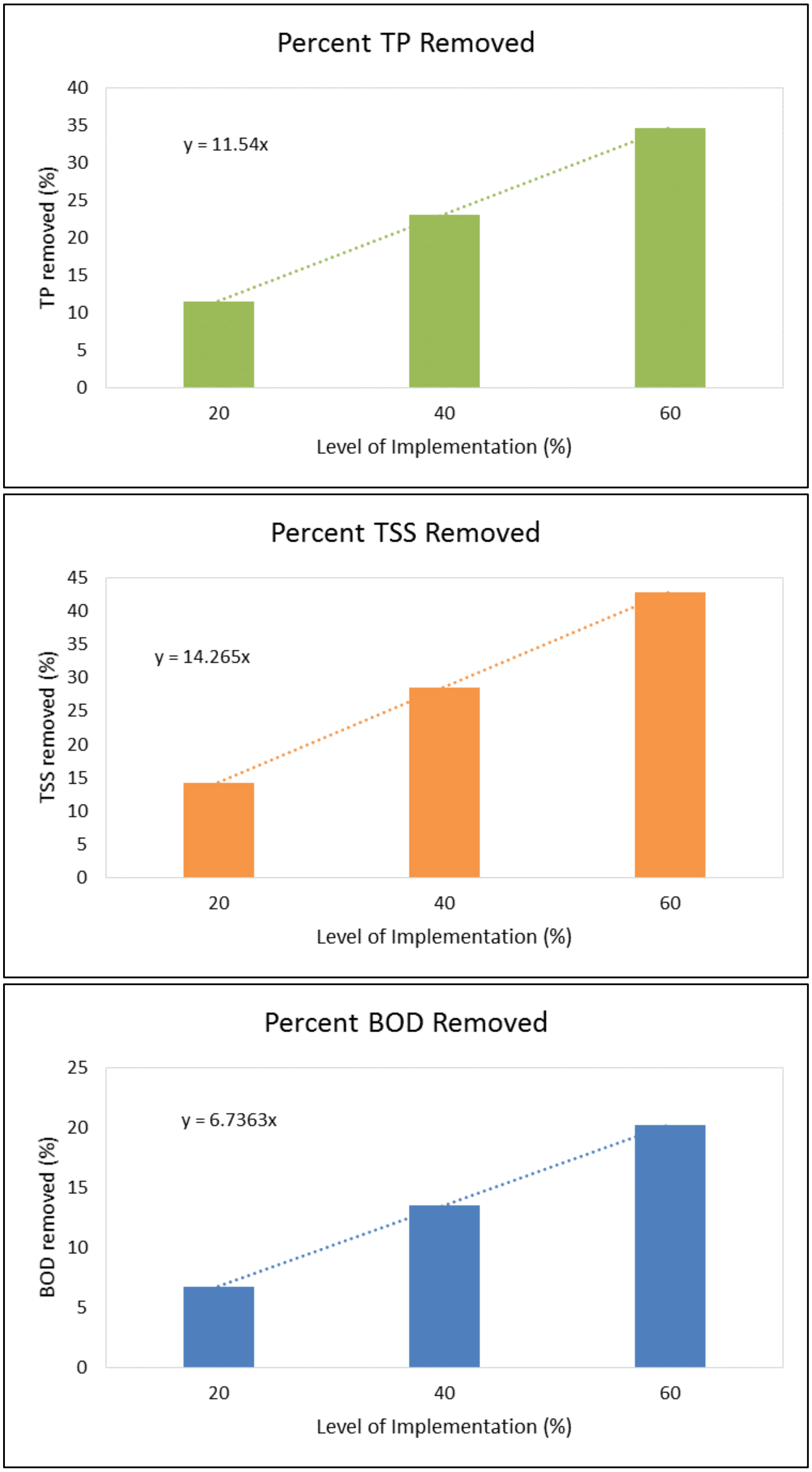

Figure 78. Implementation curves, East Branch DuPage River subwatershed.

Site-Specific Projects from Local Partners

Several site-specific BMPs, costs and timeframes were provided by DRSCW members within the East Branch DuPage River subwatershed (Table 66 and Figure 79). These projects will help reduce and assimilate nonpoint source pollutant loads identified in this TMDL. Specifically, in-river improvements that include building pool riffle sequences will result in increased aeration of the water column, contributing to increasing dissolved oxygen levels in the East Branch DuPage River and meeting the previously approved dissolved oxygen TMDL. In addition, stormwater management activities such as permeable pavement installation and reducing sediment loading from stream banks will reduce the phosphorus and other pollutants to the River that are contributing the sediment oxygen demand, resulting in increased dissolved oxygen. All of these activities will contribute to meeting the headwater conditions of GB-16 in the Lower DuPage for compliance with the GB-16 dissolved oxygen TMDL.

Table 66. Site specific BMPs for implementation within the East Branch DuPage River

Project ID	Waterbody/Location	Project Description	Cost (2018 $)	Timeframe		
				2018-2022	2023-2032	2033-2042
EB06	Rott Creek	Establish riparian buffer and increase channel sinuosity.	350,000			✓
EB07	St. Joseph Creek	Increase channel sinuosity.	300,000		✓	
EB12	E. Branch DuPage R.	Build 2 pool riffle sequences, increase presence of gravel substrates and channel sinuosity, grade banks.	750,000			✓
EB19	E. Branch DuPage R.	Build 2 riffles, increase presence of gravel substrates and channel sinuosity. Grade banks.	750,000			✓
EB21	E. Branch DuPage R.	Build 2 riffle sequences, increase presence of gravel substrates and channel sinuosity, grade banks. Increase riparian buffer.	750,000			✓
EB23	E. Branch DuPage R.	Increase presence of gravel substrates.	300,000			✓
EB26	E. Branch DuPage R.	Build 2 riffle sequences, increase presence of gravel substrates and channel sinuosity, grade banks. Increase riparian buffer.	750,000			✓
EB30	E. Branch DuPage R.	Increase presence of gravel substrate and channel sinuosity, grade banks.	750,000			✓
EB31	E. Branch DuPage R.	Build 2 riffles establish riparian buffer, increase channel sinuosity. Grade banks.	750,000		✓	
EB32	E. Branch DuPage R.	Increase channel sinuosity. Grade banks.			✓	
EB34	E. Branch DuPage R.	Build 2 riffles and increase presence of gravel substrates. Grade banks.	400,000			✓
EB35	E. Branch DuPage R.	Increase gravel substrate, channel sinuosity, grade banks.	400,000			✓
EB36	E. Branch DuPage R.	Build 2 riffle sequences, increase presence of gravel substrates, grade banks. Increase riparian buffer.	750,000			✓
EB37	Lacy Creek	Streambank grading, inclusion of pools and riffles, backwater wetlands, and potential meanders.	TBD		✓	
EB38	Lacy Creek	Convert two 250-car parking lots into permeable pavement from asphalt and gravel, including associated walkways. Both parking lots are 2.5 acres each.	TBD	✓		
EB39	Unnamed streams within Morton Arboretum	Streambank stabilization and pools and riffle structures, as well as other water velocity reducing measures on both streams	TBD	✓		
EB40	Lake Marmo and Sterling Pond within Morton Arboretum	Shoreline grading and revegetation of both ponds to reduce eroding shorelines and sedimentation.	TBD		✓	

Project ID	Waterbody/Location	Project Description	Cost (2018 $)	Timeframe		
				2018-2022	2023-2032	2033-2042
EB41	Culverts within Morton Arboretum	Current engineering of roadways and trails throughout Arboretum property utilizes traditional culverts, which have caused increased erosion in five ravines. This project would create and implement altered drainage engineering to eliminate erosion and stabilize each drainage pathway.	TBD		✓	

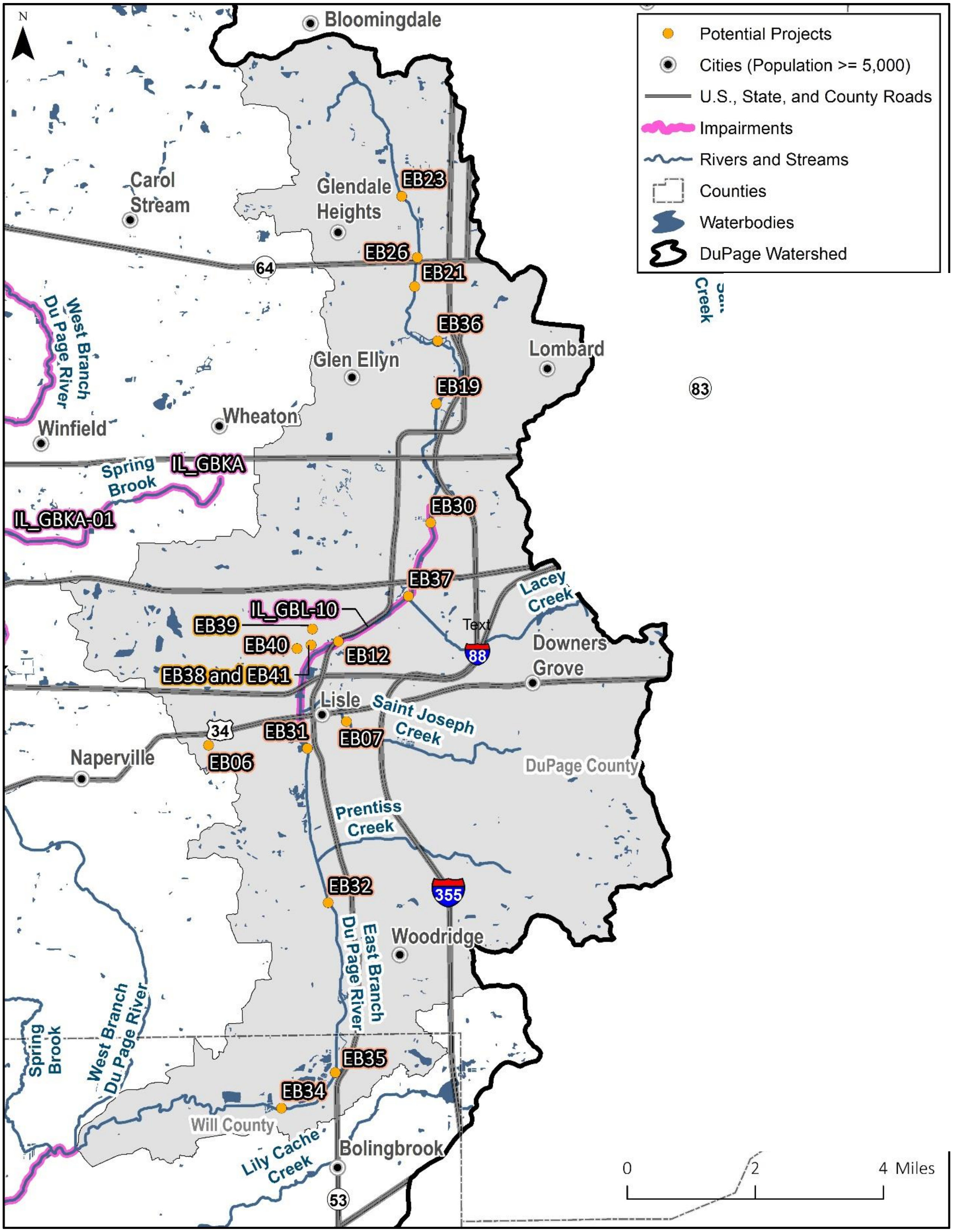

Figure 79. Potential implementation projects identified by DRSCW and others, East Branch DuPage River Subwatershed.

8.5.2 West Branch DuPage River Subwatershed

BMPs are needed in the West Branch DuPage River to address fecal coliform, sediment, nutrient, and dissolved oxygen impairments. In addition, as the West Branch DuPage River discharges into the Lower DuPage River, additional phosphorus reductions and increases in dissolved oxygen conditions are needed to comply with the GB-16 low dissolved oxygen TMDL.

Fecal Coliform Load Reductions

There are three fecal coliform-impaired segments in the West Branch DuPage River: GBK-05, GBK-09, and GBK-14. There are several point sources that discharge directly to these segments. Permit compliance is needed to meet required load reductions. In addition, a sanitary survey (described in Section 8.3) is needed to identify potential sources of fecal coliform in the direct drainage area. This survey, along with additional monitoring, can be used to identify hotspots and focus implementation activities. Disconnecting impervious areas using green infrastructure and other stormwater management practices that utilize filtration can be used to reduce stormwater runoff and associated fecal coliform loading. Programmatic activities described in Section 8.4.1 are also needed.

Nutrient and Sediment Load Reduction Scenarios

In the West Branch, urban sources contribute the majority of pollutant loading to the subwatershed (between 82 to 98%). Of those source, institutional, single family residential, open space, and transportation land use categories contribute the greatest amount. Therefore, for each of these land uses, BMPs were assigned to treat 20, 40, and 60% of the runoff they generate. BMPs were selected from STEPL that best aligned with the planned and implemented BMPs in the watershed gathered through a review of existing and current planning efforts and include:

- Permeable pavement – applied to institutional land uses
- Bioretention – applied to single family residential land uses
- Wetland detention – applied to open space land uses
- Extended wet detention ponds – applied to transportation land uses

Results of the three implementation scenarios (20, 40, and 60% implementation) are provided in Figure 80.

Dissolved Oxygen Improvements

Improvements along GBK-14 and GBKA are needed to address dissolved oxygen impairments. There are several options that can be undertaken to achieve the water quality standards addressing either or both reaeration and SOD. SOD reductions can be accomplished through implementation of structural and nonstructural practices in the watershed that will limit organic matter in the stream. Specifically, stormwater management can be used to reduce sediment and nutrient loading and street/parking lot sweeping can be used to reduce leaf litter and grass clippings. In-stream improvements are also likely needed to establish reaeration opportunities. Specifically, the inclusion of riffles and removal of stagnant water sources along these reaches can be used to provide reaeration. One project has been identified along GBK-14 by the DRSCW that will address this need. A similar project is needed for Spring Brook.

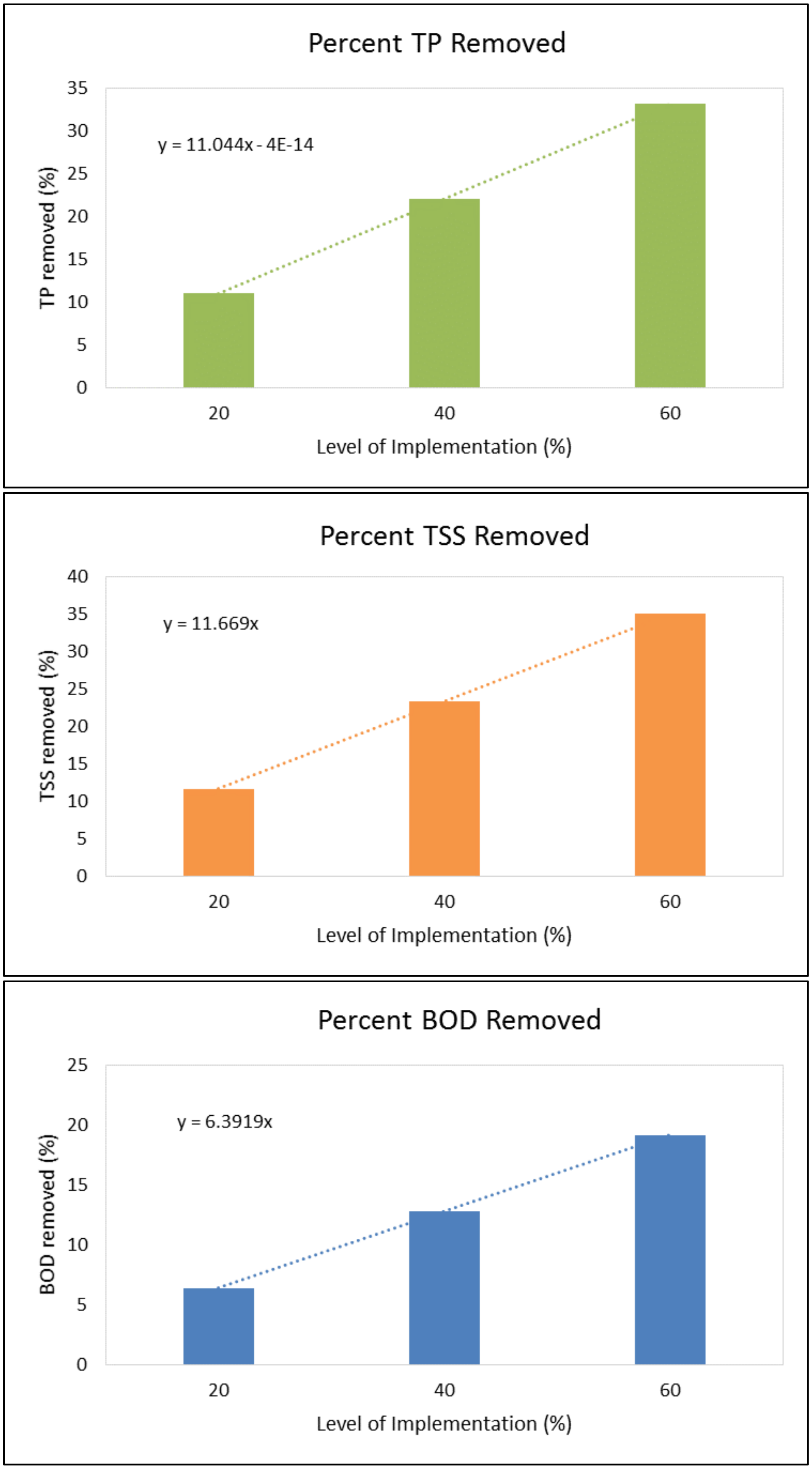

Figure 80. Implementation curves, West Branch DuPage River subwatershed.

Site-Specific Projects from Local Partners

Several site-specific BMPs, costs and timeframes were provided by DRSCW members within the West Branch DuPage River subwatershed (Table 67 and Figure 81). These projects will help reduce help to reduce and assimilate nonpoint source pollution loads identified in this TMDL. Similar to the East Branch DuPage River, these activities will contribute to meeting the headwater conditions of GB-16 in the Lower DuPage for compliance with the GB-16 dissolved oxygen TMDL.

Table 67. Site specific BMPs for implementation within the West Branch DuPage River

Project ID	Waterbody/Location	Project Description	Cost (2018 $)	Timeframe		
				2018-2022	2023-2032	2033-2042
WB01	Kress Creek	Build 2 riffle sequences, increase presence of gravel substrates and channel sinuosity, grade banks. Increase riparian buffer.	750,000			✓
WB12	W. Branch DuPage R.	Build 2 pool riffle sequences, increase presence of gravel substrates and channel sinuosity, grade banks.	750,000		✓	
WB19	Klein Creek	Build 2 pool riffle sequences, increase presence of gravel substrates and channel sinuosity, grade banks.	750,000		✓	
WB20	W. Branch DuPage R.	Build 2 riffles and increase presence of gravel substrates. Grade banks.	400,000			✓
WB27	W. Branch DuPage R.	Increase presence of gravel substrates.	200,000			✓
WB28	W. Branch DuPage R.	Increase presence of gravel substrates.	200,000			✓
WB33	W. Branch DuPage R.	Build 2 riffles and increase channel sinuosity. Grade banks.	400,000		✓	
WB34	W. Branch DuPage R.	Build 2 pool and riffle sequences, increase presence of gravel substrates. Grade banks.	400,000		✓	
WB35	W. Branch DuPage R.	Increase gravel substrate, channel sinuosity, grade banks and create 2 pools at site.	750,000		✓	
WB36	W. Branch DuPage R.	Dam Modification for fish passage. Establish riparian planting on exposed sediment.	1,000,000		✓	
WB37	W. Branch DuPage R.	Establish riparian buffer and grade banks.	150,000		✓	
WB38	W. Branch DuPage R.	Build 2 riffles and increase presence of gravel substrates. Grade banks.	400,000			✓
WB40	W. Branch DuPage R.	Build 2 riffles and increase presence of gravel substrates.	400,000			✓
WB41	W. Branch DuPage R.	Restore natural floodplain by lowering it and planting native vegetation. Meander the channel and limit bankfull to approximately the 2-year event. Remove sheet pile wall.	2,000,000	✓		
WB42	W. Branch DuPage R.	Stabilization and restoration erosion along the east bank of the river to protect the long-term integrity of an interceptor located along the east bank.	2,500,000 - 3,000,000	✓		

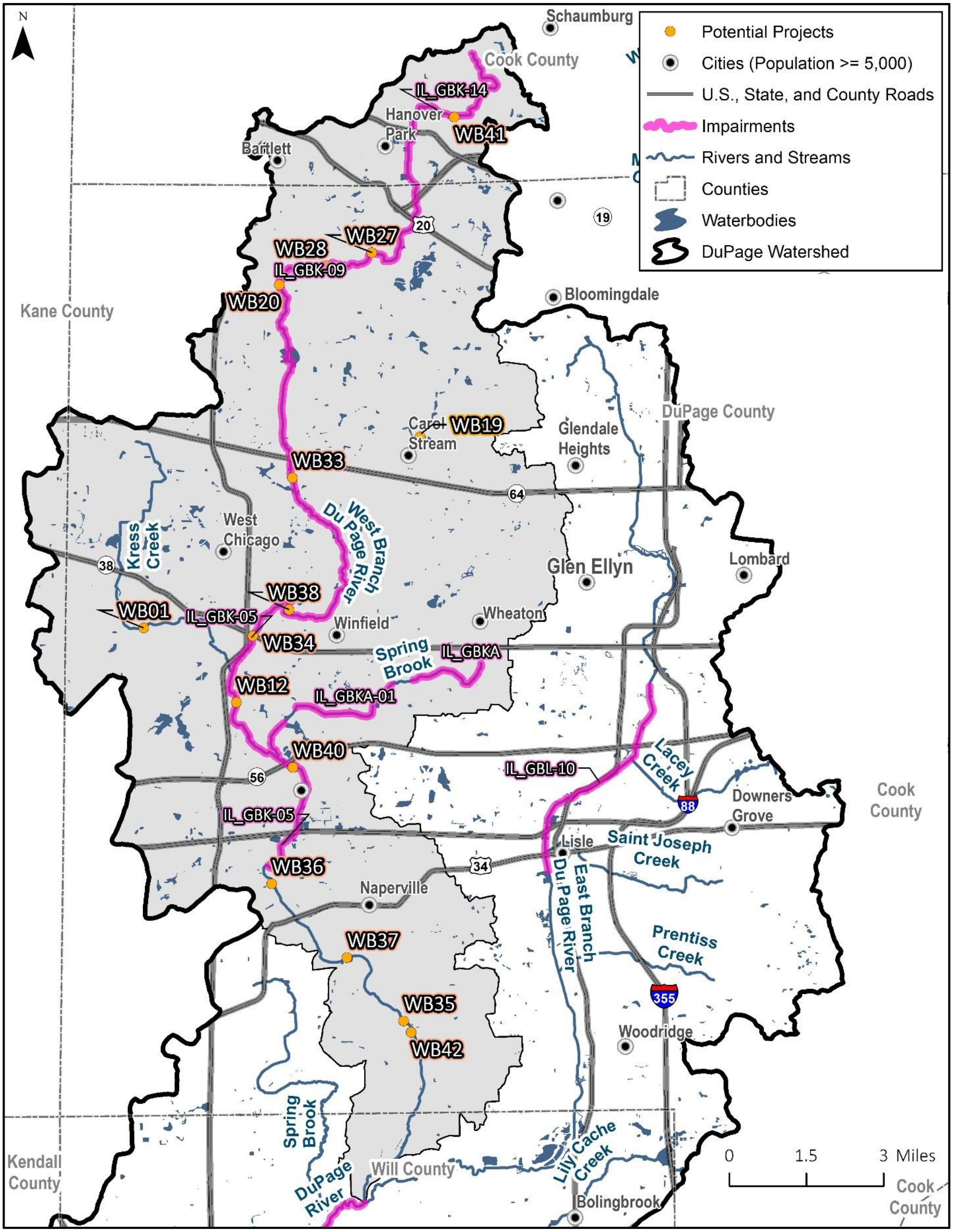

Figure 81. Potential implementation projects identified by DRSCW and others, West Branch DuPage River subwatershed.

8.5.3 Lower DuPage River Subwatershed

BMPs are needed in the Lower DuPage River to address fecal coliform, chloride, sediment, nutrient, and dissolved oxygen impairments. Impacts from upstream improvements to the East and West Branch DuPage rivers will improve phosphorus and dissolved oxygen conditions on GB-16 and potentially chloride conditions on GB-11.

Fecal Coliform Load Reductions

There are two fecal coliform-impaired segments in the Lower DuPage River: GB-11 and GB-16. There are several point sources that discharge to these segments. Permit compliance is needed to meet required load reductions. In addition, a sanitary survey (described in Section 8.3) is needed to identify potential sources of fecal coliform in the direct drainage area. This survey, along with additional monitoring, can be used to identify hotspots and focus implementation activities. Disconnecting impervious areas using green infrastructure and other stormwater management practices that utilize filtration can be used to reduce stormwater runoff and associated fecal coliform loading. Programmatic activities described in Section 8.4.1 are also needed.

Chloride Load Reductions

There is one chloride-impaired segment in the Lower DuPage River: GB-11. There are several point sources that discharge to these segments, and although they do not currently have chloride permit limits, wasteload allocations have been assigned and will be implemented as effluent limits in future permits. Nonpoint source best management practices necessary to reduce chloride loading from impervious areas within the direct drainage area to GB-11 are summarized in Section 8.4.1. While there is no impairment directly upstream of segment GB-11, it is expected that reductions in upstream watersheds will result in reductions in GB-11 due to upstream TMDLs. Reductions required in existing upstream chloride TMDLs are summarized in Table 2 and include a 35% reduction in the West Branch DuPage River and a 33% reduction in the East Branch DuPage River. Because there are limited number of exceedances of the water quality standard in GB-11, the implementation plan relies on expanding the Chloride Reduction Program developed by the DRSCW to the Lower DuPage River watershed, and additional monitoring along with an adaptive management approach. Permit limits for WWTPs in the Lower DuPage River watershed could be considered once non-point source reductions are in place.

Nutrient and Sediment Load Reduction Scenarios

In the Lower DuPage both urban land uses and cropland contribute to nutrient and sediment loading. Therefore, both urban and agricultural BMPs were evaluated in the load reduction scenario. Institutional, single family residential, open space, and transportation land use categories are contributing the largest urban pollutant loadings. Therefore for each of these land uses, BMPs were assigned to treat 20, 40, and 60% of the runoff being generated. BMPs were selected from STEPL that best aligned with the planned and implemented BMPs in the watershed gathered through a review of existing and current planning efforts and include:

- Permeable pavement – applied to institutional land uses
- Bioretention – applied to single family residential land uses
- Wetland detention – applied to open space land uses
- Extended wet detention ponds – applied to transportation land uses

Cropland loading was addressed at the same levels of implementation (20, 40, and 60%). An average agricultural BMP removal efficiency of 50% for TSS and TP was applied. No information exists for the removal efficiencies of agricultural BMPs of BOD, therefore these reductions are not quantified. Reductions in BOD, however, are expected. Summary results of the three implementation scenarios (20, 40, and 60% implementation on both urban and cropland) are provided in Figure 82.

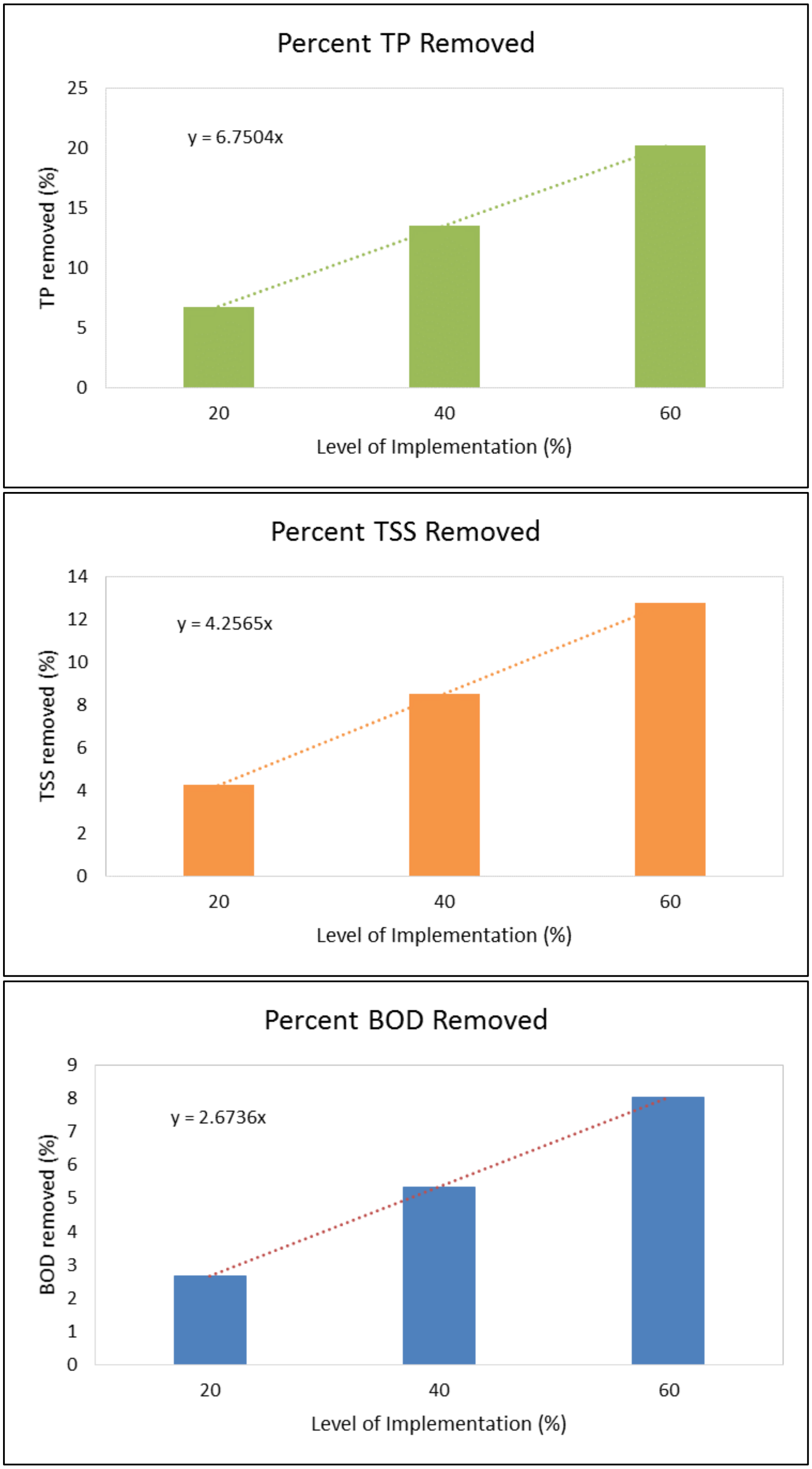

Figure 82. Implementation curves, Lower DuPage River subwatershed.

Dissolved Oxygen Improvements

The dissolved oxygen TMDL for GB-16 outlines different options to consider for implementing the TMDL. These options include changes to permit limits for $CBOD_5$ and dissolved oxygen and nonpoint source controls. Reductions in phosphorus (19% based on the difference in the existing condition [1.23 mg/L TP] and the scenario [1 mg/L TP]) are needed as well as increases in dissolved oxygen during critical conditions in the East Branch and West Branch DuPage rivers. Achieving the needed 19% reduction in TP in the East Branch and West Branch will require treatment of between 30 and 40% of the developed lands within those two watersheds. It is expected that reductions in phosphorus, thus reducing organic material, will result in lower SOD rates and coverage over time in the impaired segment. An adaptive management approach is critical in this case to track changes in water quality and adjust implementation activities over time.

8.5.4 Salt Creek Subwatershed

A separate planning study is being completed by CMAP for the Salt Creek watershed. Please see http://www.cmap.illinois.gov/programs/lta/lower-salt-creek for more information.

8.6 Progress Benchmarks and Implementation Schedule

Implementation activities will occur in three phases using outcome-based strategic planning and an adaptive management approach. Phase 1 represents the initial 5-year planning window. During this planning timeframe, the focus is on permit compliance, monitoring, identifying specific projects and funding sources, demonstration projects, and building local capacity. Phase 2 (mid-term; 2023-2032) and Phase 3 (long-term; 2033-2040) are designed to build on results from the preceding phase. To guide plan implementation through each phase using adaptive management, water quality benchmarks are identified to track progress towards attaining water quality standards. Progress benchmarks (Table 68) are intended to reflect the time it takes to implement management practices, as well as the time needed for water quality indicators to respond.

Table 68. Progress benchmarks for pollutants of concern

Indicator	Target	Segments [a]	Time-frame	Progress Benchmark
Fecal coliform	<400 count/100 ml in <10% of samples and <200 count/100ml (30-day geometric mean of at least 5 samples)	DuPage River (GB-11 and GB-16) West Branch DuPage River (GBK-05, GBK-09 and GBK-14) Spring Brook (GBKA and GBKA-01) East Branch DuPage River (GBL-10)	Phase 1	20% of load reductions
			Phase 2	40% of load reductions
			Phase 3	100% of load reductions, full attainment of water quality standards
Dissolved oxygen	For GB-16: March-July > 5.0 min & > 6.25 7-day mean Aug-Feb > 4.0 min, > 4.5 7-day mean, & > 6.0 30-day mean For GBKA and GBK-14: March-July > 5.0 min. & > 6.0 7-day mean Aug-Feb > 3.5 min, > 4.0 7-day mean, & > 5.5 30-day mean	Lower DuPage River GB-16) Spring Brook (GBKA) West Branch DuPage River (GBK-14)	Phase 1	20% of load reductions
			Phase 2	40% of load reductions
			Phase 3	100% of load reductions, full attainment of water quality standards
Chloride	<500 mg/L	Lower DuPage River (GB-11)	Phase 1	20% of load reductions
			Phase 2	40% of load reductions
			Phase 3	100% of load reductions; full attainment of water quality standards.
Nutrients and sediment	Not applicable	Not applicable	Phase 1	Not applicable
			Phase 2	
			Phase 3	

a. Progress benchmarks are not provided for Salt Creek. A separate planning study is being completed by CMAP for the Salt Creek watershed.

A schedule of implementation activities and associated milestones are provided in Table 70. This implementation schedule spans the entire DuPage River watershed, including areas with existing 319 approved watershed plans (Table 64). In areas with such plans, the smaller, HUC12 plans take precedence over this implementation plan. In addition to implementation of these plans, DRSCW, a group of permitted facilities and stakeholders, have agreed to complete a series of water quality and habitat improvement projects. These projects are provided in Table 69 and are part of a series of special conditions included in facility NPDES permits (see Appendix G for the full set of special conditions). This implementation plan assumes the projects will be completed according to their assigned completion dates. More information on DRSCW is provided in Section 8.10.

Table 69. DRSCW project schedule and objectives (per permit special conditions)

Project Name	Completion Date	Short Term Objectives	Long Term Objectives
Oak Meadows Golf Course stream restoration	December 31, 2017	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi
Fawell Dam Modification	December 31, 2018	Modify dam to allow fish passage	Raise fiBi upstream of structure
Spring Brook Restoration and dam removal	December 31, 2019	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi and fiBi
Fullersburg Woods dam modification	December 31, 2021	Improve DO, improve aquatic habitat (QHEI)	Raise miBi and fiBi
Fullersburg Woods dam modification area stream restoration	December 31, 2022	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi and fiBi
Southern West Branch Physical Enhancement	December 31, 2022	Improve aquatic habitat (QHEI)	Raise miBi and fiBi
Southern East Branch Stream Enhancement	December 31, 2023	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi and fiBi
QUAL2K East Branch and Salt Creek	December 31, 2023	Collect new baseline data and update model	Quantify improvements in watershed. Identify next round of projects for years beyond 2024.
NPS Phosphorus Feasibility Analysis	December 31, 2021	Assess nonpoint source performance from reductions in leaf litter and street sweeping	Reduce nonpoint source contributions to lowest practical levels

Table 70. Schedule and milestones

Waterbody	Target Pollutant	Milestones [a] 2018-2022	2023-2032	2033-2042
All nutrient and sediment impaired waters	Nutrients and Sediment	Identify desired sediment and nutrient load reduction scenario and begin implementation. NPDES permit compliance.	Continue implementation of BMPs needed to meet load reduction scenario chosen in Phase 1. NPDES permit compliance.	NPDES permit compliance. Evaluate implementation effectiveness, adapt if needed. Complete implementation of load reduction scenario.
All fecal coliform impaired waters	Fecal Coliform	Conduct additional monitoring e.g., sanitary surveys to identify sources of fecal coliform. Conduct demonstration stormwater projects. NPDES permit compliance. Create/expand pet waste education and outreach programs.	Evaluate results of NPDES permit compliance. Implement BMPs to best address sources identified in initial sanitary survey (e.g., wildlife management, stormwater management, etc.). Conduct additional monitoring, if needed (e.g., microbial source tracking).	Evaluate effectiveness of BMP implementation in Phase1 and Phase 2. Implement additional BMPs to achieve required load reductions.
GBL-10	Fecal Coliform	Address combined sewer overflows		
GBK-14	Dissolved Oxygen	Conduct additional monitoring to determine the extent of low dissolved oxygen conditions and determine the effect of headwater flow conditions. Identify targeted areas within the stream to increase aeration. Begin implementation of focused education efforts to address loading of organics to the stream from leaf litter, lawn clippings, etc.	Implement project to address low reaeration. Implementation of education and outreach to address loading of organics.	Address remaining reaeration problems. Implementation of education and outreach to address loading of organics.
GBKA	Fecal Coliform	Continue implementation of Spring Brook No. 1 Watershed Plan (see Table 64)		
	Dissolved Oxygen	Conduct additional monitoring to determine the effect of ponds downstream of Creekside Drive on low dissolved oxygen conditions. Identify targeted areas within the stream to increase aeration. Begin implementation of focused education efforts to address loading of organics to the stream from leaf litter, lawn clippings, etc.	Implement project to increase reaeration in the lower reach. Implementation of education and outreach to address loading of organics.	Implementation of education and outreach to address loading of organics.
		Continue implementation of Spring Brook No. 1 Watershed Plan (see Table 64)		
GBKA-01	Fecal Coliform	Continue implementation of Spring Brook No. 1 Watershed Plan (see Table 64).		

Waterbody	Target Pollutant	Milestones [a]		
		2018-2022	2023-2032	2033-2042
GB-16	Dissolved Oxygen	Continue to implement dissolved oxygen TMDLs in upstream reaches. Continue to reduce nutrient concentrations in upstream reaches. Further evaluate options for point source pollutant load reductions. Compliance with NPDES permits. Begin implementation of focused education efforts to address loading of organics to the stream from leaf litter, lawn clippings, etc.	Continue to implement dissolved oxygen TMDLs in upstream reaches. Continue to reduce nutrient concentrations in upstream reaches, achieving the target 19% reduction in TP at the headwater of GB-16. Compliance with NPDES permits. Implementation of education and outreach to address loading of organics.	Implementation of education and outreach to address loading of organics.
GB-11	Chloride	Expand chloride reduction efforts by the DRSCW to Lower DuPage River subwatershed, including development of a program targeting private salt application. Continue implementation of existing chloride reduction plan in East and West Branches.	Evaluate implementation of chloride reduction program and adapt as needed.	Evaluate implementation effectiveness of chloride reduction program, adapt as needed. Complete implementation of chloride reduction program. Address other potential sources of chloride as needed (e.g., wastewater).

a. Milestones are not provided for Salt Creek. A separate planning study is being completed by CMAP for the Salt Creek watershed.

8.7 Adaptive Management

To ensure management decisions are based on the most recent knowledge, the implementation plan follows the form of an adaptive and integrated management strategy and establishes milestones and benchmarks for evaluation of the implementation program. U.S. EPA (2008) recognizes that the processes involved in watershed assessment, planning, and management are iterative and that actions might not result in complete success during the first or second cycle. For this reason, it is important to remember that implementation will be an iterative process, relying upon adaptive management.

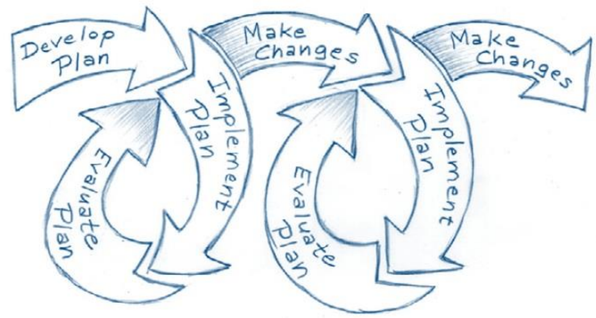

Figure 83. Adaptive management iterative process (USEPA 2008).

Adaptive management is a strategy to address natural resource management that involves a temporal sequence of decisions (or implementation actions), in which the best action at each decision point depends on the state of the managed system. As a structured iterative implementation process, adaptive management offers the flexibility for responsible parties to monitor implementation actions, determine the success of such actions and ultimately, base management decisions upon the measured results of completed implementation actions and the current state of the system. This process, depicted in Figure 83, enhances the understanding and estimation of predicted outcomes and ensures refinement of necessary activities to better guarantee desirable results. In this way, understanding of the resource can be enhanced over time, and management can be improved.

In addition to focusing future management decisions, with established assessment milestones and benchmarks, adaptive management can include a re-assessment of the TMDLs. Re-assessment of a TMDL is particularly relevant when completion of key studies, projects or programs result in data showing load reductions or the identification/quantification of alternative sources. Reopening/ reconsidering the TMDLs may include refinement or recalculation of load reductions and allocations.

The implementation phases, milestones, and benchmarks will guide the adaptive management process, helping to determine the type of monitoring and implementation tracking that will be necessary to gauge progress over time. Evaluation for adaptive management can include a variety of evaluation components to gain a comprehensive understanding of implementation progress. An implementation evaluation determines if non-structural and structural activities are put in place and maintained by implementation partners according to schedule; this is often referred to as an output evaluation. An outcome evaluation focuses on changes to behaviors and water quality as a result of implementation actions. This type of evaluation looks at changes in stakeholder behavior and awareness (i.e., non-structural BMP effectiveness), structural BMP performance, and changes to ambient water quality.

8.8 Public Education and Participation

Successful implementation will rely heavily on effective public education and outreach activities that will encourage participation and change behaviors. This section presents recommendations related to developing and implementing a coordinated watershed-wide public education and outreach program. This program will help to build the public support for implementation activities such as green infrastructure.

It is imperative to raise stakeholders' awareness about issues in the watershed and develop strategies to change stakeholders' behavior in a manner that will promote voluntary participation. Changes in awareness and behavior are surrogate indicators for longer-term changes in water quality. For example, strong public education and involvement in water quality improvement actives may encourage local governments and businesses to implement BMPs to meet the desires of citizens. Fortunately, several organizations within the watershed are already conducting education and outreach on important water quality issues. While there exist multiple regional education and outreach effort, implementation of the TMDL may provide the opportunity for these entities to work together to ensure a consistent and overarching marketing campaign across the watershed. The following existing entities can provide the foundation for such a public education program:

- DuPage County Stormwater Management
- DuPage River Salt Creek Work Group
- The Conservation Foundation
- DuPage County Health Department
- Lower DuPage River Watershed Coalition
- Chicago Metropolitan Agency for Planning
- County Forest Preserve Districts
- Metropolitan Water Reclamation District of Greater Chicago
- School and Community Assistance for Recycling and Composting Education

Examples of existing education and outreach programs and opportunities are summarized below.

DuPage County Citizen Reporter Mobile App

The DuPage County Citizen Reporter App was launched in 2016 to facilitate a method for citizens and stakeholders with in DuPage County to share and collect observations of water quality and water resource concerns. The app uses a web-based GIS system to collect and store user inputted observations that can then be vetted through a voting system. The public can view all inputs and then vote if they agree or disagree with it. Users also have the option to upload photos and comment on other reports. The app provides DuPage County the possibility of continuous civic engagement and monitoring of water ways. More information can be found at: https://gis.dupageco.org/CitizenReporter/.

Conservation in our Community

The Conservation Foundation program, Conservation in our Community, aims for residents to “embrace the idea of conservation as a core community value that not only enhances the environment, but also conserves money”. Currently, eight communities and one park district participate in the program. Suggested water related projects include:

- Volunteer groups to stencil stormwater drains
- Lunch and learns on water quality issues like stormwater runoff and erosion control for municipal employees
- Rain barrel sales

More information can be found at: http://www.theconservationfoundation.org/page.php?PageID=42.

Additional public outreach and education can include a variety of activities including newspaper articles, newsletters, radio spots, website content, workshops, demonstration projects and tours. A variety of activities can be undertaken in order to reach various target audiences.

Love Blue, Live Green Campaign

The Love Blue, Live Green is a DuPage County Stormwater Management social media campaign founded in 1988 to protect and enhance the quality of DuPage County waterways. It supports and hosts several educational events around the county that promote their mission. More information on the campaign can be found at their Facebook page: https://www.facebook.com/LoveBlueDuPage/ and twitter: https://twitter.com/lovebluedupage sites.

School and Community Assistance for Recycling and Compositing Education (SCARCE)

School and Community Assistance for Recycling and Composting Education (SCARCE) is an environmental non-profit and resource center that provide educational programs for schools, businesses, municipalities, and more to provide environmental education. They host rain barrel workshops and provide a water quality flag certification for entities that are working to improve water quality in their area. More information can be found at: https://www.scarce.org/about/.

Adopt a Stream Programs

Various Adopt a Stream Programs exist throughout the watershed. For example, the DuPage County Adopt a Stream Program found here: https://www.dupageco.org/EDP/Stormwater_Management/Water_Quality/38387/. These should be continued and expanded on impaired segments of river.

8.9 Monitoring

Monitoring is crucial to evaluating progress towards meeting water quality goals in the watershed and determining when adaptive management is needed. Monitoring is also needed to further refine source assessments so implementation activities can be focused in the most cost-effective way and to assess the effectiveness of source reduction strategies for attaining water quality standards and designated uses.

The ultimate measure of success will be documented changes in water quality, showing improvement over time (see Table 68 for progress benchmarks).

8.9.1 Water Quality Monitoring

Progress towards achieving water quality standards will be determined through ambient monitoring by Illinois EPA. The state conducts studies of ambient conditions across the state by evaluating watersheds on a rotating basis, collecting measurements of physical, chemical, and biological parameters. This ambient monitoring program will continue as the plan is implemented with a particular focus on impaired sites. Illinois EPA, in partnership with IDNR, additionally conducts Intensive Basin Surveys on a five-year rotational basis. These surveys collect water chemistry and biological (fish and macroinvertebrate) data, qualitative and quantitative instream habitat information, identify water quality conditions, and evaluate aquatic life use impairment. In addition to the monitoring conducted by Illinois EPA, the following organizations conduct water quality monitoring:

- DRSCW
- DuPage County and other NPDES permittees
- Lower DuPage River Watershed Coalition
- Forest Preserve of DuPage County through the Office of Natural Resources Aquatics Monitoring & Research Program
- Adopt-A-Stream program through DuPage County

Specific monitoring needs include sufficient data to assess fecal coliform impairments using both the single sample maximum and geometric mean water quality standards and to further evaluate the pathways of chloride in the watershed. Additional continuous dissolved oxygen monitoring and accompanying flow and water chemistry data are needed to further evaluate dissolved oxygen conditions in the Lower DuPage River watershed. Additional water quality sampling is also needed in most impaired segments to further define sources of pollutants.

8.9.2 BMP Effectiveness Monitoring

Multiple BMPs will be needed to address the water quality impairments in the DuPage River and Salt Creek watersheds. There are limited local data on the effectiveness of many BMPs; therefore, monitoring the results of programs and representative practices are critical. BMP monitoring can include quantitative monitoring of physical components (e.g., water quality and flow), qualitative (i.e., visual) monitoring of physical components (e.g., vegetation), and monitoring of behaviors using pre and post surveys. A monitoring program could be put in place as both structural and nonstructural BMPs are implemented to (1) measure success and (2) identify changes that could be made to increase effectiveness. U.S. EPA (1999) describes water quality monitoring and reporting data that are useful for assessing the effectiveness of stormwater BMPs.

8.10 Technical and Financial Assistance

A significant portion of this implementation plan focuses on voluntary efforts as opposed to permit requirements. As a result, technical and financial assistance are essential to successful implementation over time. This section identifies sources of funding and technical assistance to implement the recommended implementation practices. This section also identifies the watershed partners who will likely play a role in implementation.

Partners

There are several partners that may provide technical or financial assistance to promote successful TMDL implementation and watershed management. Two key watershed groups are present: DRSCW and the Lower DuPage River Watershed Coalition. In addition to these two entities, other federal, state, and local partners include:

- Chicago Metropolitan Agency for Planning
- Conservation Foundation
- Chicago Wilderness
- School and Community Assistance for Recycling and Composting Education
- County Forest Preserve Districts
- Counties and Soil and Water Conservation Districts
- Illinois State Water Survey
- Illinois EPA
- Illinois Farm Bureau
- University of Illinois Extension
- Illinois Department of Agriculture
- Illinois Department of Natural Resources
- U.S. EPA Region 5
- NRCS
- Farm Service Agency

DuPage River Salt Creek Workgroup

The DRSCW was formed in 2005 and consists of local communities, publicly owned treatment works, and environmental organizations in the East and West Branch DuPage rivers and Salt Creek watersheds. Members work together to “better determine the stressors to the aquatic systems through a long term water quality monitoring program and develop and implement viable remediation projects” (DRSCW webpage). Permitted facilities that are members of DRSCW are required to address a series of special conditions within their NPDES permits that address water quality concerns and includes the completion of several water quality improvement projects as listed in Table 69. Special condition language is provided in Appendix G. The permit conditions require permittees to:

- Work with other DRSCW members to determine the most cost effective means of removing dissolve oxygen and other offensive condition impairments in the DRSCW watersheds
- Participate in the development of a watershed Chloride Reduction Program
- Submit a single annual progress report that is common among DRSCW permittees

- Develop a written Phosphorus Discharge Optimization Plan, complete a feasibility study to evaluate timeframe, and construction costs of reducing phosphorus levels, and achieve required P reductions in effluent in 10-11 years, depending on phosphorus removal technique (wastewater facilities only)
- Monitor wastewater effluent and influent for phosphorus and nitrogen in accordance to their permit and submitted to Illinois EPA (wastewater facilities only)
- Submit and implement a nutrient implementation plan that identifies phosphorus reduction strategies and their implementation schedule to meet applicable water quality criteria (wastewater facilities only)

Additionally, the DRSCW has dedicated significant resources to promote the reduction of chlorides in the watershed. In 2007, the *Chloride Usage Education and Reduction Program Study* was completed. The study compiled information on chloride usage within the watershed to calculate an estimated annual chloride load. Implementation of the plan has been ongoing. Activities have included chloride reduction workshops, developing educational materials and technical resources, and surveying municipalities on practices.

Lastly, the DRSCW has been active in dam removal or modification that results in increased dissolved oxygen and fish passage. Several studies have evaluated the effect of dams in the DuPage River watershed and determined that dams were contributing to ecological degradation (Hammer et al. 2003, Midwest Biological Institute 2014, 2016). Recently in the Salt Creek watershed, a conceptual plan for the Fullersburg Woods dam modification and stream restoration was completed, and the Oak Meadows Golf Course dam was removed and 1.5 miles of stream restoration was completed. In the East Branch, the Churchill Woods dam was modified to improve water quality and address fish passage and Fawell Dam is currently proposed for dam modification.

Lower DuPage River Watershed Coalition

Lower DuPage River Watershed Coalition was formed in “to provide a local, coordinated effort to address water resource concerns using a science based approach to identify water quality stressors and develop ecologically and economically sound approaches to restore stream health”. Members include local communities, permitted facilities and local businesses interested in the Coalition’s cause. In addition, membership dues fund a bioassessment monitoring program. In 2011, the Coalition completed a watershed-based plan for the Lower DuPage River to protect and manage watershed health (see Table 64) for more information). Members of the coalition have also chosen to have the DRSCW special conditions included in their NPDES permits.

Financial Assistance Programs

There are many existing financial assistance programs which may assist with funding implementation activities. Many involve cost sharing, and some may allow the local contribution of materials, land, and in-kind services (such as construction and staff assistance) to cover a portion or the entire local share of the project. Several of these programs are presented in Table 71. In addition to these programs, partnerships between local governments can help to leverage funds. State and federal grant programs may also be available, depending on the nature of the implementation activity. A stormwater utility similar to those in place in the City of Wheaton and the Village of Downers Grove may also be used to generate local funds for stormwater programs. Table 71 was compiled from a review of existing funding opportunities as well as from existing watershed plans in the watershed.

Table 71. Potential funding sources

Funding Program	Type of Funding	Entity	Eligible Projects	Eligible Applicants	Available Funding	Website
Federal Programs						
Five Star Wetland and Urban Water Restoration Grant	Grant	U.S. EPA	On-the-ground wetland, riparian, in-stream and/or coastal habitat restoration, education and training activities through community outreach, participation and/or integration with K-12 environmental curriculum. Projects that provide benefits to the community through ecological and environmental efforts, and partnerships.	Non-profits, state government agencies, local and municipal governments, Indian tribes, and educational institutions	$10,000-$40,000 per project	http://www.nfwf.org/fivestar/Pages/home.aspx
Wetland Program Development Grants	Grant	U.S. EPA	Projects that promote the understanding of water pollution through review and refinements of wetland programs. Cause and effects, reduction and prevention, and elimination of water pollution.	States, tribes, local governments, interstate associations, and intertribal consortia (Regional grants) Nonprofits, interstate associations and intertribal consortia (National grants)	$20,000 to $600,000/fiscal year	https://www.epa.gov/wetlands/wetland-program-development-grants
North American Wetlands Conservation Act (standard grant)	Grant through the North American Wetlands Conservation Act	USFWS	Wetlands conservation projects in the United States, Canada, and Mexico. Projects must provide long-term protection, restoration, and/or enhancement of wetlands and associated uplands habitats.	Non-profits, state government agencies, local and municipal governments, Indian tribes, and educational institutions	Since 1995 1,025 projects have been funded with a combined total of over $850 million grant dollars. Requires a 1-1 partner contribution	https://www.fws.gov/birds/grants/north-american-wetland-conservation-act/standard-grants/united-states.php
North American Wetlands Conservation Act (small grant)	Grant through the North American Wetlands Conservation Act	USFWS	Wetlands conservation projects in the United States, Canada, and Mexico. Grant requests must not exceed $100,000.	Non-profits, state government agencies, local and municipal governments, Indian tribes, and educational institutions	Since 1996, 750 projects have been funded with a combined total of $43.2 million grant dollars Requires a 1-1 partner contribution	https://www.fws.gov/birds/grants/north-american-wetland-conservation-act/small-grants.php
Environmental Quality Incentive Program (EQIP)	Cost-share through contract (usually 3 years)	NRCS	Approved conservation practices that are constructed according to NRCS.	Farmers in livestock, agricultural, or forest production who utilize approved conservation practices	Up to 75% of project cost	https://www.nrcs.usda.gov/wps/portal/nrcs/main/il/programs/financial/eqip/
National and State Conservation Innovation Grants	EQIP funded grants	NRCS	Innovative problem-solving projects that boost production on farms, ranches, and private forests that improve water quality, soil health, and wildlife habitat.	Non-federal governmental or nongovernmental organizations, American Indian Tribes, or individuals. Producers involved in CIG funded projects must be EQIP eligible.	More than $22.6 million was awarded to 33 projects in 2017 Grantees much match funds	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/cig/
Environmental Education Grants Program	Grant	U.S. EPA	Environmental education programs that promote environmental awareness and stewardship and help provide people with the skills to take responsible actions to protect the environment. This program is currently waiting on the Fiscal Year 2017 budge before issuing a request for proposals.	• Local education agencies • State education or environmental agencies • Colleges or universities • Non-profit organizations 501(c)(3) • Noncommercial educational broadcasting entities • Tribal education agencies (including schools and community colleges controlled by an Indian tribe, band, or nation)	In 2015, 35 projects in the county were funded for a total of $3,306,594	https://www.epa.gov/education/environmental-education-ee-grants
State/Federal Partnerships						
Nonpoint Source Management Program (319)	Grant	U.S.EPA/ IEPA	Priority given to projects that implement cost-effective corrective and preventative BMPs on a watershed scale. Also available for BMPs on a non-watershed scale and the development of information/education nonpoint source pollution control programs. Projects that meet requirements of a NPDES permit are not eligible for 319 funding.	Units of government and other organizations	Approximately $3,000,000 is available per year, awarded amongst approximately 15 projects. Provides up to 60% project cost share	http://www.epa.illinois.gov/topics/water-quality/watershed-management/nonpoint-sources/grants/index Supplemental guidance on 319 funding for urban BMPS: http://www.epa.state.il.us/water/watershed/publications/nps-pollution/urban-bmps-supplemental-guidance.pdf

Funding Program	Type of Funding	Entity	Eligible Projects	Eligible Applicants	Available Funding	Website
Clean Water State Revolving Fund	Low interest loans, purchase of debt or refinance, subsidization	IEPA	Nonpoint source pollution control. Green infrastructure projects, construction of municipal wastewater facilities and decentralized wastewater treatment systems, watershed pilot projects, stormwater management, technical assistance (qualified nonprofit organizations only).	Corporations, partnerships, governmental entities, tribal governments, state infrastructure financing authorities	Varies	https://www.epa.gov/cwsrf
Healthy Forest Reserve Program	Easements, 30-year contracts, 10 year contracts	USDA	Projects that restore, enhance and protect forestland reserves on private land to measurably increase the recovery of threatened or endangered species, improve biological diversity, or increase carbon storage.	Private landowners	1. 10-year restoration cost-share agreement: up to 50% of average cost of approved conservation practices 2. 30-year easement: up to 75% of the easement value of the enrolled land plus 75% of the average cost of the approved conservation practices 3. 30-year contract on acreage owned by Indian Tribes 4. Permanent easements: up to 100% of the easement value of the enrolled land plus 100% of the average cost of the approved conservation practices	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/forests/
Healthy Watersheds Consortium Grant	Grant	EPA, NRCS and U.S. Endowment for Forestry and Communities	• "Healthy watershed" program development projects that aim to preserve and protect natural areas, or local demonstration/trainings • Conservation easements are *not* eligible • Grants awarded are generally within three categories: 1. Short term funding to leverage larger financing for targeted watershed protection 2. Funds to help build the capacity of local organizations for sustainable, long term watershed protection 3. New replicable techniques or approaches that advance the state of practice for watershed protection.	Consortiums or "one entity who is linked with or in a collaborative partnership with other groups or organizations having similar healthy watersheds protection goals"	$50,000-150,000 per project	https://www.epa.gov/hwp/healthy-watersheds-consortium-grants-hwcg
Partners for Fish and Wildlife Program	Technical and financial support	USFWS	Collaborations and partnerships with private landowners to improve fish and wildlife habitat on their lands. Voluntary, community-based stewardship for fish and wildlife conservation.	Private landowners	Varies per project/partners	https://www.fws.gov/midwest/partners/index.html
State Programs						
Streambank Stabilization and Restoration Program	Grant	Illinois Department of Agriculture	Labor, equipment, and materials for effective streambank stabilization demonstration sites that use inexpensive vegetative and bio-engineering techniques.	This program is currently not funded but may be reinstated in the future.	This program is currently not funded but may be reinstated in the future.	https://www.agr.state.il.us/conservation/.
Open Space Lands Acquisition and Development Grant/Land and Water Conservation Fund Grant	Grant	IDNR	Acquisition and/or development of land for public parks and open space by Illinois governments.	Local governments	Up to $750,000 for acquisition projects and $400,000 for development/renovation projects. Funding up to 50% of project cost	https://www.dnr.illinois.gov/aeg/pages/openspacelandsaquisitiondevelopment-grant.aspx
Illinois Buffer Partnership	Cost share, on site assistance from Trees Forever (Iowa) staff, project signs and field days	Illinois Buffer Partnership	Eligible projects include: Installation of streamside buffer plantings on projects including riparian buffers, livestock buffers, streambank stabilization projects, wetland development, pollinator habitat, rain gardens, and agroforestry projects.		Reimbursed up to $2,000 for 50% of the expenses remaining after other grant programs are applied	http://www.treesforever.org/Illinois_Buffer_Partnership.

Funding Program	Type of Funding	Entity	Eligible Projects	Eligible Applicants	Available Funding	Website
Local/Regional Programs						
CMAP Local Technical Assistance Program	In-kind technical assistance	CMAP	Recommended activities in CMAP's Go To 2040 plan.	Chicago Area governments, nonprofits, and intergovernmental organizations	NA	http://www.cmap.illinois.gov/programs-and-resources/lta
Water Quality Improvement Grant Program	Grant	DCSM	Eligible projects include: Stream bank stabilization involving bioengineering practices, in-stream habitat improvement, pond restoration, channel rehabilitation, riparian buffer rehabilitation, wetland creation and/or restoration, and green infrastructure to reduce or filter stormwater runoff that provide a regional water quality benefit.	Any organization or individual within DuPage County, IL	Up to 25% of construction costs for the portions of projects that provide water quality benefits not otherwise required Up to 25% of the maintenance and monitoring costs are eligible for reimbursement	https://www.dupageco.org/EDP/Stormwater_Management/Water_Quality/1312/

8.11 Reasonable Assurance

U.S. EPA requires that a TMDL provide reasonable assurance that the required load reductions will be achieved and water quality will be restored. Point source dischargers and MS4s contribute the majority of pollutant loading in the watershed. Illinois EPA will assure implementation of TMDLs through its NPDES and regulated stormwater programs. For nonpoint source control in the watershed, the implementation plan provides information that supports reasonable assurance that practices will be implemented.

The DRSCW and the Lower DuPage River Watershed Coalition are key partners who have an active role in watershed management and water quality improvement in the watershed. These entities will continue to provide leadership, with support from various other entities. These partners and their work in the watershed are summarized in Section 8.10.

Major regulatory examples of water quality improvement actions include ordinances such as the Will County watershed management ordinance, the DuPage County countywide stormwater and flood plain ordinance, the DRSCW salt reduction program implementation, and local pet waste ordinances such as the City of Geneva's, among others (see Section 8.4.1 for more details). On a state level, Illinois is developing a nutrient loss reduction strategy (https://www2.illinois.gov/epa/topics/water-quality/watershed-management/excess-nutrients/Pages/nutrient-loss-reduction-strategy.aspx) to address nutrient loading to waterways. The strategy promotes BMPs to reduce nutrient levels that have the co-benefit of increasing dissolved oxygen levels instream.

Examples of on-going activities in the watershed being led by the DRSCW include practices and strategies with co-benefits to impaired streams are also seen throughout the watershed. The recently completed dam removal and stream restoration at the Oak Meadows golf course is one example of a practice with co-benefits to aquatic habitat and other factors influencing dissolved oxygen. The project removed Oak Meadow dam, reconnected the river segment to its floodplain, established 25 acres of new wetlands and 43 acres of riparian habitat. Post project monitoring conducted in 2017 show an increase in habitat scores at all sites noted improvements in substrate, riparian, pool and riffle scores. In addition to improved habitat, dissolved oxygen scores data collected post project would suggest a modest improvement in the dissolved oxygen regime with a probable improvement in mean dissolved oxygen (DRSCW 2018). Numerous other existing and on-going planning activities exist in the watershed to improve water quality as summarized in Section 8.1.3 and Table 64.

Specific to the GB-16 Dissolved Oxygen TMDL, two TMDL scenarios are provided in Section 7.2.2. Under both scenarios, there are changes to permitted point source discharges ($CBOD_5$ and dissolved oxygen). These changes will be addressed via the NPDES permit; Illinois EPA has provided language in Section 7.2.2 that describes the Agency's approach to setting effluent limits associated with this TMDL. In addition, reducing the SOD rate and coverage and reducing total phosphorus loads is needed. As described in Section 8.5.3, a 19% reduction in total phosphorus is needed in the contributing watershed to GB-16 under both scenarios. Achieving this reduction will be the result of continued implementation of NPDES permits and targeted management practices in the watershed to reduce watershed loads.

The DRSCW, in addition to DuPage County Stormwater and other local entities, have a successful history of water quality implementation in this part of the watershed. Phosphorus reductions should result in lower SOD rates and coverage along GB-16, the extent of which is difficult to predict. The implementation plan relies on adaptive management over time and sets progress benchmarks and an implementation schedule on which to track improvements.

In addition to the above activities, educational efforts and cost-share programs will be relied upon to increase participation to levels needed to protect water quality. Existing educational programs are summarized in Section 8.8 and include adopt-a-stream programs, water quality improvement campaigns, and citizen monitoring programs. Technical and financial assistance, as summarized in Section 8.10, provide the resources needed to improve water quality and meet watershed goals.

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Appendix A

Stage 1 Report

Note that much of the content is no longer relevant.

Prepared for:
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

DuPage River/Salt Creek Watershed TMDL Stage 1 Report

AECOM, Inc.
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AECOM

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Executive Summary

As required by Section 303(d) of the Clean Water Act (CWA), the Illinois Environmental Protection Agency (Illinois EPA) is required to identify and list all state waters that fail to meet water quality standards. This list is referred to as the 303(d) list and is revisited every two years to either remove those waters that have attained their designated uses, or to include additional waters not previously deemed impaired. Waterbodies included on the 303(d) list require Total Maximum Daily Load (TMDL) development.

A TMDL is an estimation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. It assesses contributing point and nonpoint sources to identify pollution reductions necessary for designated use attainment. A TMDL identifies the source of impairment and provides reduction estimates to meet water quality standards. Pollutant reductions are then allocated to contributing sources, thus triggering the need for pollution control and increased management responsibilities amongst sources in the watershed.

For the DuPage River/Salt Creek watershed 17 impaired waterbodies were identified for TMDL development. The DuPage River/Salt Creek Watershed (Figure 2-1) is located in northeastern Illinois and originates from two branches in the northern most part of the watershed. The West Branch DuPage River is approximately 35 miles long and the East Branch DuPage River is approximately 25 miles long. Both branches flow south until they meet around Bolingbrook, creating the main branch of the DuPage River. The DuPage River flows approximately 30 additional miles before the confluence with the Des Plaines River near the town of Channahon, IL. Two tributaries and a lake will be included in the TMDL. Spring Brook is a tributary of the West Branch DuPage River and flows southwest for approximately 5.5 miles before the confluence with the West Branch of the DuPage River. Addison Creek is a tributary of Salt Creek and flows southeast for approximately 10.5 miles before the confluence with Salt Creek. Churchill Lagoon was formed by damming the East Branch DuPage River.

The only waterbody classification applicable to the DuPage River/Salt Creek watershed is the General Use classification which includes designated uses such as aquatic life, aesthetic quality, fish consumption and primary contact recreation uses. The identified impairments include total phosphorus, fecal coliform, pH, dissolved oxygen, silver, manganese, and chloride. The water quality standard criteria identified for these impairments provide an explicit assessment as to whether or not these waterbodies are in compliance.

Available data used for assessing these waterbodies originated from numerous water quality stations within the DuPage River/Salt Creek watershed. Data were obtained from both legacy and modernized USEPA Storage and Retrieval (STORET) databases, Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) data, Sierra Club, Wheaton Sanitary District, DuPage River Salt Creek Workgroup and Illinois EPA database data. Data relevant to impairments were compiled for each impaired waterbody and summary statistics were calculated to further characterize each pollutant.

Various models were recommended for TMDL development, the level of which was primarily based on the complexity of the system and the availability of data. Simple spreadsheet models were recommended for DO TMDLs and the ENSR Lake Response Model (ENSR LRM) was recommended to analyze total phosphorus impairment. Load duration curves were recommended for fecal coliform and metals analyses and could also be used to estimate BOD loading for the DO TMDL. If the system requires a more complex DO model for creek simulation, then QUAL2K could be used. QUAL2K was recommended for the pH TMDL, but is capable of simulating in-stream DO concentrations.

1.0 Introduction

This Stage 1 Total Maximum Daily Load (TMDL) report is presented as partial fulfillment by the Illinois Environmental Protection Agency (Illinois EPA) and the United States Environmental Protection Agency (US EPA) in the development of TMDLs, as part of that state's Clean Water Act (CWA) Section 303(d) compliance. The purpose of the project is to develop TMDLs for seventeen designated waterbodies in the DuPage River and Salt Creek watershed in northeastern Illinois.

Section 303(d) of the CWA and U.S. EPA's Water Quality Planning Regulations (40 CFR Part 130) require states to develop TMDLs for impaired waterbodies that are not meeting designated uses or water quality standards. A TMDL is a calculation of the maximum amount of pollutants that a waterbody can receive and still meet the water quality standards necessary to protect the designated beneficial use (or uses) for that waterbody. The TMDL process establishes the allowable loadings of pollutants for a waterbody based on the relationship between pollutant sources and water quality conditions, so that states and local communities can establish water quality based controls to reduce pollutants from both point and nonpoint sources and restore and maintain the quality of their water resources.

Water is an essential resource for the inhabitants of the Earth and protecting this resource is the goal for many across the globe. United States policies and regulations, such as the CWA, were created and are implemented to help maintain the quality of our water resources in the United States. The U.S. EPA, via the CWA, charged each state with developing water quality standards (WQS). These WQS are laws or regulations that states authorize to protect and/or enhance water quality, to ensure that a waterbody's designated use (or uses) is (are) not compromised by poor water quality and to protect public health and welfare. In general, WQS consist of three elements:

- The designated beneficial use (e.g., recreation, protection of aquatic life, aesthetic quality, and public and food processing water supply) of a waterbody or segment of a waterbody,
- The water quality criteria necessary to support the designated beneficial use of a waterbody or segment of a waterbody, and
- An anti-degradation policy, so that water quality improvements are conserved, maintained and protected.

The Illinois Pollution Control Board (IPCB) established its WQS and includes it in Title 35: Environmental Protection, Subtitle C: Water Pollution, Chapter 1: Pollution Control Board, Part 302: Water Quality Standards. Every two years the Illinois EPA submits the Illinois Integrated Water Quality Report and Section 303(d) List. This report documents surface and groundwater conditions throughout the state. The 303(d) List portion of this report identifies impaired waterbodies, grouped by watershed, and identifies suspected sources of impairment. These waters are prioritized for TMDL development into high, medium, and low categories based on designated use and pollution severity and are then targeted for TMDL development. Non-pollutant causes of impairment, such as habitat degradation and aquatic algae, are not addressed under the TMDL, but are address by programs such under the 319 program and other nonpoint source grant programs. Some non-pollutants may be addressed by reducing pollutants for which a TMDL is developed. For example, some implementation activities to reduce phosphorus can also reduce excessive algae and improve aquatic habitat.

A TMDL is a calculation of the maximum load a waterbody can be receive without exceeding water quality standards or result in non attainment of a designated use. A watershed's TMDL report consists of data analysis to quantitatively assess water quality, documentation of waterbodies or segments of waterbodies that are impaired, and identification of potential contributing sources to impairment. Based on these data, the amount and type of load reduction that is needed to bring water quality into compliance is calculated. The TMDL report provides the scientific basis for states and local communities to establish water quality-based controls to reduce pollutant loads from both point (i.e., wasteload allocations) and non-point sources (i.e., load allocations).

Illinois EPA uses a three-stage approach to develop TMDLs for a watershed:

- **Stage 1** – Watershed characterization, historical dataset evaluation, data analysis, methodology selection, data gap identification;
- **Stage 2** – Data collection to fill in data gaps, if necessary; and
- **Stage 3** – Model calibration, TMDL scenarios, and implementation plans.

The purpose of Stage 1 is to characterize the watershed background; verify impairments in the listed waterbody by comparing observed data with water quality standards or appropriate targets; evaluate spatial and temporal water quality variation; provide a preliminary assessment of sources contributing to impairments; and describe potential TMDL development approaches. If available water quality data collected for the watershed are deemed sufficient by Illinois EPA, Stage 2 may be omitted and Stage 3 will be completed. If sufficient water quality data or supporting information are lacking for an impaired waterbody, then Stage 2 is required and field samplings will be conducted in order to obtain necessary data to complete Stage 3. Stage 3 includes model development, allocations and reductions needed for waterbody improvement and implementation actions for local stakeholders.

This report documents Stage 1 in the Illinois EPA approach for TMDL development. The report is organized into six main sections. Section 1.0 discusses the definition of TMDLs and targeted impaired waterbodies in the DuPage River and Salt Creek watershed, for which TMDLs will be developed. Section 2.0 describes the characteristics of the watershed, and Section 3.0 briefly discusses the process of public participation and involvement. Section 4.0 describes the applicable water quality standards and water quality assessment. Section 5.0 presents the assessment and analysis of available water quality data. Section 6.0 discusses the methodology selection for the TMDL development, the data gaps, and provides recommendations for additional data collection, if necessary.

1.1 Definition of a Total Maximum Daily Load (TMDL)

According to the 40 CFR Part 130.2, the TMDL (the maximum load a waterbody can be receive without exceeding water quality standards or result in non attainment of a designated use) for a waterbody is equal to the sum of the individual loads from point sources (i.e., wasteload allocations or WLAs), and load allocations (LAs) from nonpoint sources (including natural background conditions). Section 303(d) of the CWA also states that the TMDL must be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety (MOS) which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. In equation form, a TMDL may be expressed as follows:

TMDL = WLA + LA + MOS

where:

WLA = Waste Load Allocation (i.e., loadings from point sources);
LA = Load Allocation (i.e., loadings from nonpoint sources including natural background); and
MOS = Margin of Safety.

TMDLs can be expressed in terms of either mass per time, toxicity or other appropriate measures [40 CFR, Part 130.2 (i)]. US EPA recommends that all TMDLs and associated LA and WLAs be expressed in terms of daily increments but may include alternative non-daily expression of pollutant loads to facilitate implementation of the applicable water quality standard. TMDLs also shall take into account the seasonal variability of pollutant loading and hydrology to ensure water quality standards are met in all seasons and during all hydrologic conditions. Though not required by CWA, Illinois EPA requires that an implementation plan be developed for each watershed, which may be used as a guideline for local stakeholders to restore water quality. This implementation plan will include recommendations for implementing best management practices (BMPs), cost estimates, institutional needs to implement BMPs and controls throughout the watershed, and time frame for completion of implementation activities.

The MOS accounts for the lack of knowledge or uncertainty concerning the true relationship between loading and attainment of water quality standards. This uncertainty is often a product of data gaps, either temporally or spatially, in the measurement of water quality. The MOS should be proportional to the anticipated level of uncertainty; the higher the uncertainty, the greater the MOS. The MOS is generally based on a qualitative assessment of the relative amount of uncertainty as a matter of best professional judgment (BPJ). The MOS can be either explicit or implicit. If an explicit MOS is used, a portion of the total allowable loading is allocated to the MOS. If the MOS is implicit, a specific value is not assigned to the MOS, but is already factored in during the TMDL development process. Use of an implicit MOS is appropriate when assumptions used to develop the TMDL are believed to be so conservative that they sufficiently account for the MOS.

1.2 Targeted Waterbodies for TMDL Development

In May 2008, Illinois EPA prepared a draft Illinois Integrated Water Quality Report and Section 303(d) List-2008 (commonly referred to as the 303(d) List) to fulfill the requirement of Section 305(b), 303(d) and 314 of the CWA (Illinois EPA, 2008). Under US EPA's review and approval, the report presents a detailed water quality assessment process and results for streams and lakes in the State of Illinois. The water quality assessments are based on biological, physicochemical, physical habitat, and toxicity data. Each waterbody has one or more of designated uses which may include aquatic life, aesthetic quality, indigenous aquatic life (for specific Chicago-area waterbodies), primary contact (swimming), secondary contact (recreation), public and food processing water supply, and fish consumption. The degree of support (attainment) of a designated use in a waterbody (or segment) is assessed as Fully Supporting (good), Not Supporting (fair), or Not Supporting (poor). Waters in which at least one applicable use is not fully supported is designated as "impaired." Potential causes and sources of impairment are also identified for these waters. The 303(d) List is prioritized on a watershed basis based on the requirements of 40 CFR Part 130.7(b)(4). Watershed boundaries are based on United States Geological Survey (USGS) ten-digit hydrologic units, to provide the state with the ability to address watershed issues at a manageable level and document improvements to a watershed's health (Illinois EPA, 2008). TMDL development is also conducted on a watershed basis so that the impaired waters upstream of an individual segment may be addressed at the same time.

Sixteen river segments and one lake segment are identified as impaired and selected for TMDL development in the DuPage River/Salt Creek Watershed (Illinois EPA, 2008). Table 1-1 summarizes these waterbodies, designated uses, and impairments identified by the Illinois EPA 2008 Integrated Report (303(d) List and Stream Assessment Report). The designated uses for these waterbodies include aesthetic quality, primary contact recreation (swimming), aquatic life, and fish consumption. The identified impairments include total phosphorus, fecal coliform, pH, dissolved oxygen, silver, manganese, and chloride. Fecal coliform is the predominant impairment within the watershed. The WQS provide numerical criteria to measure compliance for each of these water quality variables. DO is considered a non-pollutant by Illinois EPA. For dissolved oxygen impairments, the dissolved oxygen parameter itself will not be calculated as a TMDL, but will be addressed through a different, contributory parameter with a numerical WQS. This contributory parameter will be identified in the Stage 3 TMDL Report. For example, if a 50-acre lake suffers from low DO due to excessive algal densities which is related to elevated phosphorus concentrations, the Illinois EPA will develop a phosphorus TMDL for this waterbody. A TMDL will not be developed for waterbodies listed as impaired based on non-numerical WQSs (e.g., excessive algae) or statistical guidelines (e.g., total suspended solids). For other causes such as total suspended solids, the TMDL implementation plan can potentially address the impairment by reducing other TMDL parameters that are associated with this impairment. For example, a TMDL done for phosphorus in lakes will recommend BMPs in the implementation plan that when put in place could reduce siltation/sedimentation and total suspended solid impairments. Reduction of phosphorus in lakes could also reduce the impairment of excessive aquatic algae and plants.

Table 1-1: Illinois 2008 Integrated Report (303(d) and Waterbody Assessment) Information for DuPage River and Salt Creek Watershed

Waterbody ID	Waterbody Name	Water Size (Miles/ Acres)	Designated Use	Impairment
IL_GB-01	DuPage River	8	Aquatic Life	*Aquatic Plants (Macrophytes), Other Flow Regime Alteration, Phosphorus, Sedimentation/Siltation,* **Silver (1)**
			Fish Consumption	*Mercury, PCBs*
IL_GB-11	DuPage River	9.81	Aquatic Life	*Aquatic Plants (Macrophytes),* **Chloride (1)**, *DDT, Hexachlorobenzene, Other Flow Regime Alteration, PCBs, Phosphorus, Sedimentation/ Siltation, Total Suspended Solids*
			Fish Consumption	*Mercury, PCBs*
			Primary Contact Recreation	**Fecal Coliform (1)**
IL_GB-16	DuPage River	10.39	Aquatic Life	*Aquatic Plants (Macrophytes),* **Dissolved Oxygen (1)**, *Other Flow Regime Alteration, Phosphorus*
			Fish Consumption	*Mercury, PCBs*
			Primary Contact Recreation	**Fecal Coliform (1)**
IL_GBK-05	West Branch DuPage River	10.35	Aquatic Life	*Alteration in Stream-side Littoral Vegetation,* Chloride (2), *DDT,* **Dissolved Oxygen (1)**, *Other Flow Regime Alteration, Phosphorus, Sedimentation/ Siltation, Total Suspended Solids*
			Primary Contact Recreation	**Fecal Coliform (1)**
IL_GBK-09	West Branch DuPage River	4.49	Aquatic Life	Chloride (2), **Dissolved Oxygen (1)**, Iron*, **pH (1)**, *Phosphorus, Sedimentation/ Siltation*, **Silver (1)**, Zinc*
			Primary Contact Recreation	**Fecal Coliform (1)**

Waterbody ID	Waterbody Name	Water Size (Miles/ Acres)	Designated Use	Impairment
IL_GBK-14	West Branch DuPage River	10.71	Aquatic Life	Chloride (2), **Dissolved Oxygen (1), Manganese (1)**, *Phosphorus, Total Suspended Solids*
			Primary Contact Recreation	**Fecal Coliform (1)**
IL_GBKA	Spring Brook	1.87	Aquatic Life	*Alteration in Stream-side Littoral Vegetation*, Chloride (2), **Dissolved Oxygen (1),** *Phosphorus*
			Primary Contact Recreation	**Fecal Coliform (1)**
IL_GBKA-01	Spring Brook	3.55	Aquatic Life	Copper*, *Phosphorus*
			Primary Contact Recreation	**Fecal Coliform (1)**
IL_GBL-08	East Branch DuPage River	5.53	Aquatic Life	*Alteration in Stream-side Littoral Vegetation, Aquatic Algae (Macrophytes), DDT,* Dissolved Oxygen (2)**,** H*exachlorobenzene, Mercury, Other Flow Regime Alteration,* **pH (1**), *Phosphorus, Sedimentation/ Siltation, Total Suspended Solids*
			Fish Consumption	*Polychlorinated biphenyls*
IL_GBL-10	East Branch DuPage River	4.63	Aquatic Life	*Alteration in Stream-side Littoral Vegetation, Aquatic Algae (Macrophytes),* Chloride (2), DDT, Dissolved Oxygen (2), *Hexachlorobenzene, Mercury,* **pH (1)**, *Phosphorus, Sedimentation/ Siltation, Total Suspended Solids*
			Fish Consumption	*PCBs*
			Primary Contact Recreation	**Fecal Coliform (1)**
IL_GL	Salt Creek	11.26	Aquatic Life	*Aquatic Algae),* Chloride (2), Dissolved Oxygen (2), *Other Flow Regime Alteration, Phosphorus (Total)*
			Fish Consumption	*Mercury, PCBs*
			Primary Contact Recreation	**Fecal Coliform (1)**

Waterbody ID	Waterbody Name	Water Size (Miles/ Acres)	Designated Use	Impairment
IL_GL-09	Salt Creek	11.78	Aquatic Life	Aldrin, Chloride (2), DDT, Dissolved Oxygen (2), *Other Flow Regime Alteration*, **pH (1),** *Phosphorus (Total), Sedimentation/Siltation, Total Suspended Solid*
			Fish Consumption	Mercury, PCBs
			Primary Contact Recreation	**Fecal Coliform (1)**
IL_GL-10	Salt Creek	3.64	Aquatic Life	*Alteration in Stream-side Littoral Vegetation, Aquatic Algae, Aquatic Plants (Macrophytes),* Chloride (2), *Other Flow Regime Alteration*, **pH (1)**, *Phosphorus (Total)*
			Fish Consumption	Mercury, PCBs
			Primary Contact Recreation	**Fecal Coliform (1)**
IL_GL-19	Salt Creek	3.1	Aquatic Life	*Alteration in Stream-side Littoral Vegetation*, Chloride (2), Dissolved Oxygen (2), *Other Flow Regime Alteration*, **pH (1)**, *Phosphorus, Sedimentation/Siltation, Total Suspended Solids*
			Fish Consumption	*Mercury, PCBs*
			Primary Contact Recreation	**Fecal Coliform (1)**
IL_GLA-02	Addison Creek	6.61	Aquatic Life	*Aldrin, Alteration in Stream-side Littoral Vegetation,* Chloride (2), *Chromium (Total), DDT, Hexachlorobenzene, Nickel, Other Flow Regime Alteration, Phosphorus*
			Primary Contact Recreation	**Fecal Coliform (1)**
IL_RGG	Churchill Lagoon	21	Aesthetic Quality	**Phosphorus (Total) (1)(3)**, *Total Suspended Solids, Aquatic Algae*
			Aquatic Life	*Aldrin, Aquatic Algae,* **Phosphorus (Total) (1)(3)**, *Silver, Total Suspended Solids*

(1) These parameters have numeric standards and will have TMDL allocations.
(2) These parameters are or will be addressed by implementation activities within the watershed based on previous TMDL studies.
(3) At the time of this report, dam removal is being discussed for this lagoon and the numeric standard may not be applicable to this waterbody. More information will be available in the Stage 3 TMDL Report.
*The source causing impairment is believed to originate solely from point sources. The point source will be required to meet the water quality standard at the point of discharge. The Illinois EPA, based on the information available, believes that the compliance with the WQS will be achieved after all point source dischargers have installed the appropriate controls. A TMDL will not be prepared for this pollutant at this time, but will assess the waterbody again after the appropriate point source controls have been operational.

Table 1-2: Waterbodies targeted for TMDL development in the DuPage River and Salt Creek Watershed and potential sources of impairment

Waterbody ID	Waterbody Name	Impairment	Potential Source(s)
IL_GB-01	DuPage River	Silver	Urban Runoff/Storm Sewers
IL_GB-11	DuPage River	Chloride	Municipal Point Source Discharges, Urban Runoff/Storm Sewers
		Fecal Coliform	Source Unknown
IL_GB-16	DuPage River	Dissolved Oxygen	Impacts from Hydrostructure Flow Regulation/modification, Urban Runoff/ Storm Sewers
		Fecal Coliform	Municipal Point Source Discharges, Urban Runoff/Storm Sewers, Site Clearance (Land Development or Redevelopment), Source Unknown
IL_GBK-05	West Branch DuPage River	Dissolved Oxygen	Impacts from Hydrostructure Flow Regulation/modification, Municipal Point Source Discharges, Urban Runoff/ Storm Sewers
		Fecal Coliform	Source Unknown
IL_GBK-09	West Branch DuPage River	pH	Source Unknown
		Dissolved Oxygen	Municipal Point Source Discharges, Urban Runoff/Storm Sewers
		Silver	Urban Runoff/Storm Sewers
		Fecal Coliform	Urban Runoff/Storm Sewers
IL_GBK-14	West Branch DuPage River	Manganese	Urban Runoff/Storm Sewers
		Dissolved Oxygen	Source Unknown
		Fecal Coliform	Urban Runoff/Storm Sewers
IL_GBKA	Spring Brook	Dissolved Oxygen	Channelization, Urban Runoff/ Storm Sewers
		Fecal Coliform	Source Unknown
IL_GBKA-01	Spring Brook	Fecal Coliform	Source Unknown
IL_GBL-08	East Branch DuPage River	pH	Upstream Impoundments (e.g., PI-566 NRCS Structures)
IL_GBL-10	East Branch DuPage River	pH	Source Unknown
		Fecal Coliform	Source Unknown, Urban Runoff/Storm Sewers
IL_GL	Salt Creek	Fecal Coliform	Urban Runoff/Storm Sewers
IL_GL-09	Salt Creek	pH	Source Unknown
		Fecal Coliform	Combined Sewer Overflows, Urban Runoff/Storm Sewers

Waterbody ID	Waterbody Name	Impairment	Potential Source(s)
IL_GL-10	Salt Creek	pH	Source Unknown
		Fecal Coliform	Urban Runoff/Storm Sewers
IL_GL-19	Salt Creek	pH	Urban Runoff/Storm Sewers
		Fecal Coliform	CSOs, Urban Runoff/Storm Sewers
IL_GLA-02	Addison Creek	Fecal Coliform	Combined Sewer Overflows, Urban Runoff/Storm Sewers
IL_RGG	Churchill Lagoon	Phosphorus (Total)(1)	Municipal Point Source Discharges, Runoff from Forest/Grassland/Parkland, Urban Runoff/Storm Sewers

(1) At the time of this report, dam removal is being discussed for this lagoon and the numeric standard may not be applicable to this waterbody. More information will be available in the Stage 3 TMDL Report

1.3 Previous TMDL Development in Watersheds

Previous TMDL Reports have been developed in these watersheds. See Tables 1.3 to 1.5 for information on the parameters that the TMDLs addressed.

The development of the West Branch DuPage River, East Branch DuPage River and Salt Creek TMDLs began in 2000. The West Branch DuPage River was approved by USEPA in May 2004 and the other two were approved in September of 2004. As a result of these TMDL processes many stakeholders in the watershed organized the DuPage River Salt Creek Workgroup (DRSCW) that consists of community groups, municipalities, and environmental organizations. This group was formed to better determine the stressors in the aquatic system through a long term quality monitoring program and develop and implement viable implementation projects to accurately address the stressors. For more information on this group, please visit their website at http://www.drscw.org/about_us.htm. More information on watershed groups can be found in Section 3.0. The implementation plan, which is done in Stage 3 of TMDL development, will include information on projects completed or ongoing in the watershed.

Table 1-3: Previous East Branch DuPage River Watershed TMDL Parameters

Waterbody ID	Waterbody Name	Pollutant(s)
IL_GBL-05 IL_GBL-10	East Branch DuPage River	Chloride, DO, TDS
IL_GBL-08	East Branch DuPage River	DO
IL_GBLB-01	St. Joseph Creek	DO

Table 1-4: Salt Creek Watershed TMDL

Waterbody ID	Waterbody Name	Pollutant(s)
IL_GL	Salt Creek	Chloride, DO, TDS
IL_GL-03	Salt Creek	DO, TDS, TSS
IL_GL-09	Salt Creek	Chloride, DO, TDS, TSS
IL_GL-10	Salt Creek	Chloride, TDS
IL_GL-19	Salt Creek	Chloride, DO, Sedimentation/siltation, TDS, TSS
IL_GLA-02	Addison Creek	Chloride, DO, TDS
IL_GLA-04	Addison Creek	DO, TSS
IL_GLB-01	Spring Brook	DO, TSS
IL_GLBA	Meacham Creek	DO

Table 1-5: Previous West Branch DuPage River Watershed TMDL Parameters

Waterbody ID	Waterbody Name	Pollutant(s)
IL_GBK-05 IL_GBK-07 IL_GBK-09	West Branch DuPage River	Chloride, TDS
IL_GBK-12	West Branch DuPage River	Chloride
IL_GBKA	Spring Brook	TDS

2.0 Watershed Characterization

As part of the Stage I report, relevant geologic and hydrologic characteristics and general information are obtained for the watershed of interest. This section describes the general characteristics of the DuPage River/Salt Creek watershed including location (Section 2.1), topography (Section 2.2), land use (Section 2.3), soil information (Section 2.4), population (Section 2.5), climate and precipitation (Section 2.6) and hydrology (Section 2.7).

2.1 Watershed Location

A watershed is a geographic area that shares a hydrologic connection - all the water within that area drains to a common waterway. Water movement can be influenced by topography, soil composition and water recharge (i.e. precipitation, snow melt, groundwater) ("What is a Watershed", 2007). Watersheds are important because pollution at the water's source may impact water quality in all down-gradient areas including its convergence with a common waterway. Understanding the watershed is an essential step in the TMDL process – an essential tool in maintaining water quality standards within Illinois.

The DuPage River/Salt Creek Watershed (Figure 2-1) is located in northeastern Illinois and is approximately 520 mi^2 (332,600 acres). The watershed includes the DuPage River (USGS HUC 0712000408) and Salt Creek (USGS HUC 0712000404) which are within Cook, Kendal, Will, Gundy, and DuPage counties. The DuPage River originates from two branches in the northern most part of the watershed. The West Branch DuPage River and East Branch DuPage River are approximately 35 miles and 25 miles long, respectively. Both branches flow south until they meet around Bolingbrook, creating the main branch of the DuPage River. The DuPage River approximately runs an additional 30 miles before the confluence with the Des Plaines River near the town of Channahon, IL. Spring Brook, another tributary to the DuPage River, flows southwest for approximately 5.5 miles before the confluence with the West Branch DuPage River.

Salt Creek and Addison Creek are 40 miles and 6.5 miles long, respectively, prior to their confluence approximately 3 miles upstream of the Des Plaines River. The Des Plaines River flows southwest, and after its confluence with the DuPage River, joins the Illinois River, a major tributary of the Mississippi River. Figure 2-2 displays the waterbodies targeted for TMDL development.

Figure 2-1: DuPage River/Salt Creek Watershed Overview

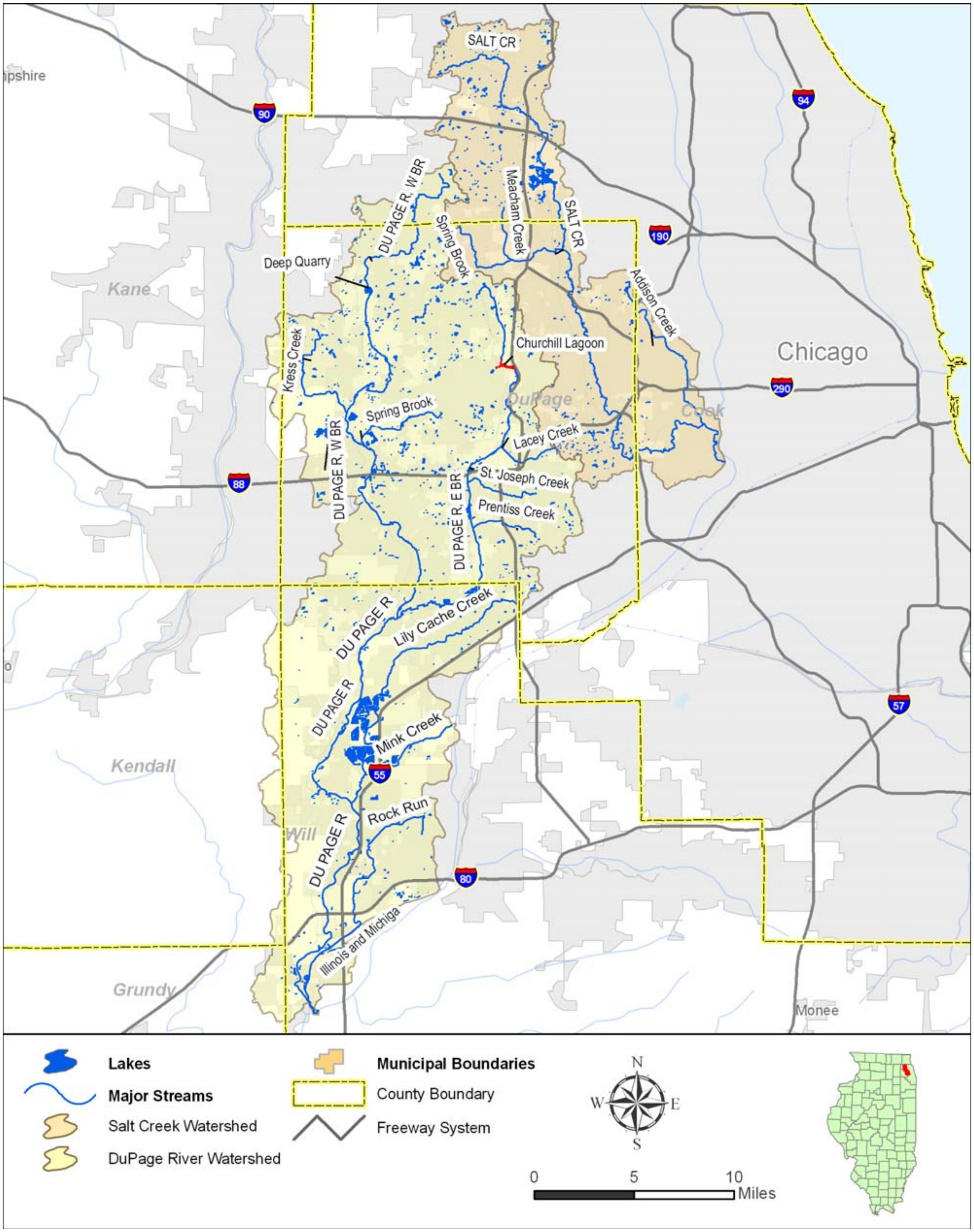
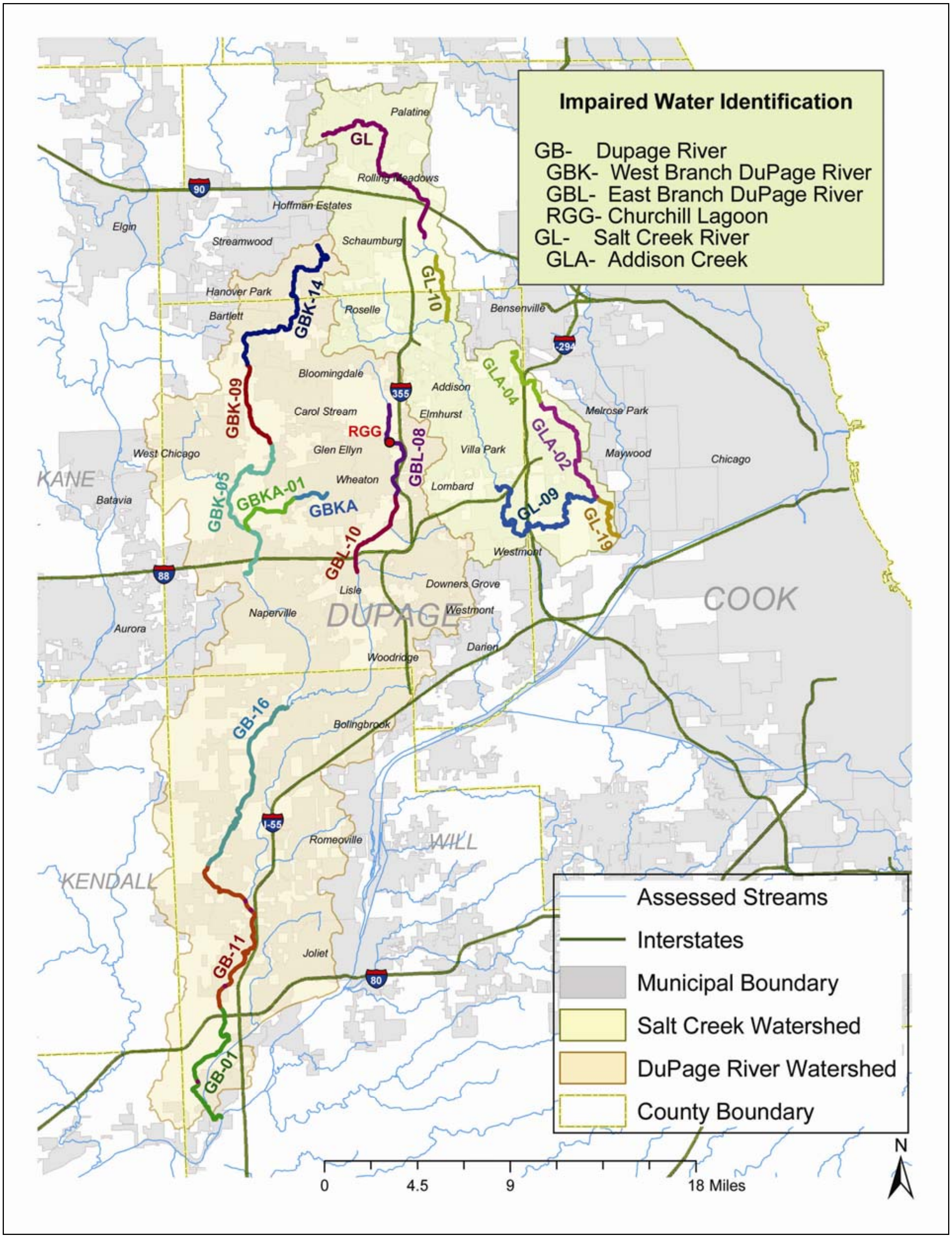


Figure 2-2: DuPage River/Salt Creek Watershed Waterbodies for TMDL Development

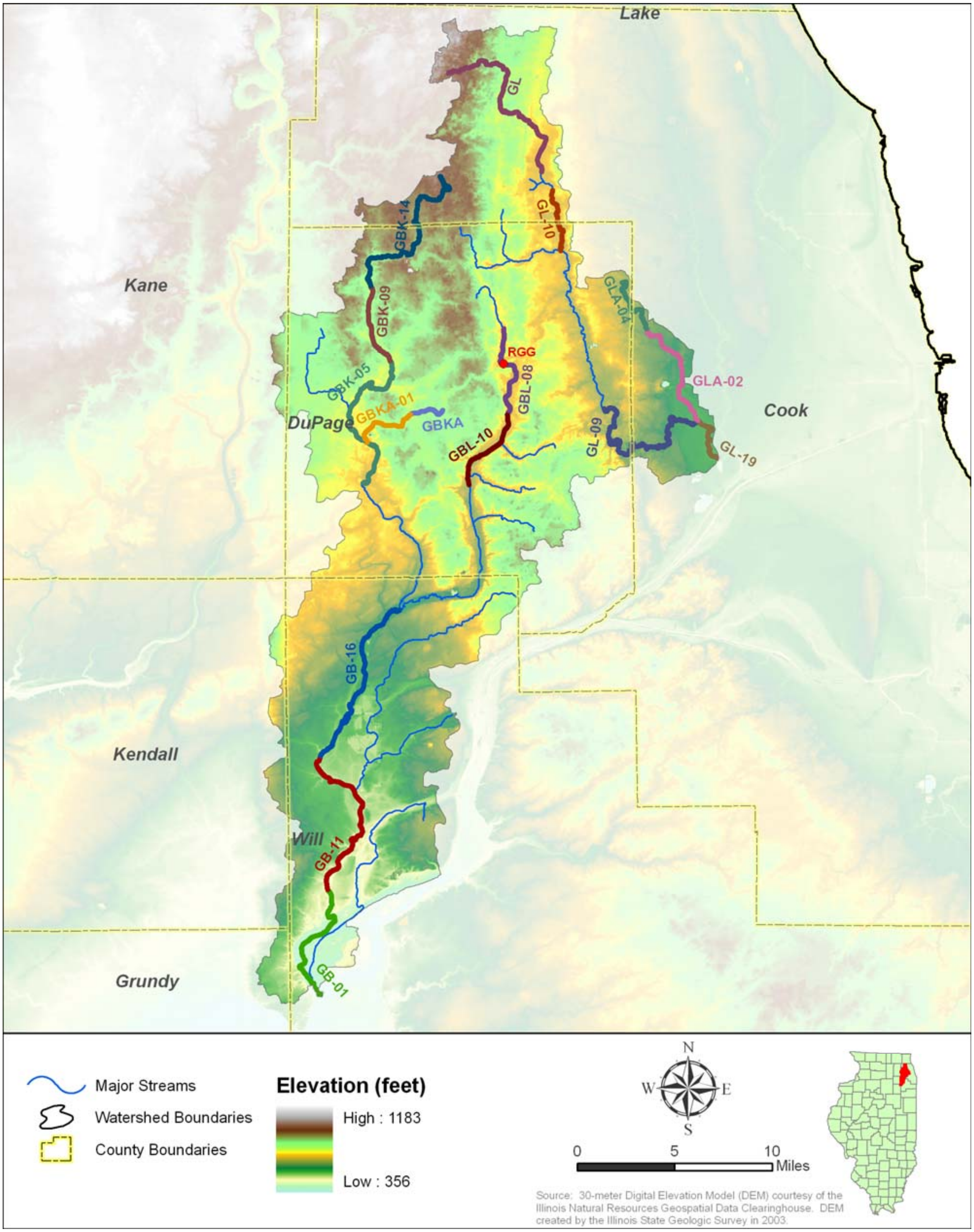


2.2 Topography

Topography influences soil types, precipitation, and subsequently, watershed hydrology and pollutant loading. For the DuPage/Salt Creek watershed, a USGS 30-meter resolution digital elevation model (DEM) was obtained from the Illinois Natural Resources Geospatial Data Clearinghouse to characterize the topography. The DEM was then cropped to the extents of the Salt Creek and DuPage River watersheds combined, as provided by the Illinois EPA, and analyzed. Figure 2-3 displays elevations throughout the DuPage River/Salt Creek watershed. In general, the watershed starts at a higher elevation in the north and west and grades down to a lower elevation in the south or east toward the Des Plaines River, resulting in overall surface water flow from northwest to southeast. There is an increased elevation ridge that separates the Salt Creek and DuPage River watersheds. The percent change in elevation across the DuPage River/Salt Creek Watershed is approximately 93% and ranges from 974 feet to 505 feet.

The elevation at the Salt Creek headwaters is 895 feet and flow approximately 43 miles before it enters the Des Plaines River (elevation of 607 feet), resulting in a stream gradient of 6.72 feet per mile (0.0013 slope). The elevation at the DuPage River headwaters is 974 feet and flow into the Des Plaines River 63 miles downstream (elevation of 505 feet). The resulting stream gradient is 7.44 feet per mile (0.0014 slopes).

Figure 2-3: DuPage River/Salt Creek Watershed Digital Elevation Model (DEM)



2.3 Land Use

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

Tables 2-1 and 2-2 summarize the land use for the DuPage River and Salt Creek watersheds, respectively. Figure 2-4 shows land use and land cover in the DuPage River/Salt Creek Watershed and indicates that urban lands are dominant in both sub-watersheds, accounting for 65.0% of the total area in the DuPage River watershed and 84.8% in the Salt Creek watershed. In the DuPage River watershed, urban open space is the predominant land use (26.7% of the total land cover), while medium density urban built-up is the predominant land use in the Salt Creek watershed (37.0% of total land cover). Agricultural land accounts for 21.2% of land cover in the DuPage watershed, but only 0.3% in the Salt Creek watershed. Of the agricultural land in the DuPage watershed, soybeans and corn contribute the most to the agricultural land cover (9.1% and 8.1%, respectively). The other land uses are very similar between the two watersheds. In the DuPage River watershed, forested land accounts for 9.5% of the area, while wetlands (1.9%), surface water (1.8%) and barren and exposed land (0.6%) account for the remaining land uses. In the Salt Creek watershed, forested land makes up 11.9% of the area, and surface water (2.0%), wetland (1.0%) and barren and exposed land (0.03%) are the other existing land uses.

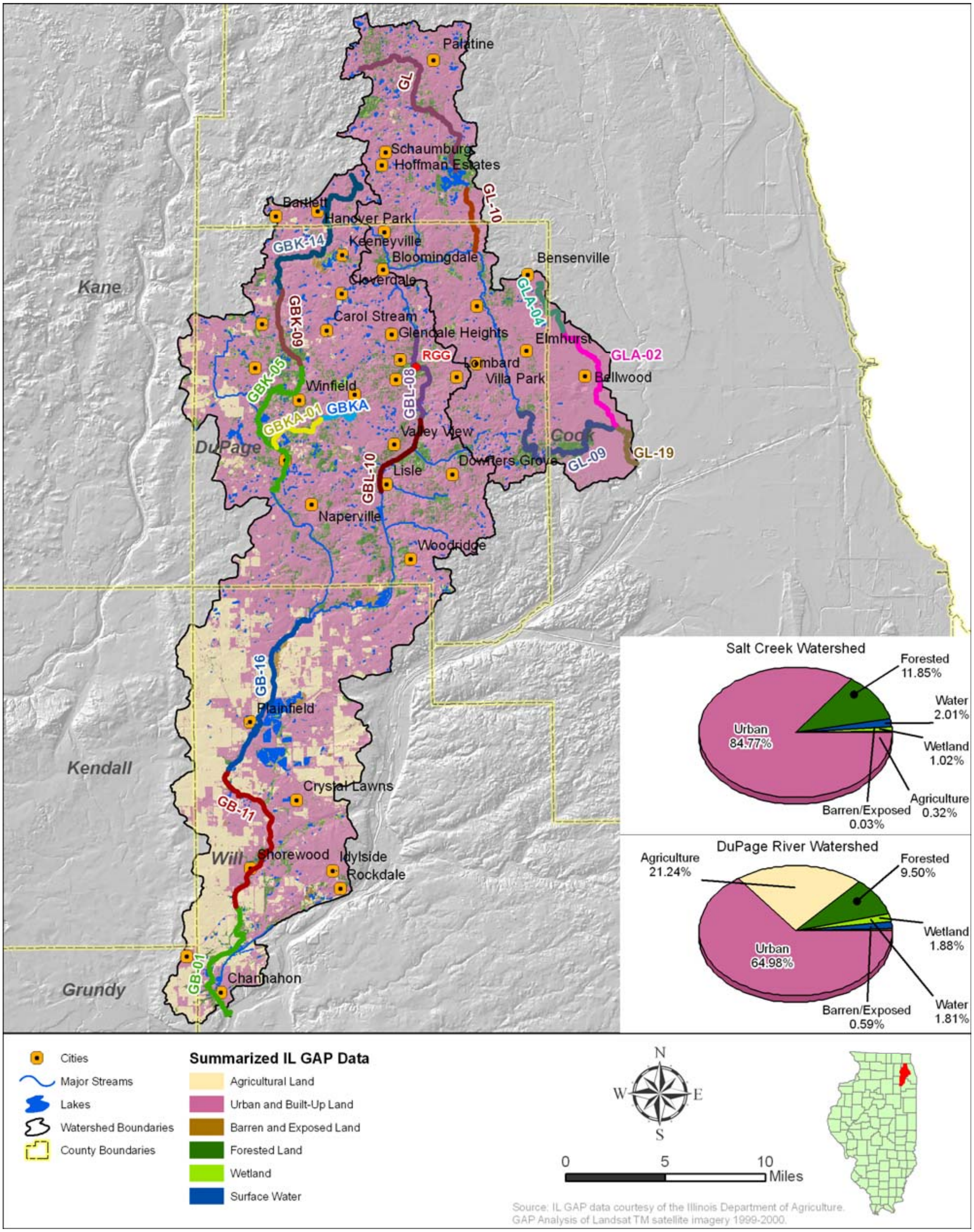
Table 2-1: Summary of IL GAP Data for the DuPage River Watershed

IL Gap Classification	Acreage	Percent	Summarized Acreage	Summarized Percentage
Urban and Built-up Land: Urban Open Space	64115.6	26.7%	156250.6	65.0%
Urban and Built-up Land: Low/Medium Density:	55019.6	22.9%		
Urban and Built-up Land: High Density	18784.5	7.8%		
Urban and Built-up Land: Low/Medium Density: Low (TM Scene 2331)	18330.9	7.6%		
Agricultural Land: Soybeans	21776.2	9.1%	51080.1	21.2%
Agricultural Land: Corn	19549.8	8.1%		
Agricultural Land: Rural Grassland	8110.7	3.4%		
Agricultural Land: Other Agriculture	1077.7	0.5%		
Agricultural Land: Other Small Grains and Hay	443.2	0.2%		
Agricultural Land: Winter Wheat	122.3	0.1%		
Forested Land: Upland: Mesic	12275.8	5.1%	22802.8	9.5%
Forested Land: Partial Canopy/Savanna Upland	6053.1	2.5%		
Forested Land: Upland: Dry-Mesic	4461.7	1.9%		
Forested Land: Upland: Dry	12.2	0.01%		
Wetland: Shallow Marsh/Wet Meadow	2175.2	0.9%	4524.6	1.9%
Wetland: Floodplain Forest: Wet	1101.3	0.5%		
Wetland: Floodplain Forest: Wet-Mesic	638.3	0.3%		
Wetland: Deep Marsh	483.5	0.2%		
Wetland: Shallow Water	124.10	0.1%		
Wetland: Seasonally/Temporarily Flooded	2.2	0.0%		
Other: Surface Water	4344.9	1.8%	4344.9	1.8%
Other: Barren and Exposed Land	1416.0	0.6%	1416.0	0.6%

Table 2-2: Summary of IL GAP Data for the Salt Creek Watershed

IL Gap Classification	Acreage	Percent	Summarized Acreage	Summarized Percentage
Urban and Built-up Land: Low/Medium Density: Medium (TM Scene 2331)	35101.9	37.0%	80406.6	84.8%
Urban and Built-up Land: Urban Open Space	20698.3	21.8%		
Urban and Built-up Land: High Density	15439.8	16.3%		
Urban and Built-up Land: Low/Medium Density: Low (TM Scene 2331)	9166.7	9.7%		
Forested Land: Upland: Mesic	5673.3	6.0%	11239.4	11.9%
Forested Land: Partial Canopy/Savanna Upland	3684.0	3.9%		
Forested Land: Upland: Dry-Mesic	1882.1	2.0%		
Other: Surface Water	1903.9	2.0%	1903.9	2.0%
Wetland: Shallow Marsh/Wet Meadow	677.2	0.7%	970.1	1.0%
Wetland: Deep Marsh	176.8	0.2%		
Wetland: Floodplain Forest: Wet-Mesic	74.5	0.1%		
Wetland: Floodplain Forest: Wet	41.6	0.04%		
Agricultural Land: Corn	162.8	0.2%	302.7	0.3%
Agricultural Land: Soybeans	138.6	0.2%		
Agricultural Land: Other Small Grains and Hay	1.3	0.0%		
Other: Barren and Exposed Land	26.9	0.03%	26.9	0.03%

Figure 2-4: DuPage River/Salt Creek Watershed Land Use Map



2.4 Soils

Soils data and Geographic Information Systems (GIS) files from the Natural Resources Conservation Service (NRCS) were used to characterize soils in the DuPage River and Salt Creek watershed. General soils data and map unit delineations for the country are provided as part of the Soil Survey Geographic (SSURGO) database. Field mapping methods using national standards are used to construct the soil maps in the SSURGO database. Mapping scales generally range from 1:12,000 to 1:63,360; SSURGO is the most detailed level of soil mapping prepared by the NRCS. A map unit is composed of several soil series having similar properties. Identification fields in the GIS coverage can be linked to a database that provides information on chemical and physical soil characteristics. The SSURGO database contains many soil characteristics associated with each map unit.

The SSURGO data were analyzed based on drainage class (Figure 2-6), hydrologic group (Figure 2-5) and K-factor (Figure 2-7), a coefficient of the Universal Soil Loss Equation (USLE). The drainage class, as stated in the SSURGO database is, “The natural drainage condition of the soil [which] refers to the frequency and duration of wet periods” (Soil Survey Staff, “Table Column Descriptions”). Poorly drained soils can be found in areas where there is frequent flooding such as land adjacent to lakes and streams. However, some excessively drained areas can be found interspersed around the lakes. Excessively drained areas may in part be caused by anthropogenic sources, such as construction of residential and paved areas near the lakes. It may also be a part of the natural geology, with localized areas prone to excessive drainage. The majority of the eastern border of the watershed is moderately well drained.

Soils that remain saturated or inundated for a sufficient length of time become hydric through a series of chemical, physical and biological processes. Once a soil takes on hydric characteristics, it retains those characteristics even after the soil is drained. Therefore hydric soils are the best indicator of what is or once was a wetland (SMC 2007). Wetlands help control flooding by retaining water when it rains and then releasing it slowly back into lakes and streams. The longer a soil is inundated the more likely it is that it will become hydric.

The hydrologic soil group classification identifies soil groups with similar infiltration and runoff characteristics during periods of prolonged wetting. Typically, clay soils that are poorly drained have lower infiltration rates, while well-drained sandy soils have the greatest infiltration rates. USDA has defined four hydrologic groups (A, B, C, or D) for soils. Type A soil has high infiltration while D soil has very low infiltration rate. Table 2-3 summarizes the group characteristics and Figure 2-5 shows the distribution of hydrologic soil groups. Generally, areas to the east contain a moderate to slow infiltration rate (hydrologic group C), while areas near the lakes on the western side of the watershed contain both slow (hydrologic group D) to moderately high infiltration rates (hydrologic group B).

Table 2-3: Relative Characteristics of Hydrologic Soil Groups

HSG Runoff	Run off Potential	Infiltration Rate	Transmission Rate
A	Low	High	High
B	Moderate	Moderate	Moderate
C	High	Low	Low
D	High	Very Low	Very Low

A commonly used soil attribute of interest is the K-factor, a coefficient used in the USLE. The K-factor is a dimensionless measure of a soil's natural susceptibility to erosion. Factor values may range from 0 for water surfaces to 1.00 (although in practice, maximum K-factor values do not generally exceed 0.67). Large K-factor values reflect greater potential for soil erodibility.

The compilation of K-factors from the SSURGO data was done in several steps. Soils are classified in the SSURGO database by map unit symbol. Each map unit symbol is made up of components and each component as part of that map unit is further broken down into horizons (or layers). The K-factor was determined by selecting the dominant components in the most surficial horizon per each map unit. The distribution of K-factor values in the DuPage River and Salt Creek watershed is shown in Figure 2-7. K-factors range from 0.15 to 0.43 in this watershed. Areas with the highest K-factor are dispersed throughout the watershed with the greatest concentration within DuPage County.

Figure 2-5: DuPage River/Salt Creek Watershed SSURGO Hydrologic Soil Group

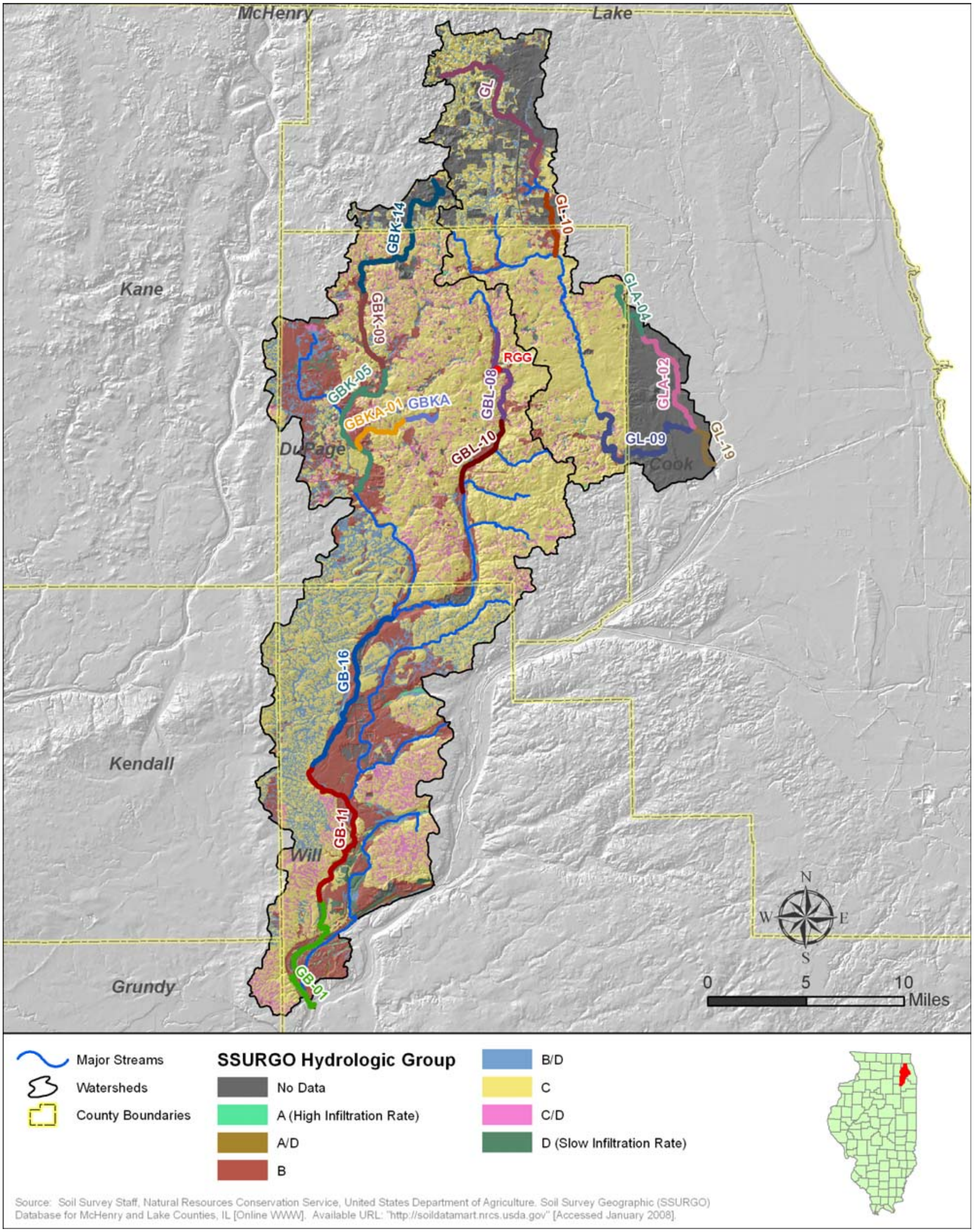


Figure 2-6: DuPage River/Salt Creek Watershed SSURGO Drainage Class

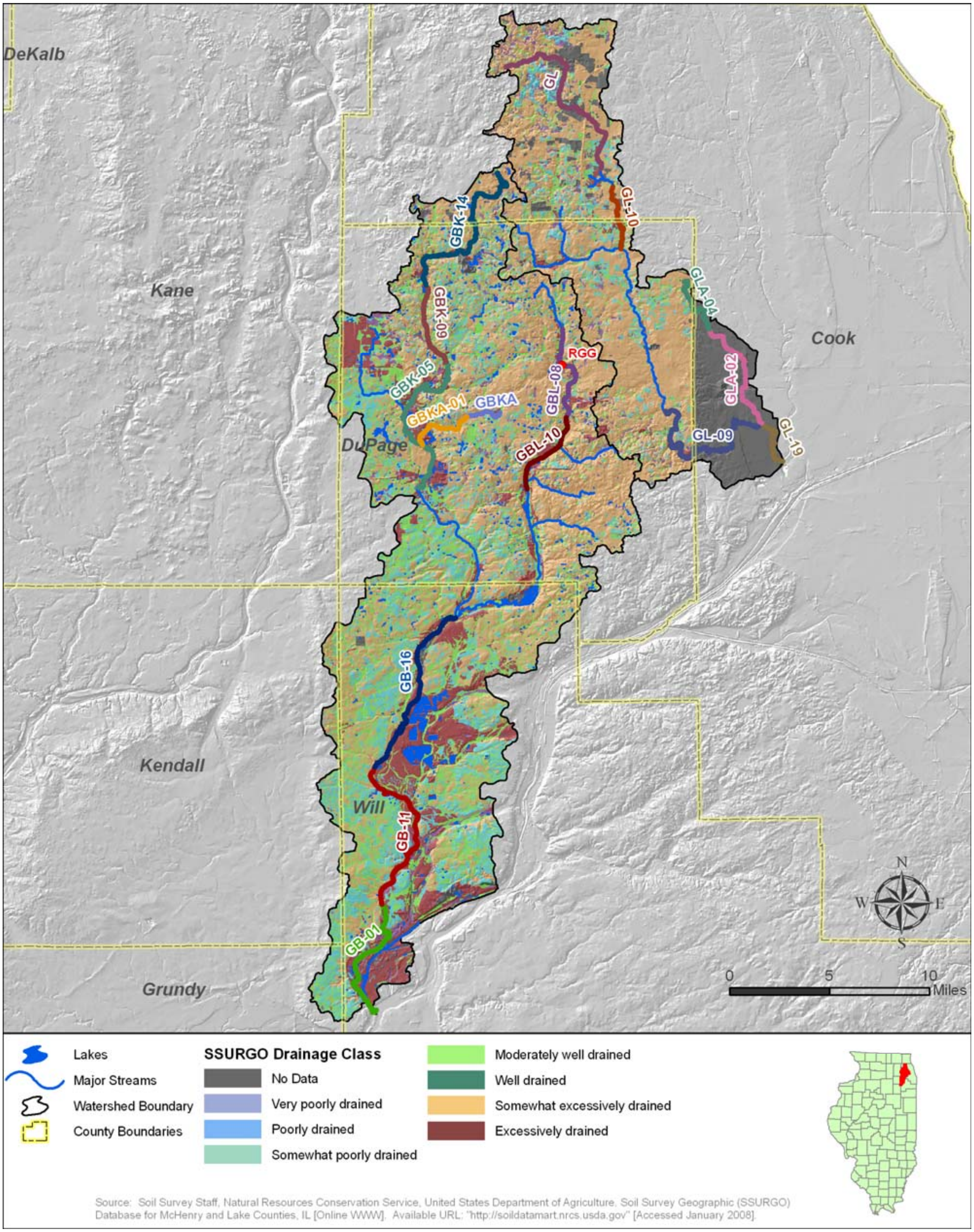
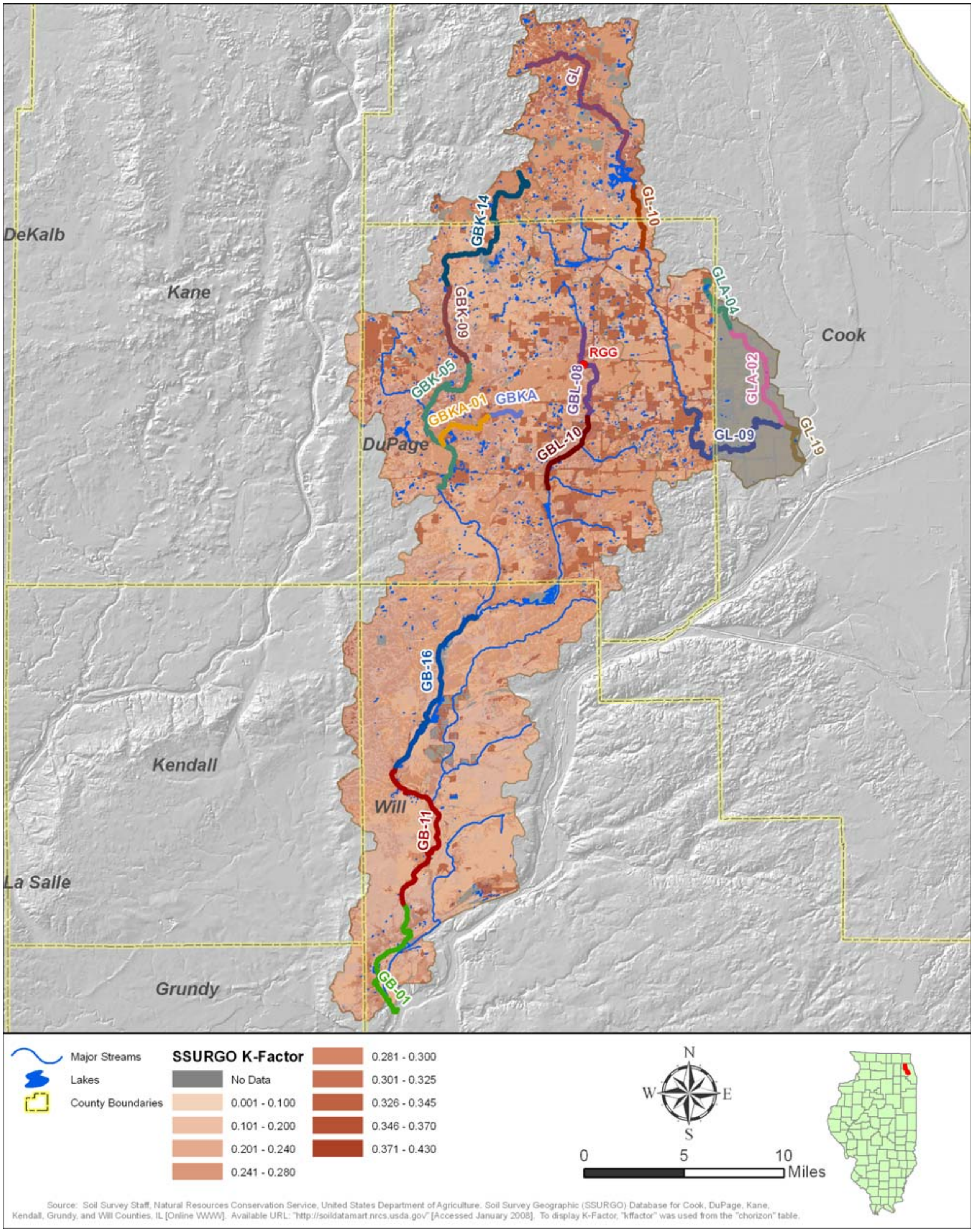


Figure 2-7: DuPage River/Salt Creek Watershed SSURGO K-Factor



2.5 Population

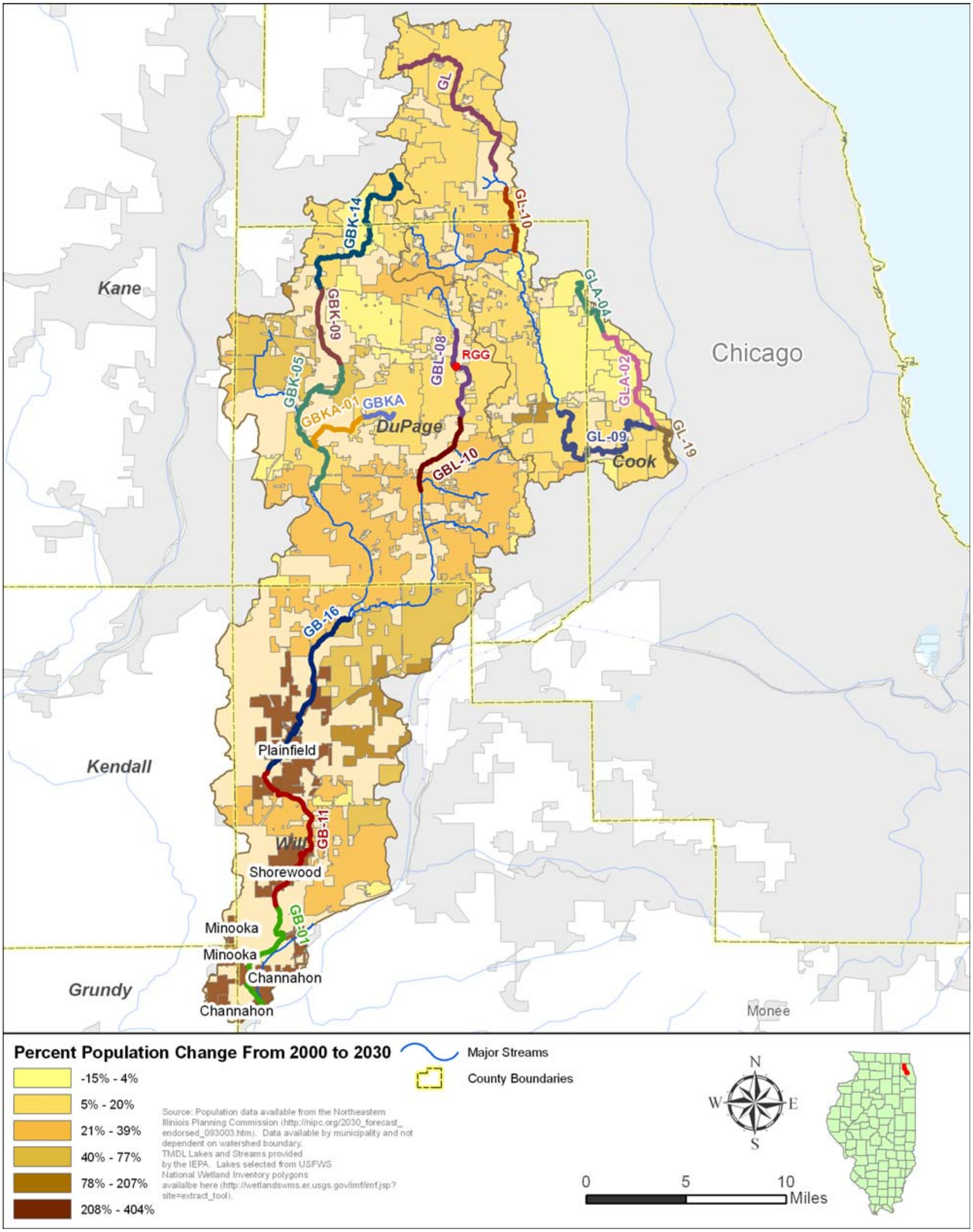
Circumstances in the DuPage River/ Salt Creek watershed today are not only the product of the geologic and natural processes that have occurred in the watershed, but also a reflection of human impacts and population growth. Development has changed the watershed’s natural drainage system as channelization and dredging have replaced slow moving shallow streams and wetlands. This alteration has affected the way water runs off of the landscape both in increased volume and velocity, resulting in the potential increase in pollutant transport.

Census 2000 data in format of TIGER/Line Shape file were downloaded to analyze the population in the DuPage River/Salt Creek watershed. Census data were also available for groups of census blocks, but the original census block data was used since it is a finer resolution and, therefore, more accurate.

In 2000, approximately 4.8 million, people resided in the DuPage River/Salt Creek watershed, roughly 9,250 persons per square mile. The Salt Creek watershed accounts for nearly 80% of the population, but only 40% of the area. Census blocks with the greatest populations occur in the central and southern areas of the DuPage River watershed in Aurora, Naperville, and Joliet.

The Illinois Department of Commerce and Economic Opportunity provide population projections by municipality on their website (“Population Projections”, 2005). Figure 2-8 depicts the projected percent population change in the watershed from 2000 to 2030. In general, the southern portion of the watershed is expected to have the most growth (~400%). The town of Plainfield, with a population of 13,038 persons in 2000, is projected to grow to 65,743 persons in 2030, an increase of approximately 404%. Also in the southern area of DuPage River watershed, Chinnahon, Minooka, and Shorewood are also expected grow in population by 400%, 287%, and 207%, respectively. Based on these data, development will grow dramatically in the southern portion of the watershed, but in general, the entire watershed will continue to increase in population over the years.

Figure 2-8: DuPage River/Salt Creek Watershed Population Projection



2.6 Climate

Northeast Illinois has a continental climate with highly variable weather. The temperatures of continental climates are not buffered by the influence of a large waterbody (like an ocean, inland sea or Great Lake). Areas with continental climates often experience wide temperature fluctuations throughout the year. Temperature and precipitation data were obtained from the Illinois State Climatologist Office website. The nearest monitoring station to the DuPage River/Salt Creek Watershed is the City of Wheaton, which is located in the central area of the watershed. For the DuPage River/Salt Creek watershed, the highest temperatures in the summer can range from high 80s to over 100 degrees Fahrenheit and the lowest winter temperatures might range between sub-zero and the teens. Precipitation in the form of rainfall is greatest in the growing season (April through September) (Figure 2-9).

Climate data were analyzed for the City of Wheaton between the years of 1950 and 2008, although data were not available for all years. The mean high summer temperature was 84.2° F and the mean low temperature in winter was 17.9° F. Mean annual high temperatures were approximately 61° F, while mean annual low temperatures were approximately 40° F (Table 2-4). Mean monthly precipitation data in Wheaton are displayed in Figure 2-9. Wheaton receives most of its precipitation in the spring and summer months, with maximum precipitation occurring in June (4.1 inches). The least amount of average rainfall precipitation occurs in February (1.6 inches). Annual total precipitation average was approximately 35.2 inches.

Impacts of the climate on the watershed can result from the warm summer temperatures and occasional long dry spells. These conditions lead to shallow water depth, warm water temperatures and low dissolved oxygen which makes the river inhospitable to less tolerant fish and invertebrate species. Additionally, heavy flooding can occur during the spring months, resulting in pollutant transport (SMC 2007; USFWS 1998).

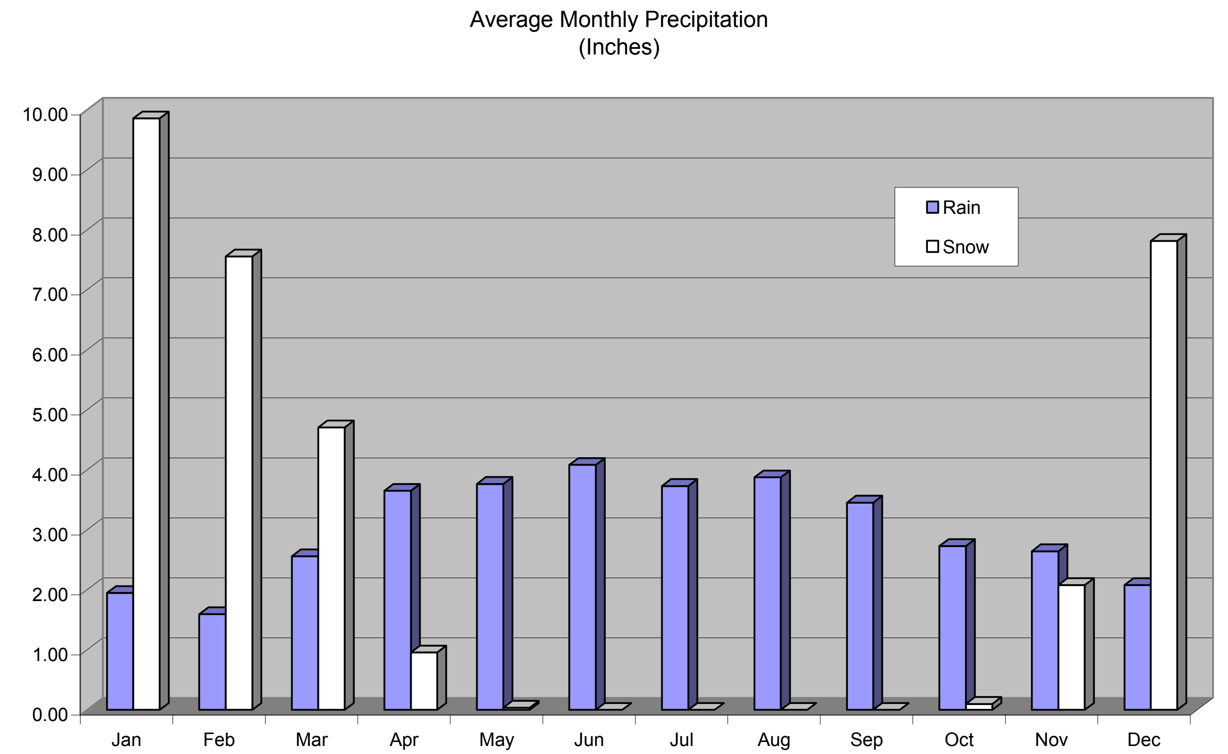
Table 2-4: Temperature Characterization, Wheaton, IL (1950-2008)

	Average High (°F)	Average Low (°F)	Average Number of Days with High > 90 (°F)	Average Number of Days with Low < 32 (°F)	Mean (°F)
January	31.36	14.63	0.00	28.50	23.02
February	36.35	18.37	0.00	25.13	27.38
March	47.61	27.31	0.00	22.28	37.49
April	62.05	38.05	0.12	8.69	50.09
May	73.41	47.59	1.12	1.35	60.52
June	82.76	57.47	6.52	0.02	70.14
July	85.83	62.26	8.51	0.02	74.07
August	84.00	60.94	5.86	0.00	72.49
September	77.50	52.96	2.08	0.20	65.26
October	65.45	42.22	0.04	5.48	53.86
November	49.19	31.29	0.00	17.07	40.26
December	36.04	20.02	0.00	26.25	28.00
Annual	61.27	39.69	23.98	129.03	50.51
Spring	61.04	37.64	1.20	31.53	49.37
Summer	84.24	60.28	20.68	0.03	72.29
Fall	64.10	42.18	2.16	22.16	53.16
Winter	34.59	17.88	0.00	77.51	26.29

Annual/seasonal values may differ from the sum of the monthly values due to rounding.

Source: www.sws.uiuc.edu/atmos/statecli

Figure 2-9: Mean Monthly Precipitation in Wheaton, IL



Average precipitation derived from averages from Wheaton datasets dating 1936-2008
Source: Illinois State Climatologist Office
www.isws.illinois.edu/atmos/statecli

2.7 Hydrology

Understanding how water moves and flows is an important component of understanding a watershed. All of the parameters listed in the previous sections (i.e. topography, soils, and precipitation) impact hydrology. Hydrological data are available from the USGS website (www.usgs.gov, 2008). The USGS maintains stream gages throughout the U.S. and it monitors conditions such as gage height and stream flow, and at some locations, precipitation.

Four gage stations within the DuPage River/Salt Creek Watershed were chosen for stream flow data: East Branch of DuPage River at Downers Grove, IL (05540160), West Branch of DuPage River at Naperville, IL (05540130), DuPage River at Shorewood, IL (05540500), and Salt Creek at Western Springs, IL (05531500). The Salt Creek gage is located just upstream from the Addison Creek confluence near the confluence with the Des Plaines River. The East Branch is located upstream of the confluence with the West Branch. The West Branch of the DuPage River gage station is located immediately upstream of the confluence with the East Branch. Finally, the DuPage River at Shorewood is located immediately upstream of the confluence of the DuPage River mainstem and the Des Plains River. Figure 2-10 shows the location of these four USGS gages, and others, throughout the watershed.

Figure 2-11 depicts the stream flow measured at Salt Creek for the period of 1945 to 2007. The drainage area upstream of this gage was 115 square miles. The highest average monthly stream flows at Salt Creek were measured in April (233.0 cubic feet per second (cfs)), while the lowest monthly stream flows were measured in September (93.9 cfs). Overall the highest stream flow for this gage occurs during the late winter and spring months, while low flows occur during the fall. The annual stream flow for the Salt Creek gage was measured at about 136.8 cfs.

The East Branch DuPage gage drains an area of 26.6 square miles, and data at this gage exist from 1989 to 2007. Over this period the average stream flow of the East Branch was 49.5 cfs (Figure 2-12). Similar to the Salt Creek gage, stream flows were highest in the late winter and spring months with lower flows in the fall. Maximum average monthly flows occurred in April (69.0 cfs) while lowest average monthly flows occurred in September (35.2 cfs).

Figure 2-13 displays the stream flow measured at the West Branch DuPage River for the period ranging from 1988 to 2007. The drainage area upstream of this gage was 123 square miles and the highest average monthly stream flows at the West Brach were measured in April (230.6 cfs). Minimum average monthly stream flows of 102.0 cfs were measured in September. The annual stream flow for the West Branch gage was approximately 152.9 cfs.

Data from the main stem of the DuPage River gage exist from 1940 to 2007. This gage drains an area of 324 square miles and over the duration of its existence the average stream flow of the DuPage was 307.3 cfs (Figure 2-14). Peak stream flows occur in the late winter and spring months, with lower flows in the fall. Maximum monthly flow occurred in April (517.7 cfs) while lowest monthly flows were measured in September (189.9 cfs).

Churchill lagoon sometimes referred to as Churchill Woods Forest Preserve Lake was constructed in the 1930s by the Civilian Conservation Corps (CCC). It was created by damming the East Branch of the DuPage River. The surface area is 21 acres with a maximum depth of 8 feet and 3.67 miles of shoreline length. The 137 acre Churchill Woods Forest Preserve which contains the lagoon provides fishing, boating, and picnic and hiking facilities.

Figure 2-10: DuPage River/Salt Creek Watershed USGS Gaging Stations and Water Quality Stations

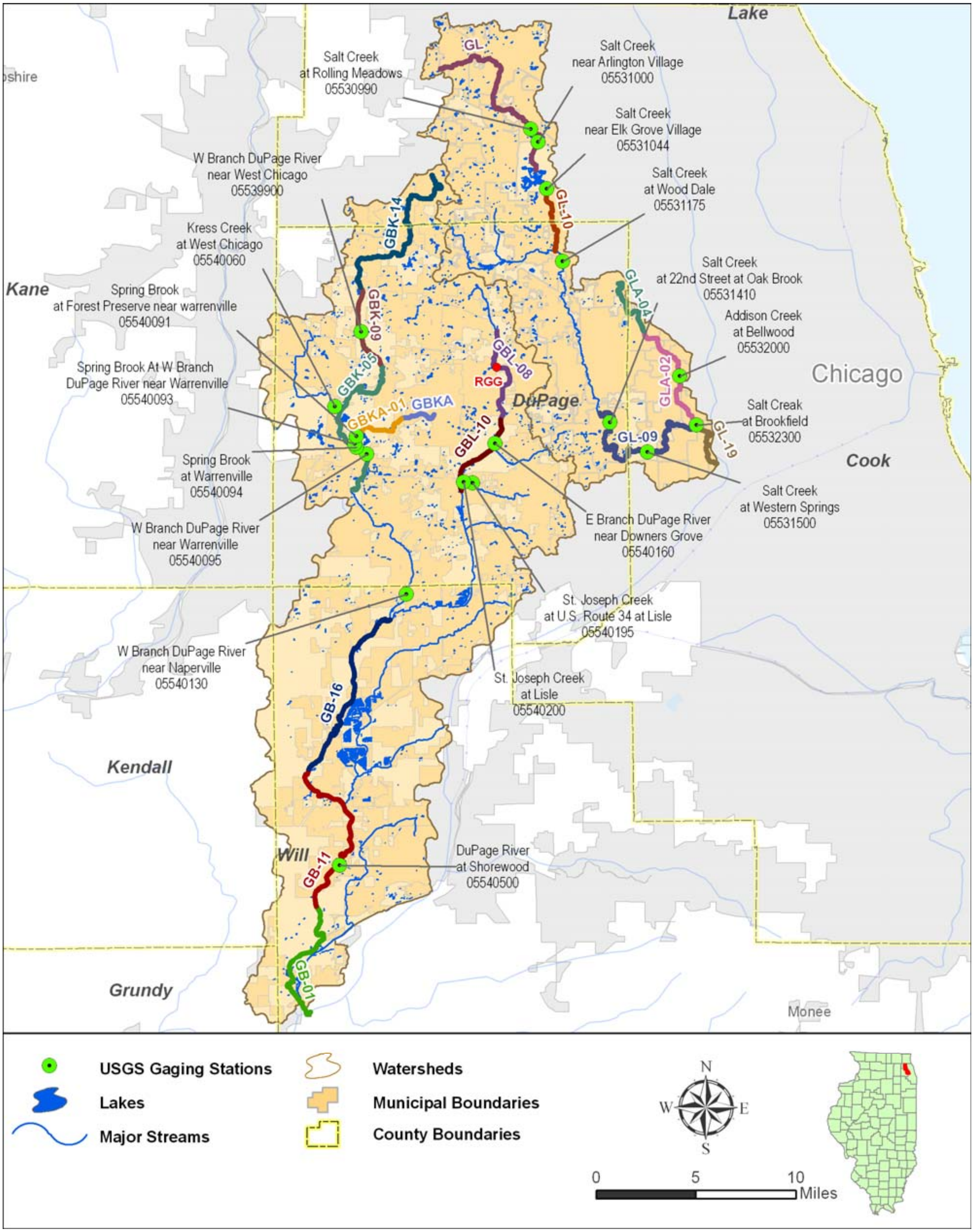


Figure 2-11: Mean Monthly Flow in Salt Creek at Western Springs, IL USGS Station 1945-2007

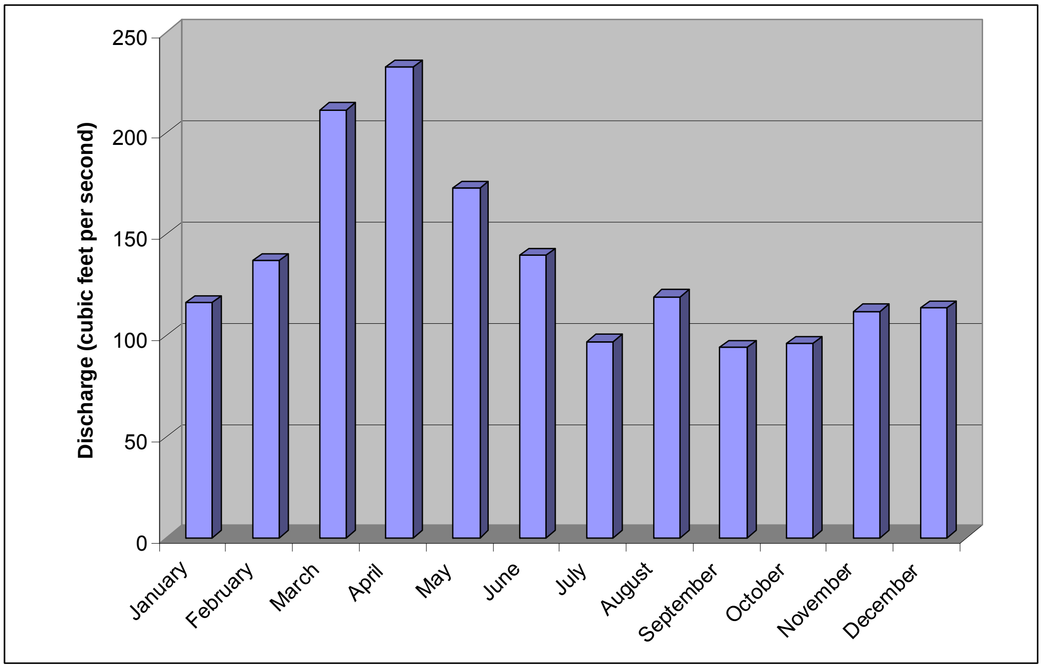


Figure 2-12: Mean Monthly Flow in East Branch of DuPage River at Downers Grove, IL USGS Station 1989-2007

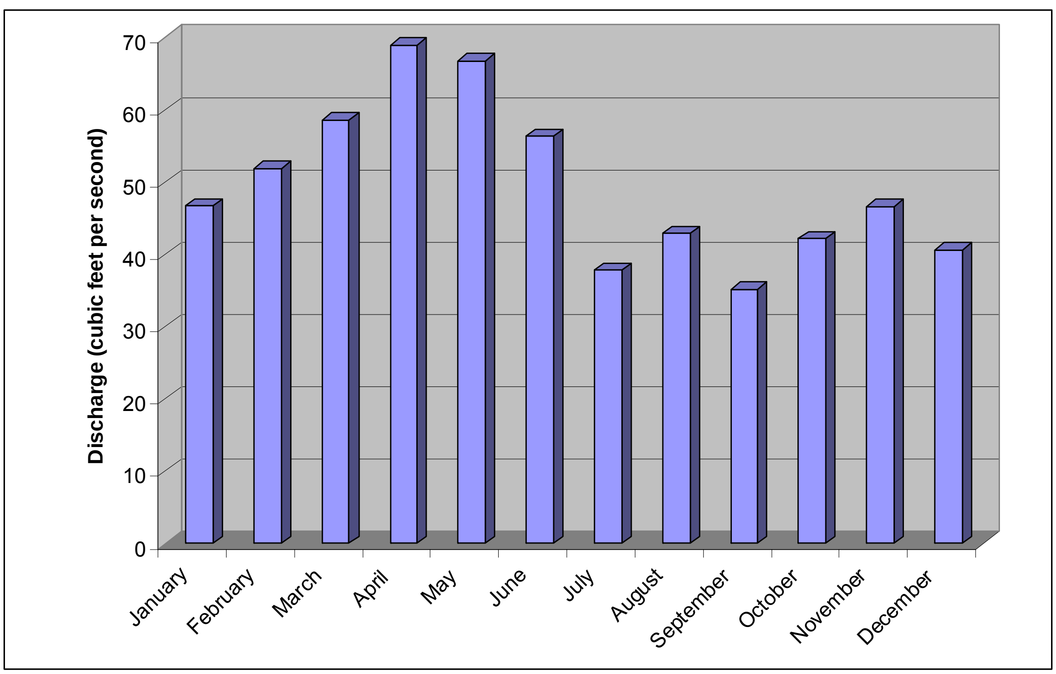


Figure 2-13: Mean Monthly Flow for West Branch of DuPage River at Naperville, IL USGS Station 1988-2007

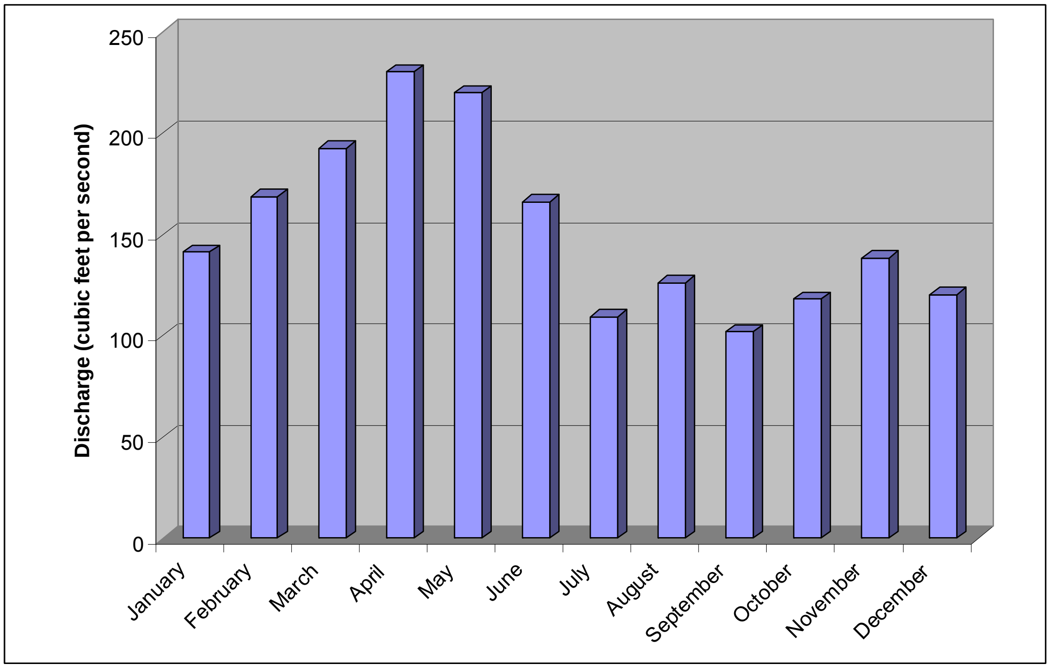
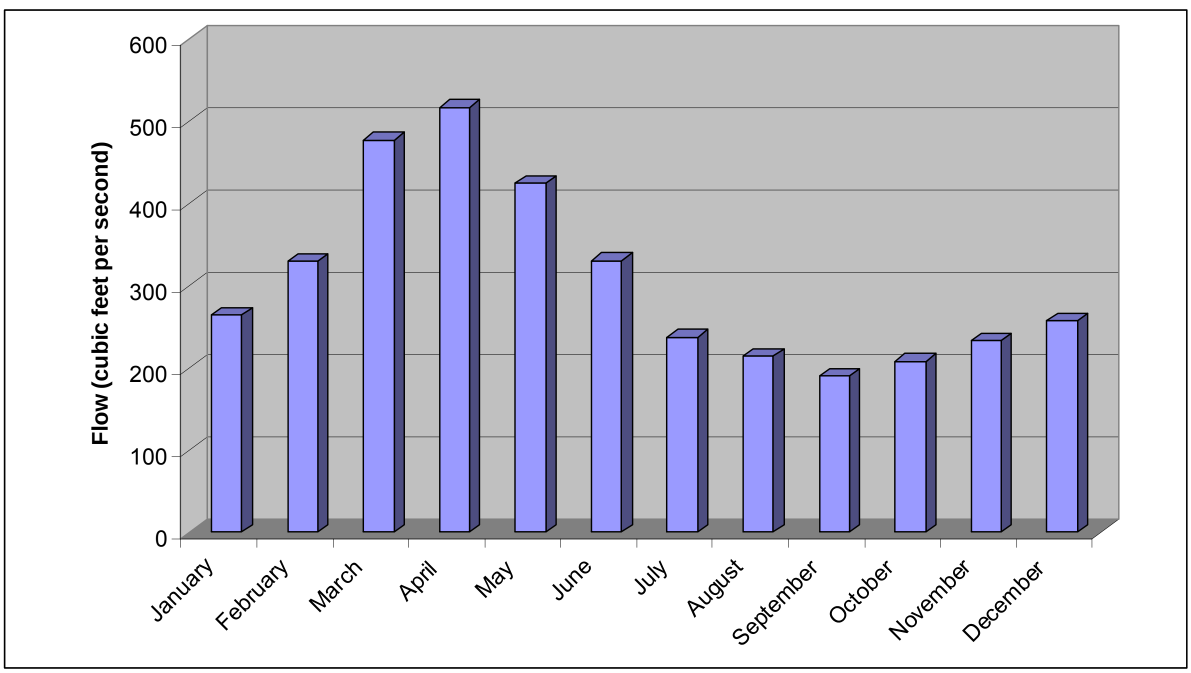


Figure 2-14: Mean Monthly Flow for DuPage River at Shorewood, IL USGS Station 1940-2007



3.0 Public Participation and Involvement

The Illinois EPA is committed to keeping the watershed stakeholders and general public informed and involved throughout the TMDL process. Success for any TMDL implementation plan relies on a knowledgeable public to assist in follow-through required for attainment of water uses within their watershed. It is important to engage the local citizens as early in the process as possible by providing opportunities to learn and process information. This ensures that concerns and issues are identified at an early stage, so that they can be addressed and facilitate maximum cooperation in the implementation of the recommended courses of actions identified in the TMDL process. All stakeholders should have access to enough information to allay concerns, gain confidence in the TMDL process and understand the purpose and the regulatory authority or other responsible party that will implement recommendations.

Illinois EPA, along with AECOM, will hold up to two public meetings within the DuPage River/Salt Creek watershed throughout the course of TMDL development. This section will be regularly updated after public meetings have occurred. The Illinois EPA regularly meets with the DuPage River Salt Creek Workgroup to keep them informed on the TMDL progress.

General information regarding the process of TMDL development in Illinois can be found at http://www.epa.state.il.us/water/tmdl. This link also contains paths to notices of public meetings and other TMDL-related watershed information for the entire state of Illinois.

Background information regarding watersheds, watershed management, best management practices and the Clean Water Act (CWA) can be found on the EPA's water website at http://www.epa.gov/watertrain/.

For other reports and studies concerning the DuPage River and Salt Creek watershed, please visit the watershed workgroup website (http://www.drscw.org/). The website contains reports, data and additional links to other sources specifically related to this watershed.

4.0 Applicable Water Quality Standards and TMDL Targets

Water pollution control programs are designed to protect the beneficial uses of the water resources within the state. Each state has the responsibility to set water quality standards that protect these beneficial uses, also called “designated uses.” Illinois waters are designated for various uses including aquatic life, primary contact (e.g., swimming, water skiing), secondary contact (e.g., boating, fishing), industrial use, drinking water, food-processing water supply and aesthetic quality. Illinois’ WQS provide the basis for assessing whether the beneficial uses of the state’s waters are being attained.

4.1 Illinois Pollution Control Program

The Illinois Pollution Control Board (IPCB) is responsible for setting WQS to protect designated uses. The federal Clean Water Act requires the states to review and update WQS every three years. Illinois EPA, in conjunction with USEPA, identifies and prioritizes those standards to be developed or revised during this three-year period. The IPCB has established four primary sets (or categories) of narrative and numeric water quality standards for surface waters: general use; public and food processing; secondary contact and indigenous aquatic life; and Lake Michigan basin standards. Each set of standards is intended to help protect various designated uses established for each category.

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. These responsibilities were subsequently assumed by the Illinois Department of Energy and Natural Resources who, in July 1995, became part of the Illinois Department of Natural Resources. The Illinois WQS 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.

Water resource management activities involving interstate waters are also coordinated with various interstate committees and commissions. The Illinois EPA participates in water-resource management activities of the Association of State and Interstate Water Pollution Control Administrators, International Joint Commission of the Great Lakes Water Quality Board, Ohio River Valley Water Sanitation Commission, Upper Mississippi River Conservation Committee, Upper Mississippi River Basin Association, Council of Great Lakes Governors, and other interstate committees and commissions.

4.2 Designated Uses

The waters of Illinois are classified by designated uses assessed in 2008 (Table 4-1). Designated uses applicable to the DuPage River/Salt Creek watershed include: aesthetic quality, aquatic life, and primary contact. The corresponding water quality standard classification for these designated uses is the General Use Standard.

Table 4-1: Illinois Designated Uses and Applicable Water Quality Standards

Illinois EPA Designated Uses	Illinois Waters where Designated Use and Standards Apply	Applicable Illinois Water Quality Standards
Aquatic Life	Streams, Inland Lakes	General Use Standards
	Lake Michigan Basin waters	Lake Michigan Basin Standards
Aesthetic Quality	Inland Lakes	General Use Standards
	Lake Michigan Basin Waters	Lake Michigan Basin Standards
Indigenous Aquatic Life	Specific Chicago area Waters	Secondary Contact and Indigenous Aquatic Life Standards
Primary Contact	Streams, Inland Lakes	General Use Standards
	Lake Michigan Basin Waters	Lake Michigan Basin Standards
Secondary Contact	Streams, Inland Lakes	General Use Standards
	Lake Michigan Basin Waters	Lake Michigan Basin Standards
	Specific Chicago area Waters	Secondary Contact and Indigenous Aquatic Life Standards
Public and Food Processing Water Supply	Streams, Inland Lakes, Lake Michigan basin Waters	Public and Food Processing Water Supply Standards
Fish Consumption	Streams, Inland Lakes	General Use Standards
	Lake Michigan Basin Waters	Lake Michigan Basin Standards
	Specific Chicago Area Waters	Secondary Contact and Indigenous Aquatic Life Standards

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

4.3 Applicable Illinois Water Quality Standards

For aquatic life use assessments, Illinois EPA relies on biological indicators to provide direct reliable measures of aquatic community health and facilitates detection of cumulative impacts on aquatic life from multiple stressors. The primary biological measures used are the fish Index of Biotic Integrity, the macroinvertebrate Index of Biotic Integrity and the Macroinvertebrate Biotic Index. By relying more on biological indicators than on less reliable surrogates (e.g., water chemistry), the assessments of aquatic life use achieve their primary purpose: to determine the degree to which a water body provides for the protection and propagation of fish, shellfish, and wildlife (i.e., the Clean Water Act's interim aquatic life goal). In these terms, an Illinois EPA assessment conclusion of Full Support for aquatic life use indicates conditions that meet the Clean Water Act's interim aquatic life goal. In a minority of streams, where biological data is not available, aquatic life use assessments are based primarily on physiochemical water data. The streams in this watershed were assessed at less than Full Support and water chemistry was analyzed for violations. Tables 4-2 and 4-3 summarize the potential impairments and standards that apply to streams and lakes within the DuPage River/Salt Creek Watershed.

Table 4-2: Summary of Water Quality Standards for Potential Impairments of Stream Segments in the DuPage River/Salt Creek Watershed

Parameter	Units	General Use Water Quality Standard
Chloride	mg/L	500
Dissolved Oxygen	mg/L	**For most waters[1]:** March-July > 5.0 min. & > 6.0- 7-day mean[1] Aug-Feb > 3.5 min, > 4.0- 7-day mean[1], & > 5.5- 30-day mean[1]. **For waters with enhanced protection[1]:** March-July > 5.0 min & > 6.25- 7-day mean[1] Aug-Feb > 4.0 min, > 4.5- 7-day mean[1], & > 6.0- 30-day mean[1].
Fecal Coliform	count/100 mL	May – October 200[2], 400[3]
Manganese - Total	mg/L	1.0
pH	s.u.	Within the range of 6.5 – 9.0 except for natural causes
Phosphorus – Total[4]	mg/L	0.05
Silver – Total	µg/L	5.0

1. Applies to the dissolved oxygen concentration in the main body of all streams, in the water above the thermocline of thermally stratified lakes and reservoirs, and in the entire water column of unstratified lakes and reservoirs. Additional dissolved oxygen criteria are found in 35 Ill Adm. Code 302.206, including the list of waters with enhanced dissolved oxygen protection and methods for assessing attainment of dissolved oxygen minimum and mean values.
2. Geometric mean based on a minimum of 5 samples taken over not more than a 30 day period.
3. Standard shall not be exceeded by more than 10% of the samples collected during any 30 day period.
4. Standard applies in particular inland lakes and reservoirs (greater than 20 acres) and in any stream at the point where it enters any such lake or reservoir.

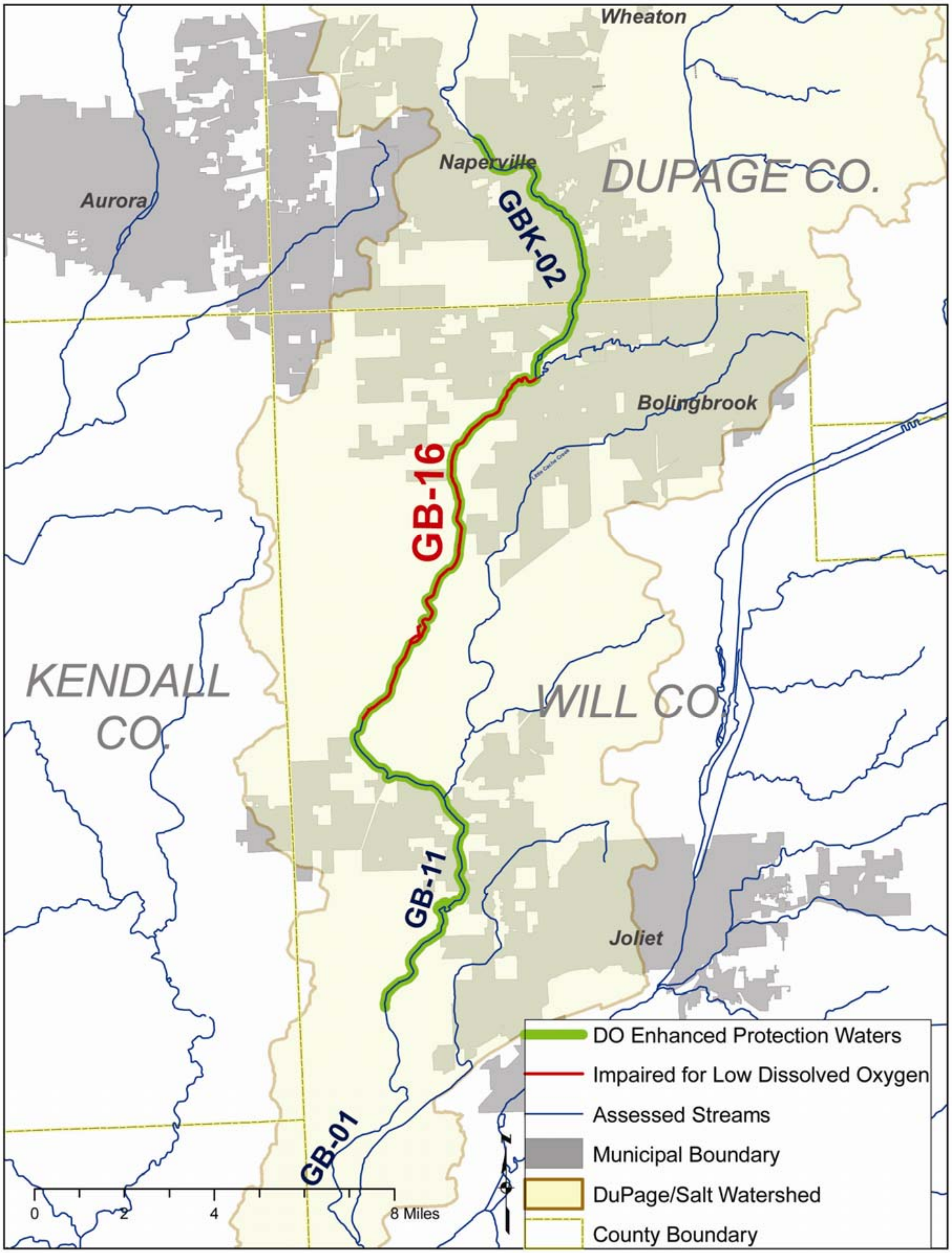
Due to limited state resources, fecal coliform bacteria is not normally sampled at a frequency necessary to apply the General Use standard, i.e., at least five times per month during May through October, and very little data available from others are collected at the required frequency. Therefore, assessment guidelines are based on application of the standard when sufficient data is available to determine standard exceedances; but, in most cases, attainment of the *primary contact* use is based on a broader methodology intended to assess the likelihood that the General Use standard is being attained. To assess the *primary contact* use, Illinois EPA uses all fecal coliform bacteria from water samples collected in May through October, over the most recent five-year period (i.e., 2002 through 2006). Based on these water samples, geometric means and individual measurements of fecal coliform bacteria are compared to the concentration thresholds in Table C-16. To apply the guidelines, the geometric mean of fecal coliform bacteria concentration is calculated from the entire set of May through October water samples, across the five years. No more than 10% of all the samples may exceed 400/100 ml for a water body to be considered Fully Supporting.

As for the application of the dissolved oxygen standard, DuPage River segments GB-11 and GB-16 are waters with enhanced protection according to 35 Ill Adm. Code 302.206, Figure 4-1. Waters with enhanced protection have a more stringent standard than all other waters of the State. These waters were chosen based on the potential biota and the dissolved oxygen needed for said biota to thrive. All other waters in the DuPage River and Salt Creek watersheds are not considered enhanced protection waters and the standard for “most waters” applies. DuPage River GB-16 is impaired for dissolved oxygen on the 2008 303(d) List according to the enhanced protection dissolved oxygen standard.

Table C-16. Guidelines for Assessing *Primary Contact* Use in Illinois Streams and Inland Lakes.

Degree of Use Support	Guidelines
Fully Supporting (Good)	No exceedances of the fecal coliform bacteria standard in the last five years and the geometric mean of all fecal coliform bacteria observations ≤200/100 ml, and ≤10% of all observations exceed 400/100 ml.
Not Supporting (Fair)	One exceedance of the fecal coliform bacteria standard in the last five years (when sufficient data is available to assess the standard) or The geometric mean of all fecal coliform bacteria observations in the last five years ≤200/100 ml, and >10% of all observations in the last five years exceed 400/100 ml or The geometric mean of all fecal coliform bacteria observations in the last five years >200/100 ml, and ≤25% of all observations in the last five years exceed 400/100 ml.
Not Supporting (Poor)	More than one exceedance of the fecal coliform bacteria standard in the last five years (when sufficient data is available to assess the standard) or The geometric mean of all fecal coliform bacteria observations in the last five years >200/100 ml, and >25% of all observations in the last five years exceed 400/100 ml

Figure 4-1: Segments with Enhanced Protection in the DuPage River/Salt Creek Watershed



4.4 TMDL Targets

In order for a waterbody to be listed as Fully Supporting, it must meet all of its applicable designated uses. Because WQS are designed to protect those designated uses, a pollutant's numeric WQS is therefore used as the target or endpoint for establishing a TMDL. Table 4-3 summarizes the endpoints that will be used in the TMDL development for the DuPage River/Salt Creek watershed.

Table 4-3: TMDL Targets for Impaired Waterbodies in the DuPage River/Salt Creek Watershed

Segment ID	Waterbody Name	Impairment	TMDL Target	Units
IL_GL	Salt Creek	Fecal Coliform	<400	cfu/100 ml
IL_GL-09	Salt Creek	pH	6.5-9.0	s.u.
		Fecal Coliform	<400	cfu/100 ml
IL_GL-10	Salt Creek	pH	6.5-9.0	s.u.
		Fecal Coliform	<400	cfu/100 ml
IL_GL-19	Salt Creek	pH	6.5-9.0	s.u.
		Fecal Coliform	<400	cfu/100 ml
IL_GLA-02	Addison Creek	Fecal Coliform	<400	cfu/100 ml
IL_GB-01	DuPage River	Silver (total)	<5.0	µg/L
IL_GB-11	DuPage River	Chloride	<500	mg/L
		Fecal Coliform	<400	cfu/100 ml
IL_GB-16	DuPage River	Dissolved Oxygen[1]	*	mg/L
		Fecal Coliform	<400	cfu/100 ml
IL_GBK-05	W. Br. DuPage River	Dissolved Oxygen	*	mg/L
		Fecal Coliform	<400	cfu/100 ml
IL_GBK-09	W. Br. DuPage River	pH	6.5-9.0	s.u.
		Dissolved Oxygen	*	mg/L
		Silver (total)	<5.0	µg/L
		Fecal Coliform	<400	cfu/100 ml
IL_GBK-14	W. Br. DuPage River	Manganese (total)	<1.0	mg/L
		Dissolved Oxygen	*	mg/L
		Fecal Coliform	<400	cfu/100 ml
IL_GBKA	Spring Brook	Dissolved Oxygen	*	mg/L
		Fecal Coliform	<400	cfu/100 ml
IL_GBKA-01	Spring Brook	Fecal Coliform	<400	cfu/100 ml
IL_GBL-08	E. Br. DuPage River	pH	6.5-9.0	s.u.
IL_GBL-10	E. Br. DuPage River	pH	6.5-9.0	s.u.
		Fecal Coliform	<400	cfu/100 ml

Segment ID	Waterbody Name	Impairment	TMDL Target	Units
IL_RGG	Churchill Lagoon	Total Phosphorus	<0.05	mg/L

1. Segment GB-16 is considered a water with enhanced protection for dissolved oxygen and the enhanced protection dissolved oxygen standard applies

* Refer to Table 4-2 for the dissolved oxygen standard

5.0 Water Quality Assessment

This section discusses the pollutants of concern for the DuPage River/Salt Creek watershed. The available water quality data were analyzed, assessed, and compared with WQS to verify the impairments of the 16 stream segments and Churchill Lagoon. The water quality conditions in the watershed were evaluated by sampling location and time. Available point and non-point source data were also assessed and discussed in more detail throughout the remainder of the section.

5.1 Water Quality Data

The DuPage River/Salt Creek Watershed has 17 impaired waters within its drainage area. Figure 5-1 shows the water quality data stations within the watershed that contain data relevant to the impaired segments. The following sections address both stream and lake impairments.

Data analysis was focused on all available data collected since the year 2000. The information presented in this section is a combination of both legacy and modernized USEPA Storage and Retrieval (STORET) database and data from the Illinois EPA database, Sierra Club, Wheaton Sanitary District, Metropolitan Water Reclamation District of Greater Chicago, and DuPage River Salt Creek Workgroup. Table 5-1 contains the monitoring entities for each water segment.

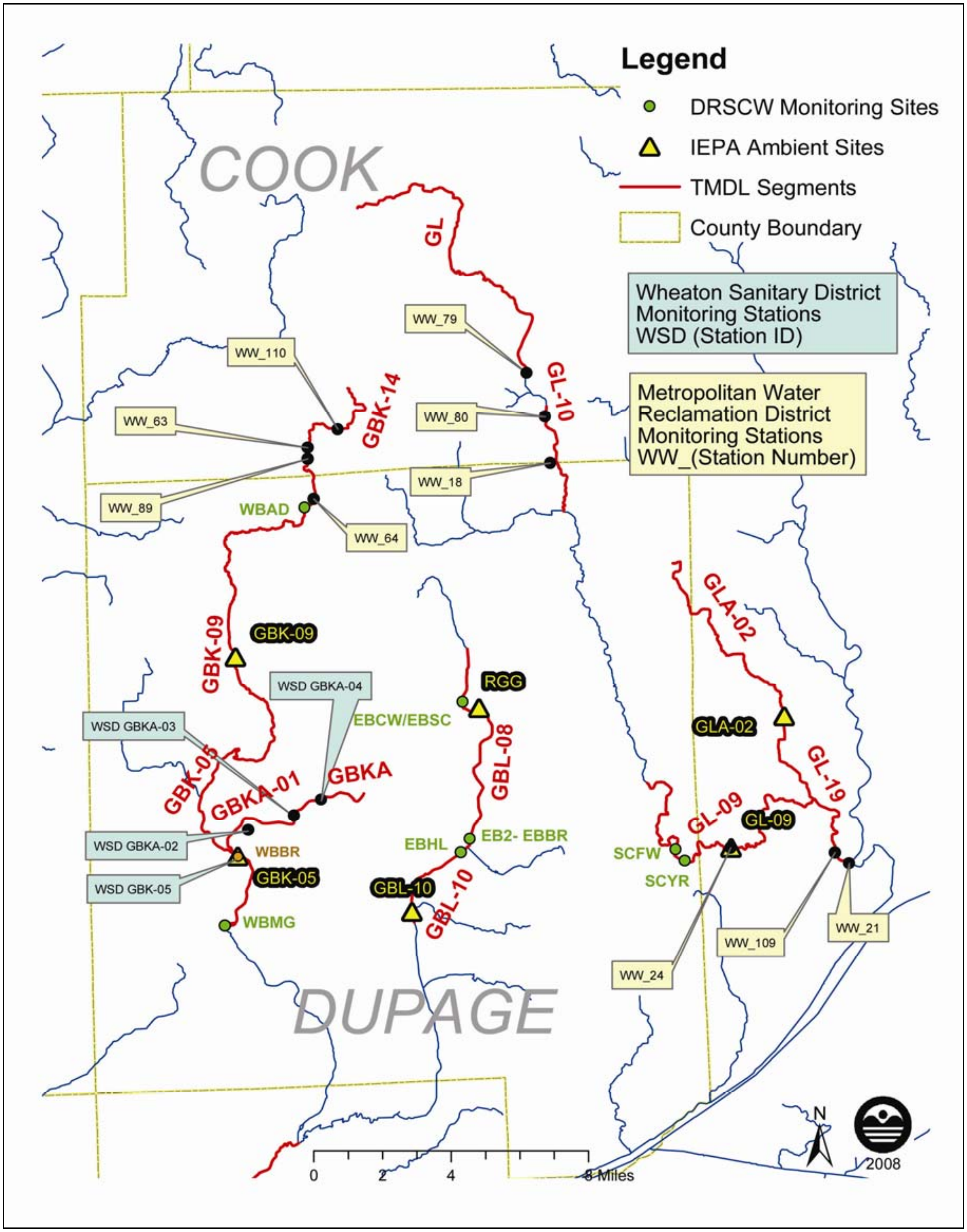
Data relevant to impairments were compiled for each impaired waterbody and summarized. The following parameters were grouped by impairment and discussed in relation to the relevant Illinois numeric WQS. For all assessments, compliance was determined at the surface of a stream or at the one-foot depth from the lake surface.

Table 5-1: Monitoring Station Information

Segment	Parameter	Entity
GB-01	Silver	Illinois EPA
GB-11	Chloride	Illinois EPA
	Fecal	Illinois EPA
GB-16	DO	Illinois EPA
	Fecal	Illinois EPA
GBK-05	DO	DRSCW, Illinois EPA, Sierra Club
	DO	WSD
	Fecal	Illinois EPA, WSD
GBK-09	DO	DRSCW, Illinois EPA, MWRDGC
	Fecal	Illinois EPA, MWRDGC
	Hardness	Illinois EPA
	pH	DRSCW, Illinois EPA, MWRDGC
	Silver	Illinois EPA
GBK-14	DO	MWRDGC
	Fecal	MWRDGC

Segment	Parameter	Entity
GBK-14	Mn, Total and Soluble	MWRDGC
GBKA	DO	WSD
	Fecal	WSD
GBKA-01	Copper	WSD
	Fecal	WSD
GBL-08	pH	DRSCW, Sierra Club
GBL-10	Fecal	Illinois EPA
	pH	DRSCW, Illinois EPA, Sierra Club
GL	Fecal	MWRDGC
GL-09	Fecal	Illinois EPA, MWRDGC
	pH	DRSCW, Illinois EPA, MWRDGC
GL-10	Fecal	MWRDGC
	pH	MWRDGC
GL-19	Fecal	MWRDGC
	pH	MWRDGC
GLA-02	Fecal	Illinois EPA
RGG	Phosphorus	Illinois EPA

Figure 5-1: Monitoring Stations Used for Assessing Impairments



5.1.1 Fecal Coliform

Figures 5-2 through 5-4 contain the available fecal coliform data. Data is available from the years indicated in the time series graphs, but for statistical purposes more recent data was used shown in Table 5-2, ranging from 1999 to 2007. The WQS for fecal coliform is a 200 cfu/100ml geometric mean based on a minimum of five samples taken over any 30 day period or a 400 cfu/100ml maximum not to be exceeded in more than 10% of samples taken during any 30 day period. Due to the unlikelihood of having five fecal coliform samples per month upon which to judge compliance, a single exceedance of 400 cfu/100 ml is often interpreted as an instantaneous maximum for assessment purposes.

Table 5-2: Fecal Coliform Data Summary

Segment	Stations	Data Years	No. of Samples	Violations >200	Violations >400	Min	Max	Average	Median
GB-11	IEPA GB-11	1999-2005	53	26	20	10	10900	1016	140
GB-16	IEPA GB-16	2001-2005	34	22	19	10	14000	1880	520
GBK-05	IEPA GBK-05 WSD GBK-05	1999-2006	89	77	59	1	56000	3305	670
GBK-09	IEPA GBK-09 WW_64, 89	1999-2007	197	179	155	20	60000	3965	2000
GBK-14	WW_63, 110	2001-2007	31	31	28	320	550000	22589	2100
GBKA	WSD GBKA-04	2005-2006	23	22	19	63	9200	1953	1200
GBKA-01	WSD GBKA-01, 02, 03	2005-2006	48	29	23	17	10114	1214	385
GBL-10	IEPA GBL-10	1999-2005	51	49	45	144	25600	4734	2000
GL	WW_79	2001-2007	57	20	15	0	330000	7090	80
GL-09	IEPA GL-09 WW_24	2001-2007	137	104	88	20	86000	2732	680
GL-10	WW_18, 80	2001-2007	150	110	96	20	100000	2595	710
GL-19	WW_21, 109	2001-2007	71	67	60	0	110000	5589	100
GLA-02	IEPA GLA-02	1999-2005	48	47	43	90	27800	4718	1972

Figure 5-2. Fecal Coliform Time Series for GB-16, GB-11 and GBL-10

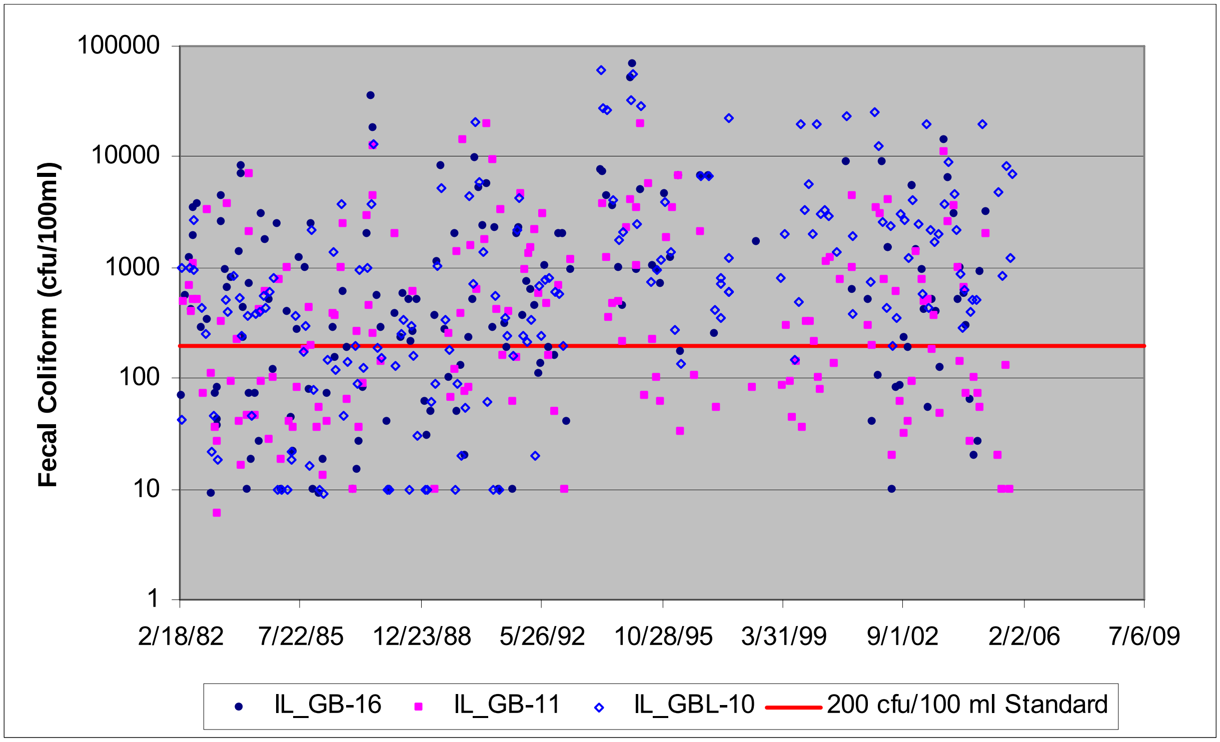


Figure 5-3. Fecal Coliform Time Series for GBK-05, GBK-09, GBK-14, GBKA and GBKA-01

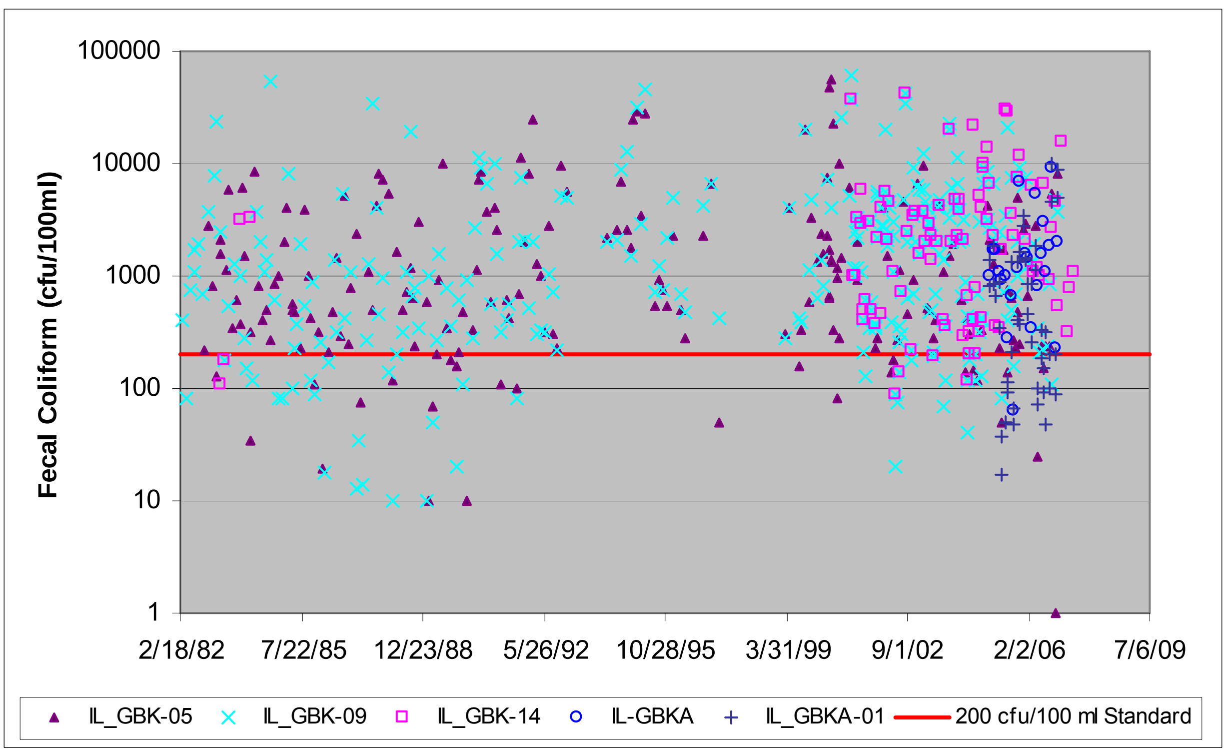
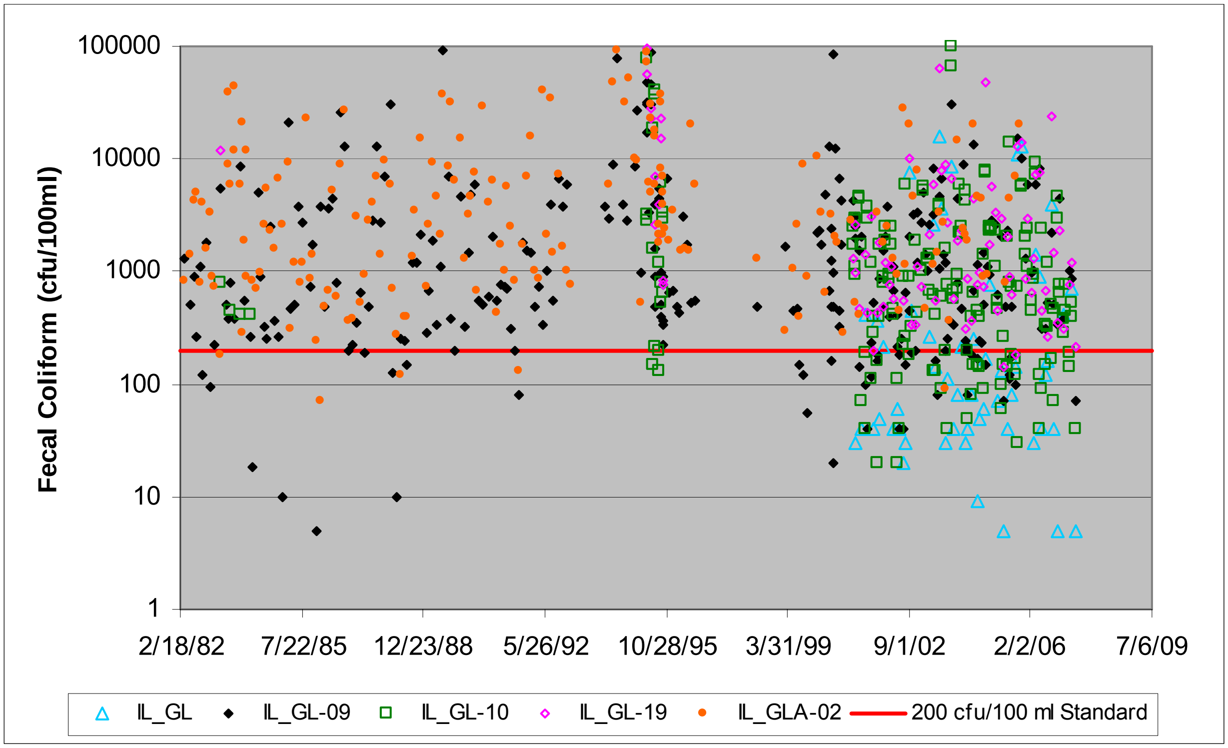


Figure 5-4. Fecal Coliform Time Series for GL, GL-09, GL-10, GL-19 and GLA-02



5.1.2 Dissolved Oxygen

The DO WQS for all segments except GB-16 is a 5.0 mg/L instantaneous minimum for March through July and 3.5 mg/L for August through February. Segment GB-16 is subject to enhanced protection so the WQS is a 5.0 mg/L instantaneous minumum for March through July and 4.0 mg/L for August through February. Five waterbody segments were determined to be impaired for low DO based on this criterion. Data ranged from 1964 to 2007. A data summary for recent dissolved oxygen data is contained in Table 5-3. Figure 5-5 contains summary information for Illinois EPA monthly DO data for GB-16 enhanced waterbody. Figures 5-6 and 5-7 contain continuous hourly monitoring data for GB-16 and GBK-05. Figure 5-8 contains monthly data for GBK-05, GBK-14, GBKA and GBK-09. Figure 5-9 contains continuous hourly data for GBK-09.

Table 5-3: Dissolved Oxygen Data Summary

Segment	Stations	Data Years	Observations	Violations	Minimum
GB-16	IEPA GB-08 IEPA GB-16*	2000- 2006	443	28	3.54
GBK-05	IEPA GBK-05 Sierra WB1 DRSCW WBMG* WSD GBK-05*	1999- 2007	15818	908	1.50
GBK-09	IEPA GBK-09 WW_64, 89 DRSCW WBAD*	1999- 2007	3198	77	4.33
GBK-14	WW_63, 110	2001-2007	40	9	0.00
GBKA	WSD GBKA-04	2005- 2006	23	9	0.80

* Continuous Monitoring Data

Figure 5-5. Dissolved Oxygen Time Series for GB-16 (Monthly Monitoring)

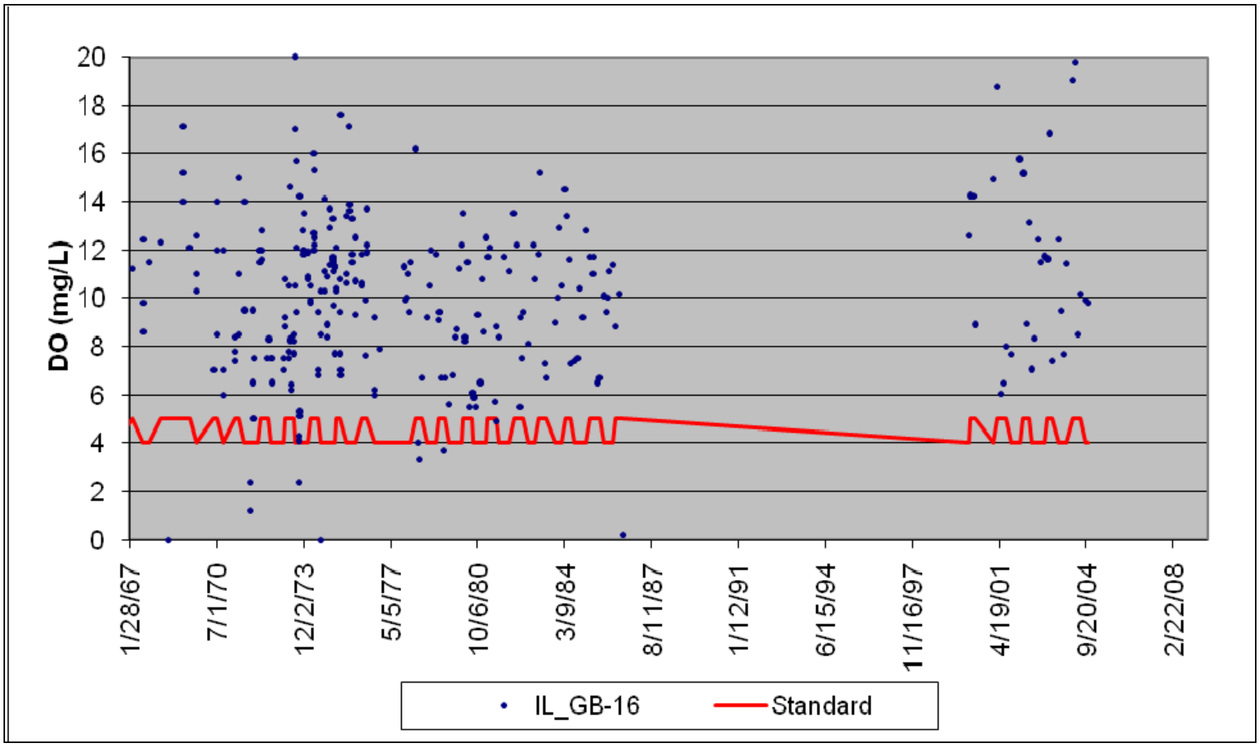


Figure 5-6. Dissolved Oxygen Data for GB-16 Provided by Illinois EPA (Continuous Hourly Monitoring)

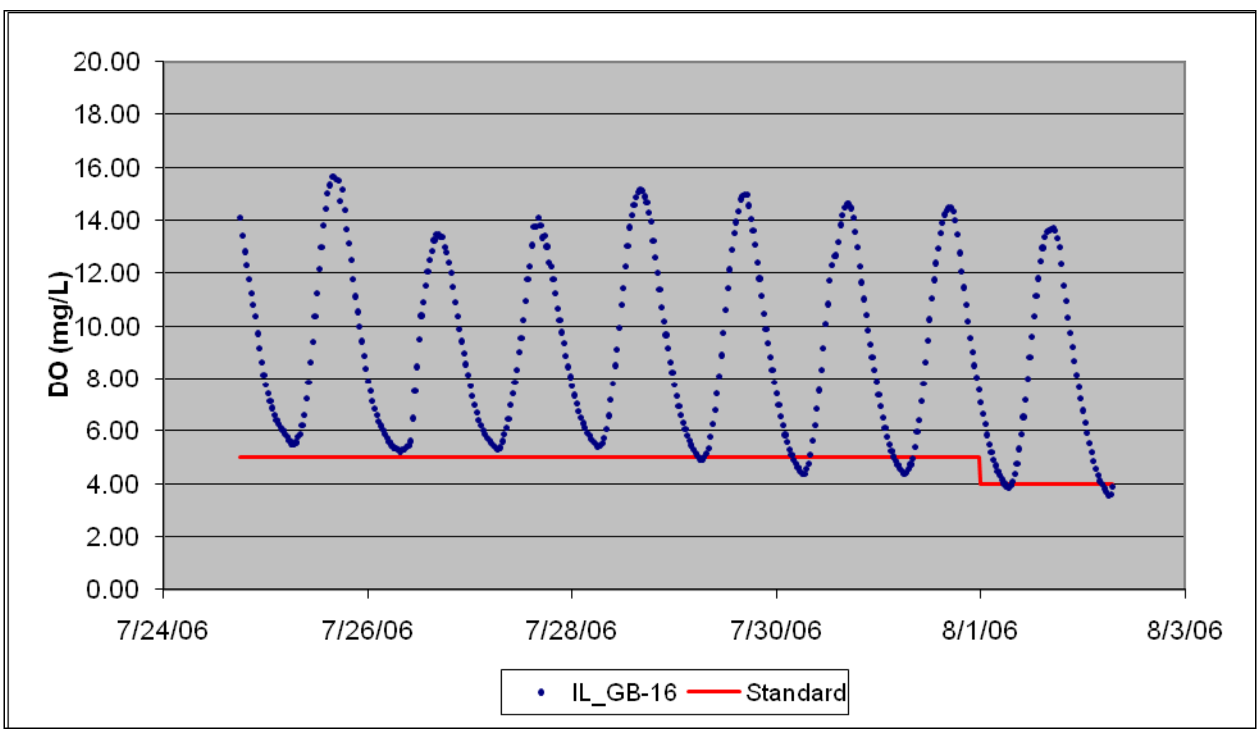


Figure 5-7. Dissolved Oxygen Data for GBK-05 Provided by Wheaton Sanitary District and DuPage River Salt Creek Workgroup (Continuous Hourly Monitoring)

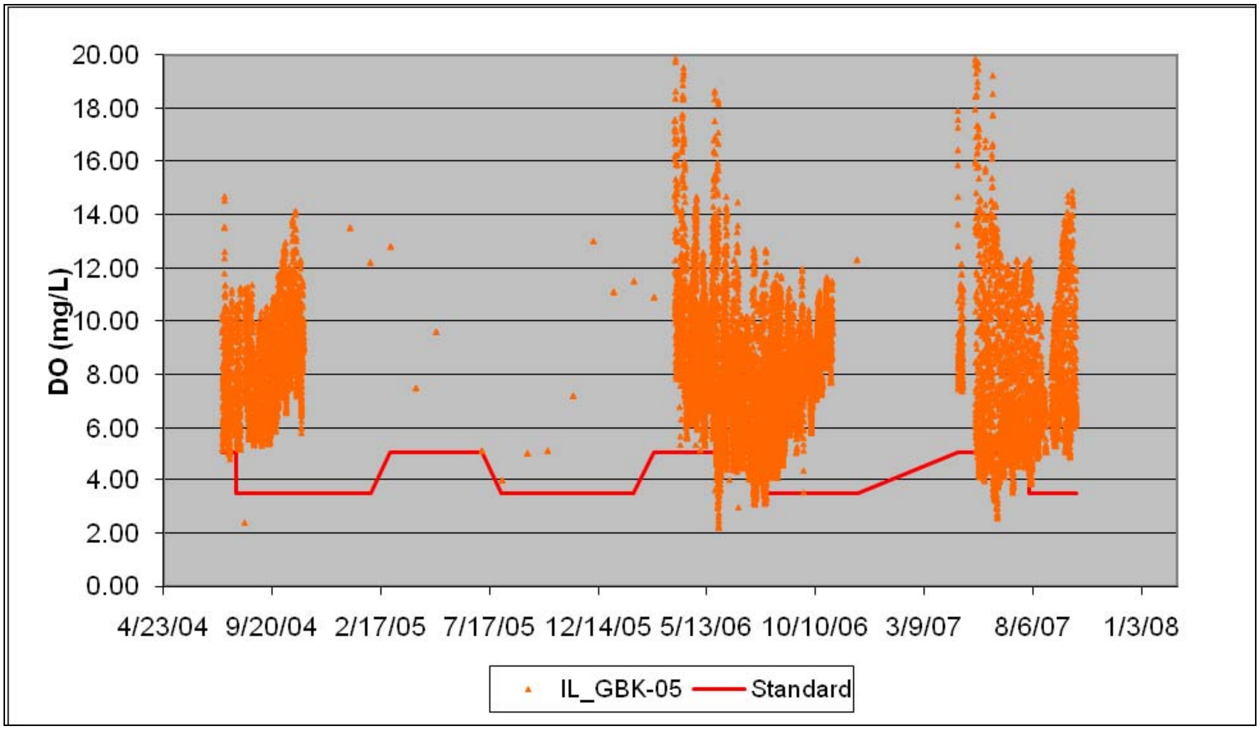


Figure 5-8. Dissolved Oxygen Time Series Data for GBK-05, GBK-14, GBKA and GBK-09 (Monthly Monitoring)

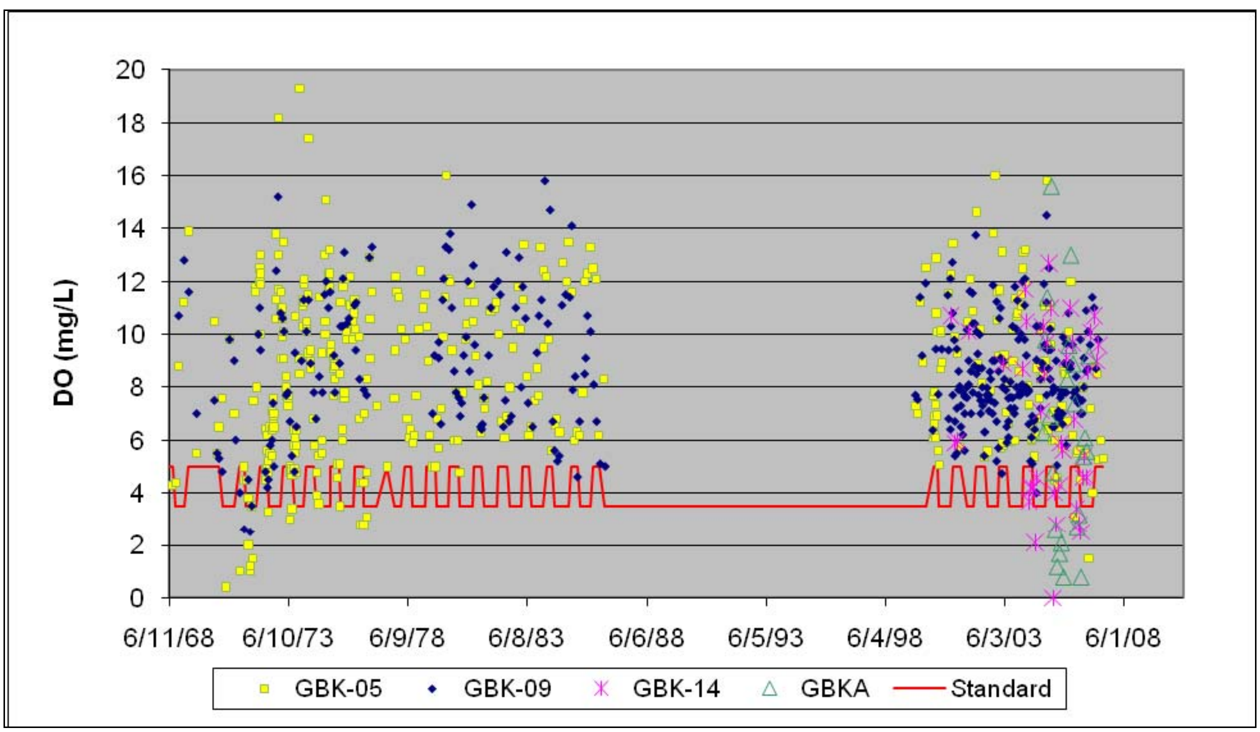
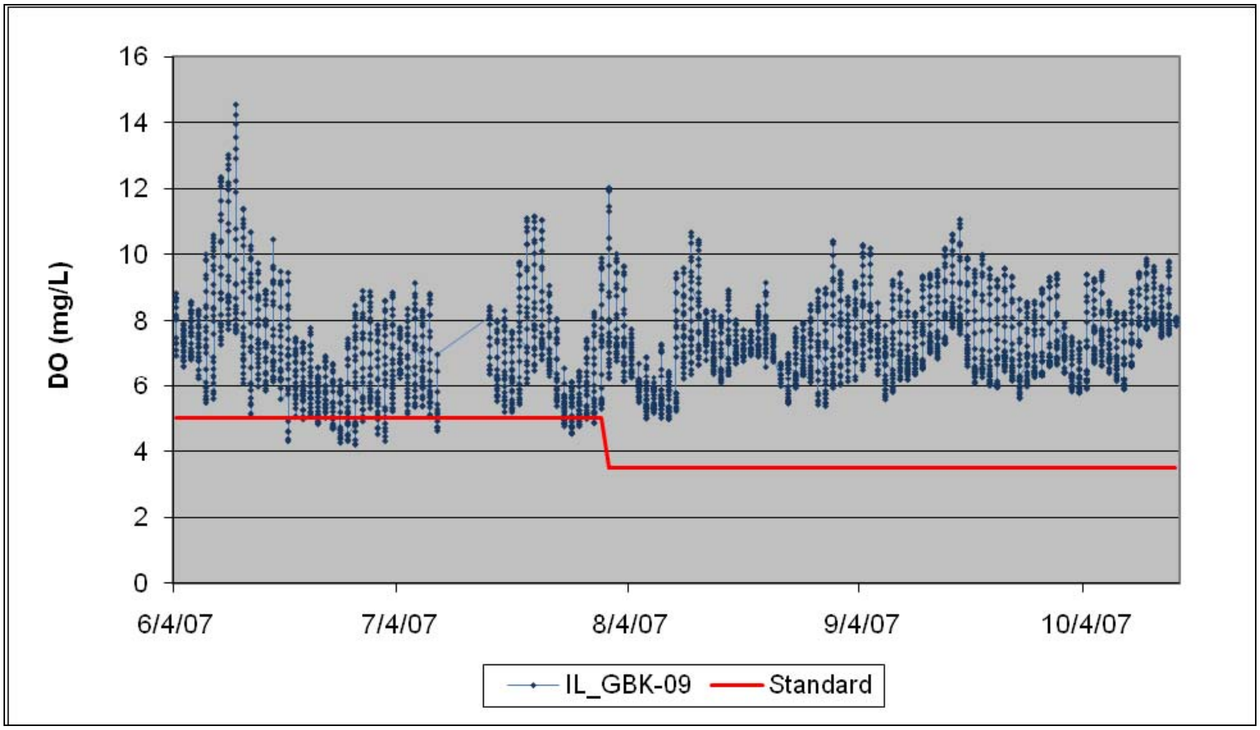


Figure 5-9. Dissolved Oxygen Data for GBK-09 Provided by DuPage River Salt Creek Workgroup (Continuous Monitoring)



5.1.3 pH

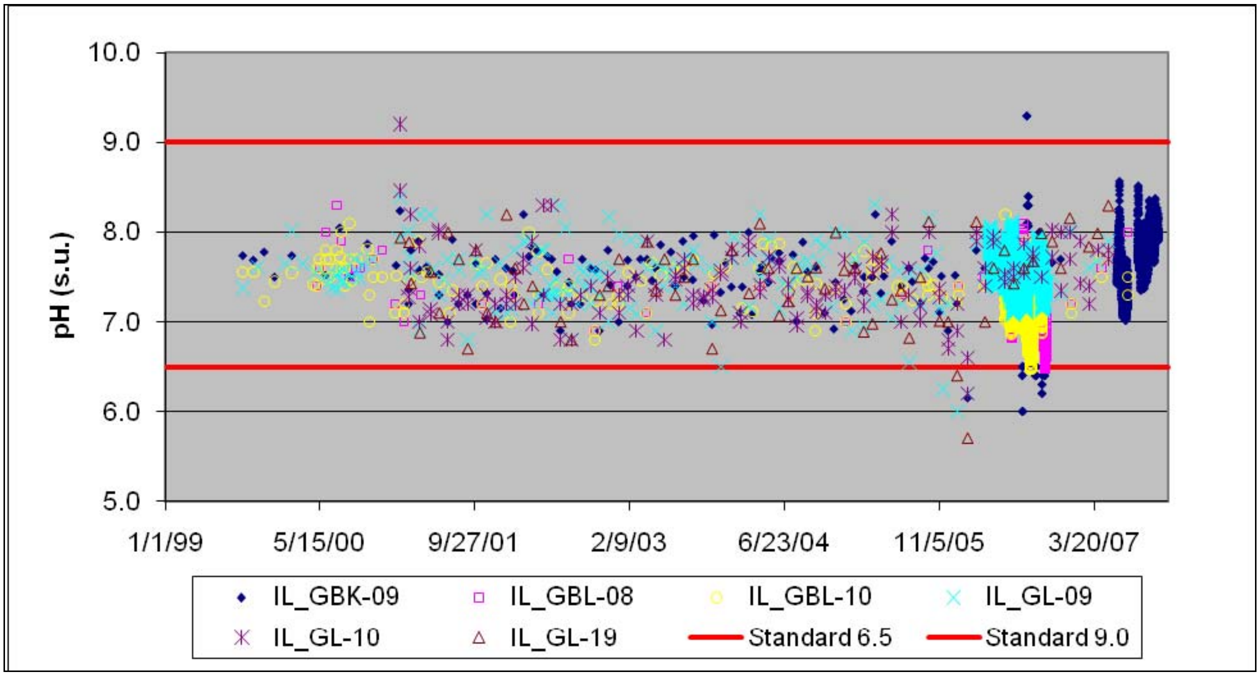
The WQS dictates an acceptable pH range between 6.5 and 9.0 s.u. Six segments are slated for TMDL development and all indicated at least one violation within the available data. Figure 5-10 displays pH data available since 1999 and Table 5-4 contains corresponding summary information.

Table 5-4: Recent pH Data Summary

Segment	Stations	Data Years	Observations	Violations	Min	Max	Average
GBK-09	IEPA GBK-09 WW_64, 89 DRSCW WBAD*	1999-2007	2594	24	6.0	9.3	7.7
GBL-08	DRSCW EBSC* Sierra EB1	2000-2007	1695	8	6.4	8.3	7.2
GBL-10	DRSCW EBHL* Sierra EB2 IEPA GBL-10	1999-2007	2843	6	6.4	8.2	7.2
GL-09	IEPA GL-09 DRSCW SCYR, SCFW* WW_24	1999-2007	6291	3	6.0	8.4	7.6
GL-10	WW_18, 80	2001-2007	149	2	6.2	9.2	7.5
GL-19	WW_121, 109	2001-2007	68	2	5.7	8.3	7.5

*Continuous Monitoring Stations

Figure 5-10: pH Distribution 1999 to 2007



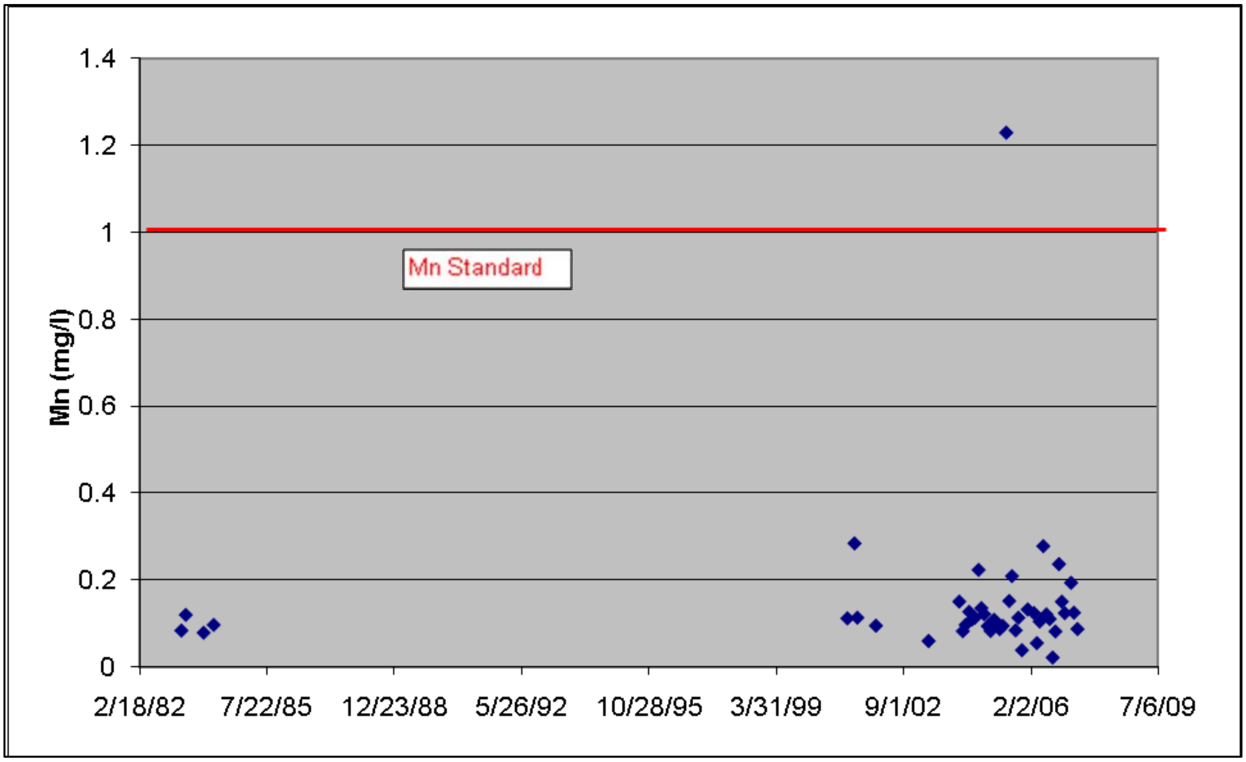
5.1.4 Manganese

The applicable WQS for manganese is 1 mg/L. Table 5-5 and Figure 5-11 summarize available manganese data for a segment on the West Branch of the DuPage River (IL_GBK-14), the only waterbody impaired for manganese. Available total manganese data ranged mostly from 2001 to 2007 with a few data points in 1983 and 1984.

Table 5-5: Manganese Data Summary

Segment	Units	# Observations	# Violations	Min	Max	Average	Median	Standard Deviation
IL_GBK-14	mg/L	45	1	0.02	1.23	0.15	0.11	0.17

Figure 5-11: Manganese Time Series for IL_GBK-14



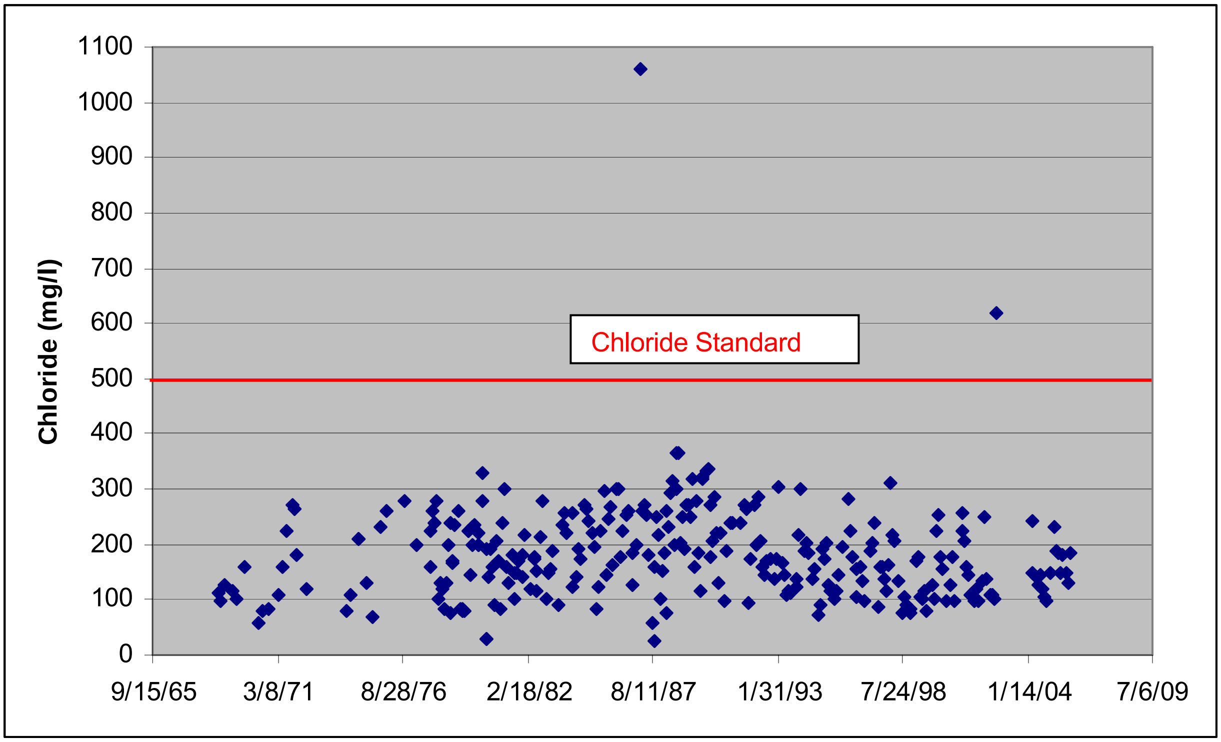
5.1.5 Chloride

Two chloride exceedances were recorded at the IL_GB-11 segment of the DuPage River. The general use water quality standard for chloride is 500 mg/L and available data used for assessment ranged from 1968 to 2005. Table 5-6 and Figure 5-12 summarize the available chloride data.

Table 5-6: Chloride Data Summary

Segment	Units	# Observations	# Violations	Min	Max	Average	Median	Standard Deviation
IL_GB-11	mg/L	287	2	24	1060	182.9	174	90.4

Figure 5-12: Chloride Time Series for IL_GB-11



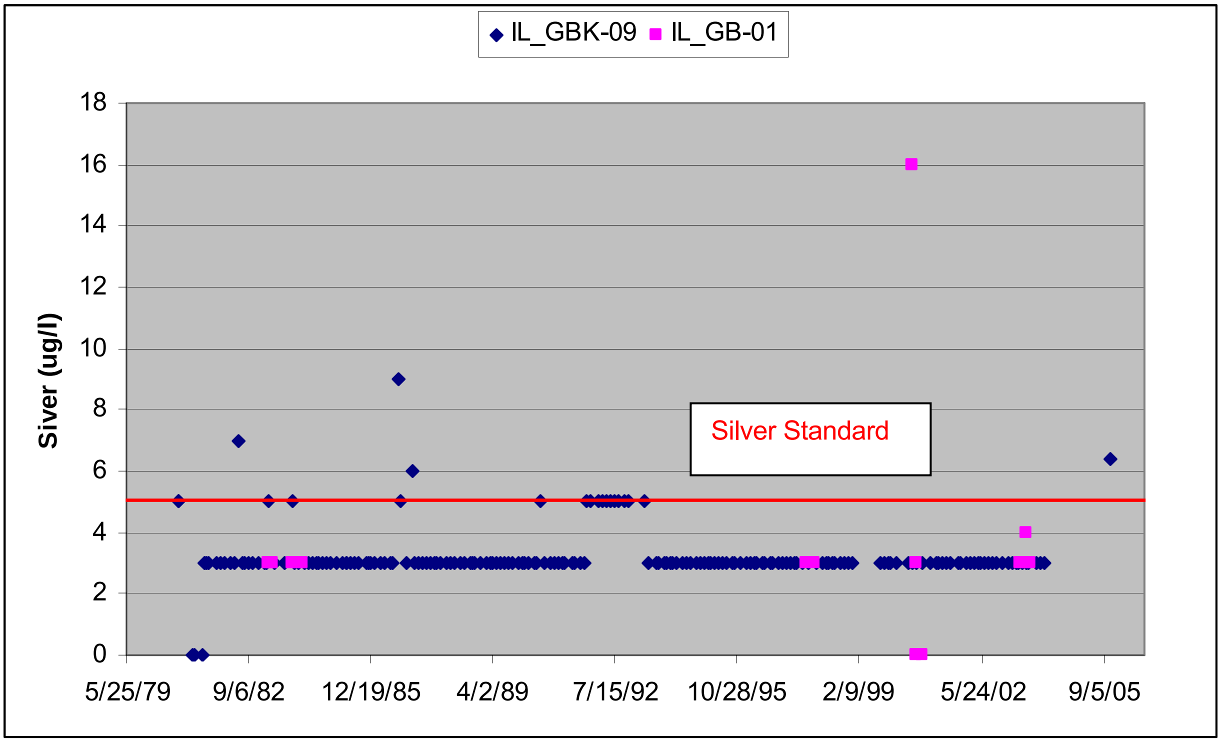
5.1.6 Silver

Two segments were listed for silver impairment within the DuPage River/Salt Creek Watershed, IL_GB-01 on the main stem and IL_GBK-09 on the West Branch of the DuPage River. Table 5-7 and Figure 5-13 summarize total silver data. Ambient data indicate that the silver water quality standard of 5 µg/L was violated on 5 occasions, one in 2000 on IL_GB-01 and the other 4 on IL_GBK-09. Data used for analysis ranged from 1980 to 2003.

Table 5-7: Silver Data Summary

Segment	Units	# Observations	# Violations	Min	Max	Average	Median	Standard Deviation
IL_GB-01	µg/L	18	1	0	16	3.44	3	3.29
IL_GBK-09	µg/L	195	4	0	9	3.21	3	0.90

Figure 5-13: Silver Time Series for IL_GB-01 and IL_GBK-09



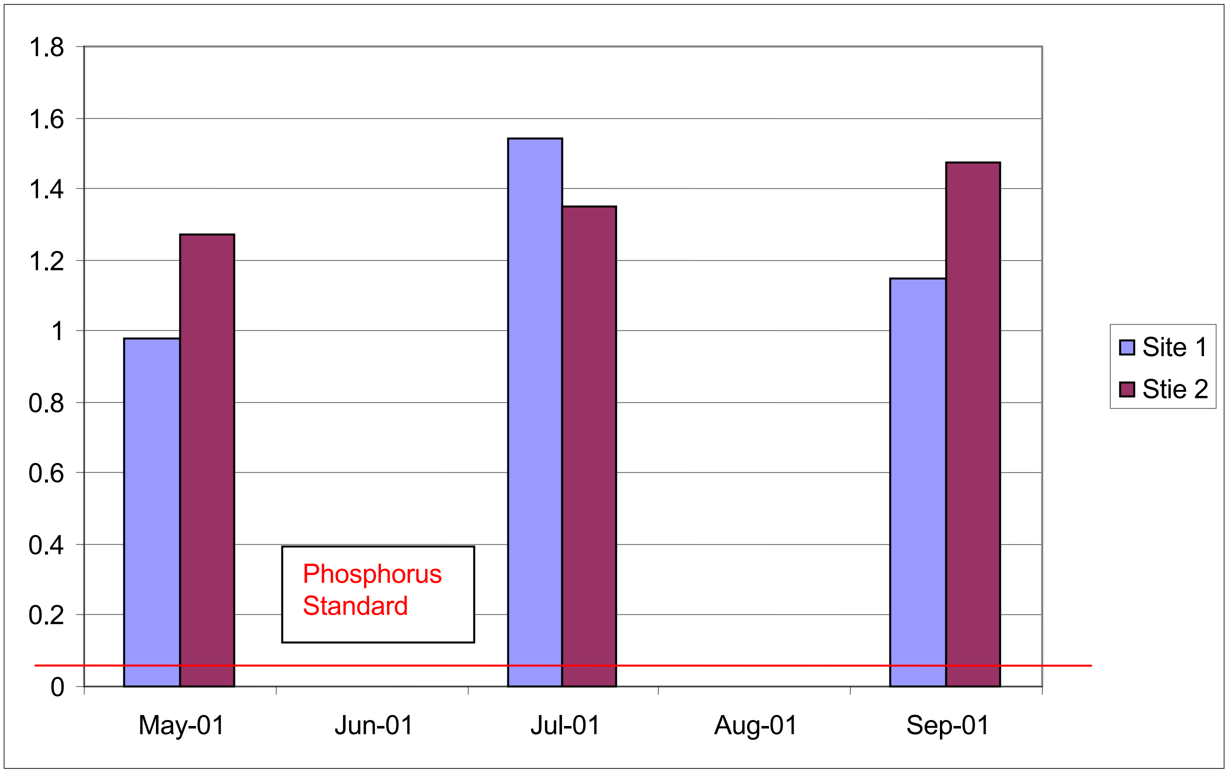
5.1.7 Total Phosphorus

The numeric water quality criteria for total phosphorus is a maximum concentration of 0.05 mg/L and is applicable only to lakes with a surface area of 20 acres or greater. Phosphorus concentrations for Churchill Lagoon (IL_RGG) are summarized in Table 5-8 and Figure 5-14. Data used for assessments were only available in 2001.

Table 5-8: Phosphorus Data Summary

Segment	Units	# Observations	# Violations	Min	Max	Average	Median	Standard Deviation
IL_RGG	mg/L	6	6	0.976	1.540	1.294	1.310	0.210

Figure 5-14. Phosphorus Data for RGG



5.2 Point Sources

A number of point source dischargers actively maintain National Pollutant Discharge Elimination System (NPDES) permits within the DuPage River/Salt Creek watershed. Discharge Monitoring Reports (DMRs) for each discharger will be required for the Stage 3 analysis of the TMDL, as available data will be quantified and analyzed to determine the point source loading for each receiving water. Table 5-9 lists the existing NPDES permits as provided by EPA's Enforcement Compliance History Online (ECHO) database. Geographic locations are provided in Figure 5-8.

Phase I of the NPDES Storm Water program began in 1990 and required medium and large municipal separate storm sewer systems (MS4s) to obtain NPDES coverage. The expanded Phase II program began March 2003 and requires small MS4s in urbanized areas to obtain NPDES permits and implement six (6) minimum control measures. An urbanized area as delineated by the Bureau of Census is defined as a central place or places and the adjacent densely settled surrounding area that together have a residential population of at least 50,000 people and an overall population density of at least 500 people per square miles. Table 5-10 lists the MS4s within the DuPage River/Salt Creek Watershed and Figure 5-17 indicates the location.

MS4 Permit Requirements:

1. Develop a storm water management program comprised of best management practices (BMPs) and measurable goals for each of the following six minimum control measures:
    - Public education and outreach on storm water impacts
    - Public involvement and participation
    - Illicit discharge detection and elimination
    - Construction site storm water runoff control
    - Post construction storm water management in new development and redevelopment
    - Pollution prevention/good housekeeping for municipal operations
2. Submit a completed Notice of Intent. Operators can choose to share responsibilities for meeting the Phase II program requirements. Those entities choosing to do so may submit jointly with other municipalities or governmental entities. The Notice of Intent form is available below.
3. Submit an annual report to IEPA in June of each year starting in 2004. The reports must include:
    - The status of compliance with the permit conditions, including an assessment of the BMPs and progress toward the measurable goals;
    - Results of any information collected and analyzed, including monitoring data;
    - A summary of the storm water activities planned for the next reporting cycle;
    - A change in any identified best management practices or measurable goals;
    - If applicable, notice of relying on another governmental entity to satisfy some of the permit obligations.

Table 5-9: Existing NPDES Discharges in the DuPage River/Salt Creek Watershed

Watershed	NPDES Number	Facility	Receiving Water	Permitted Flow (MGD)
DUPAGE R- MAINSTEM	IL0074322	ATC/VANCOM, INC.-	UNNAMED TRIB OF DUPAGE	0.002
DUPAGE R- MAINSTEM	IL0069744	BOLINGBROOK STP #3	DUPAGE RIVER	1.4
DUPAGE R- MAINSTEM	IL0061450	BOUGHTON TRUCKING & MATERIALS	DUPAGE RIVER	0
DUPAGE R- MAINSTEM	IL0045381	CAMELOT UTILITIES INC.	DUPAGE RIVER	0.1
DUPAGE R- MAINSTEM	IL0032727	CITIZENS UTIL CO-#1	LILLY CACHE	0
DUPAGE R- MAINSTEM	IL0049166	CITIZENS UTIL CO-	MINK CREEK	0.4
DUPAGE R- MAINSTEM	IL0021121	CREST HILL WEST STP	ROCK RUN CREEK	1.3
DUPAGE R- MAINSTEM	IL0053163	ELMHURST-CHICAGO	LILY CACHE CREEK	0
DUPAGE R- MAINSTEM	IL0063240	FIRESIDE RESORT	UNNAMED TRIB TO ROCK	0.022
DUPAGE R- MAINSTEM	IL0034479	HANOVER PARK STP #1	W. BR. DUPAGE RVR	2.42
DUPAGE R- MAINSTEM	IL0055913	MINOOKA STP	DUPAGE RIVER TO DES	1.092
DUPAGE R- MAINSTEM	IL0034061	NAPERVILLE	DUPAGE RIVER	22.5
DUPAGE R- MAINSTEM	IL0063975	PIERCE & STEVENS	DUPAGE RIVER	0.034
DUPAGE R- MAINSTEM	IL0074373	PLAINFIELD NORTH STP	DUPAGE RIVER-DES PLAINES	3.5
DUPAGE R- MAINSTEM	IL0020508	PLAINFIELD WWTP	DUPAGE RIVER	1.71
DUPAGE R- MAINSTEM	IL0059765	PRAIRIE GROUP	DUPAGE RIVER	0.103
EAST BR DUPAGE R	IL0032735	CITIZENS UTIL CO-#2	EAST BRANCH OF DUPAGE	3
EAST BR DUPAGE R	IL0028967	GLENDALE HEIGHTS STP	ARMITAGE DITCH	5.26
EAST BR DUPAGE R	IL0021130	BLOOMINGDALE-	EAST BRANCH DUPAGE	3.45
EAST BR DUPAGE R	IL0032689	BOLINGBROOK STP #1	E BR DUPAGE RVR	2.04
EAST BR DUPAGE R	IL0028380	DOWNERS GROVE SD	E. BR. DUPAGE RVR & ST.	11
EAST BR DUPAGE R	IL0031844	DUPAGE COUNTY-	EAST BRANCH DUPAGE	12
EAST BR DUPAGE R	IL0053155	ELMHURST CHICAGO	EAST BRANCH OF DUPAGE	3.5
EAST BR DUPAGE R	IL0021547	GLENBARD WW AUTH-GLENBARD	E. BR. DUPAGE RIVER	16.02
EAST BR DUPAGE R	IL0022471	GLENBARD WW AUTH-LOMBARD	EAST BRANCH DUPAGE RIVER	0
SALT CR	IL0070416	A.G. COMMUNICATIONS	ADDISON CREEK VIA STORM	0.0186
SALT CR	IL0064866	ACCURATE CAST	SALT CREEK	0.0007
SALT CR	IL0033812	ADDISON NORTH STP	SALT CREEK	5.3
SALT CR	IL0027367	ADDISON SOUTH-A.J.	SALT CREEK	3.2
SALT CR	IL0070947	AMOCO PIPELINE-	VARIOUS WATERS OF THE	0
SALT CR	IL0063487	ARLINGTON INTERNATL	SALT CREEK	0
SALT CR	IL0021849	BENSENVILLE STP	ADDISON CREEK	4.7
SALT CR	IL0065021	BLACKHAWK MOLDING	SALT CREEK	0.0038
SALT CR	IL0044890	BROOKFIELD CSOS	SALT CREEK	0
SALT CR	IL0035831	CONGRESS DEV HILSIDE LANDFILL	DES PLAINES RIVER	0
SALT CR	IL0028746	ELMHURST WWTP	SALT CREEK, DES PLAINES	8
SALT CR	IL0026280	ITASCA STP	SALT CREEK	2.6

Watershed	NPDES Number	Facility	Receiving Water	Permitted Flow (MGD)
SALT CR	IL0033588	LAGRANGE PARK CSOS	SALT CREEK	0
SALT CR	IL0036340	MWRDGC EGAN WRP	SALT CREEK	30
SALT CR	IL0068381	OFFICE PARK OF	SALT CREEK	0.21
SALT CR	IL0066427	PRAIRIE MATERIAL	STORM SEWER TRIB TO	0.0074
SALT CR	IL0030813	ROSELLE STP	SALT CREEK	2
SALT CR	IL0030953	SALT CREEK SANITARY	SALT CREEK	3.3
SALT CR	IL0002127	UNION PACIFIC	MUD CREEK TRIB TO	0.775
SALT CR	IL0069124	VANEE FOODS	UNNAMED TRIB TO ADDISON	0
SALT CR	IL0033618	VILLA PARK WET	SALT CREEK	0
SALT CR	IL0050695	WALL'S MHP-ELMHURST	FLAGG CREEK	0.034
SALT CR	IL0045039	WESTERN SPRINGS	SALT CREEK, FLAGG CREEK	0
SALT CR	IL0020061	WOOD DALE NORTH STP	SALT CREEK	1.97
SALT CR	IL0034274	WOOD DALE SOUTH STP	SALT CREEK	1.13
WEST BR DUPAGE R	IL0026352	CAROL STREAM STP	KLEIN CREEK (DESPLAINES	5.4
WEST BR DUPAGE R	IL0054712	BALL HORTICULTURAL	CRESS CREEK	0.04
WEST BR DUPAGE R	IL0027618	BARTLETT WWTP	WEST BRANCH OF DUPAGE	3.679
WEST BR DUPAGE R	IL0067458	BLACHFORD, INC.-WEST	STORM SEWER TRIB TO	0.0967
WEST BR DUPAGE R	IL0045241	BP AMOCO NAPERVILLE	WEST BRANCH OF DUPAGE	0.827
WEST BR DUPAGE R	IL0028428	DUPAGE COUNTY-	WEST BRANCH OF DUPAGE	0.0058
WEST BR DUPAGE R	IL0028398	DUPAGE COUNTY-	SPRING BROOK CREEK	0.5
WEST BR DUPAGE R	IL0063495	KERR-MCGEE-WEST	WEST BRANCH DUPAGE	0.021
WEST BR DUPAGE R	IL0002402	LAGROU DISTRIBUTION	KRESS CREEK	0.0005
WEST BR DUPAGE R	IL0036137	MWRDGC HANOVER	W. BR. DUPAGE RIVER	12
WEST BR DUPAGE R	IL0037028	PLEASANT RIDGE MHP	KLEIN CREEK TO DUPAGE	0.027
WEST BR DUPAGE R	IL0069671	REED KEPPLER FAMILY	TRIB OF KRESS CREEK	0
WEST BR DUPAGE R	IL0048721	ROSELLE-BOTTERMAN	WEST BRANCH OF DUPAGE	1.4
WEST BR DUPAGE R	IL0052043	SIDWELL COMPANY-	WEST BRANCH OF DUPAGE	0.004
WEST BR DUPAGE R	IL0046451	UNION PACIFIC	KRESS CREEK	0.011
WEST BR DUPAGE R	IL0023469	WEST CHICAGO STP	W. BR. DUPAGE RIVER	7.64
WEST BR DUPAGE R	IL0031739	WHEATON S.D.	SPRING CREEK	8.9

Table 5-10: Municipal Separate Storm Sewer Systems in the DuPage River/Salt Creek Watershed

Municipality	MS4 Permit No.	Permit Name	Drainage Area (Sq. miles)
Addison	ILR400001	ADDISON TOWNSHIP	36
Arlington Hts	ILR400282	VILLAGE OF ARLINGTON HEIGHTS	7.4
Aurora	ILR400005	AURORA TOWNSHIP	34
Barrington	ILR400285	VILLAGE OF BARRINGTON	4.9
Bartlett	ILR400286	VILLAGE OF BARTLETT	14.9
Batavia	ILR400009	BATAVIA TOWNSHIP	24.5
Bensenville	ILR400292	VILLAGE OF BENSENVILLE	5.9

Municipality	MS4 Permit No.	Permit Name	Drainage Area (Sq. miles)
Berkeley	ILR400166	BERKELEY VILLAGE	1
Bloomingdale	ILR400013	BLOOMINGDALE TOWNSHIP	36
Bolingbrook	ILR400298	VILLAGE OF BOLINGBROOK	23
Broadview	ILR400167	BROADVIEW VILLAGE	1.4
Brookfield	ILR400302	VILLAGE OF BROOKFIELD	
Carol Stream	ILR400308	VILLAGE OF CAROL STREAM	8
Channahon	ILR400623	VILLAGE OF CHANNAHON	7
Chicago	ILR400173	CHICAGO CITY	1
Clarendon Hills	ILR400175	CLARENDON HILLS VILLAGE	1.7
Crest Hill	ILR400319	CITY OF CREST HILL	3
Darien	ILR400180	DARIEN CITY	8.6
Downers Grove	ILR400040	DOWNERS GROVE TOWNSHIP	45
Downers Grove	ILR400183	DOWNERS GROVE VILLAGE	14
Elk Grove	ILR400048	ELK GROVE TOWNSHIP	15
Elmhurst	ILR400187	ELMHURST CITY	10.2
Franklin Park	ILR400195	FRANKLIN PARK VILLAGE	1.7
Geneva	ILR400056	GENEVA TOWNSHIP	13
Glen Ellyn	ILR400199	GLEN ELLYN VILLAGE	7
Glendale Hts	ILR400342	VILLAGE OF GLENDALE HEIGHTS	5.3
Hanover Park	ILR400347	VILLAGE OF HANOVER PARK	6.7
Hillside	ILR400354	VILLAGE OF HILLSIDE	2.1
Hinsdale	ILR400355	VILLAGE OF HINSDALE	4.5
Hoffman Estates	ILR400210	HOFFMAN ESTATES VILLAGE	
Inverness	ILR400359	VILLAGE OF INVERNESS	6.9
Itasca	ILR400360	VILLAGE OF ITASCA	5.1
Joliet	ILR400361	CITY OF JOLIET	41.4
Lisle	ILR400376	VILLAGE OF LISLE	7.1
Lombard	ILR400378	VILLAGE OF LOMBARD	10.5
Maywood	ILR400384	VILLAGE OF MAYWOOD	0
Melrose Park	ILR400386	VILLAGE OF MELROSE PARK	5.1
Minooka	ILR400638	VILLAGE OF MINOOKA	3.2
Naperville	ILR400396	CITY OF NAPERVILLE	227
Northlake	ILR400406	CITY OF NORTHLAKE	4.4
Oak Brook	ILR400407	VILLAGE OF OAK BROOK	8
Oakbrook Terrace	ILR400232	OAKBROOK TERRACE CITY	1.1
Oswego	ILR400415	VILLAGE OF OSWEGO	14.4
Palatine	ILR400416	VILLAGE OF PALATINE	13.4
Plainfield	ILR400426	VILLAGE OF PLAINFIELD	15.9
Rockdale	ILR400433	VILLAGE OF ROCKDALE	2
Rolling Meadows	ILR400435	CITY OF ROLLING MEADOWS	5.6
Romeoville	ILR400436	VILLAGE OF ROMEOVILLE	14.9
Roselle	ILR400437	VILLAGE OF ROSELLE	5.4
Schaumburg	ILR400443	VILLAGE OF SCHAUMBURG	19.3
Shorewood	ILR400445	VILLAGE OF SHOREWOOD	5
St. Charles	ILR400454	CITY OF ST CHARLES	13
Stone Park	ILR400248	STONE PARK VILLAGE	4
Streamwood	ILR400456	VILLAGE OF STREAMWOOD	1
Villa Park	ILR400463	VILLAGE OF VILLA PARK	4.6
Warrenville	ILR400274	CITY OF WARRENVILLE	90

Municipality	MS4 Permit No.	Permit Name	Drainage Area (Sq. miles)
Wayne	ILR400149	WAYNE TOWNSHIP	36
West Chicago	ILR400466	CITY OF WEST CHICAGO	13.9
Westchester	ILR400468	VILLAGE OF WESTCHESTER	3
Western Springs	ILR400469	VILLAGE OF WESTERN SPRINGS	1.1
Westmont	ILR400254	WESTMONT VILLAGE	5
Wheaton	ILR400470	CITY OF WHEATON	11.4
Winfield	ILR400474	VILLAGE OF WINFIELD	2.7
Wood Dale	ILR400478	CITY OF WOOD DALE	4
Woodridge	ILR400480	VILLAGE OF WOODRIDGE	9

Figure 5-15: Existing NPDES Dischargers in the DuPage River/Salt Creek Watershed

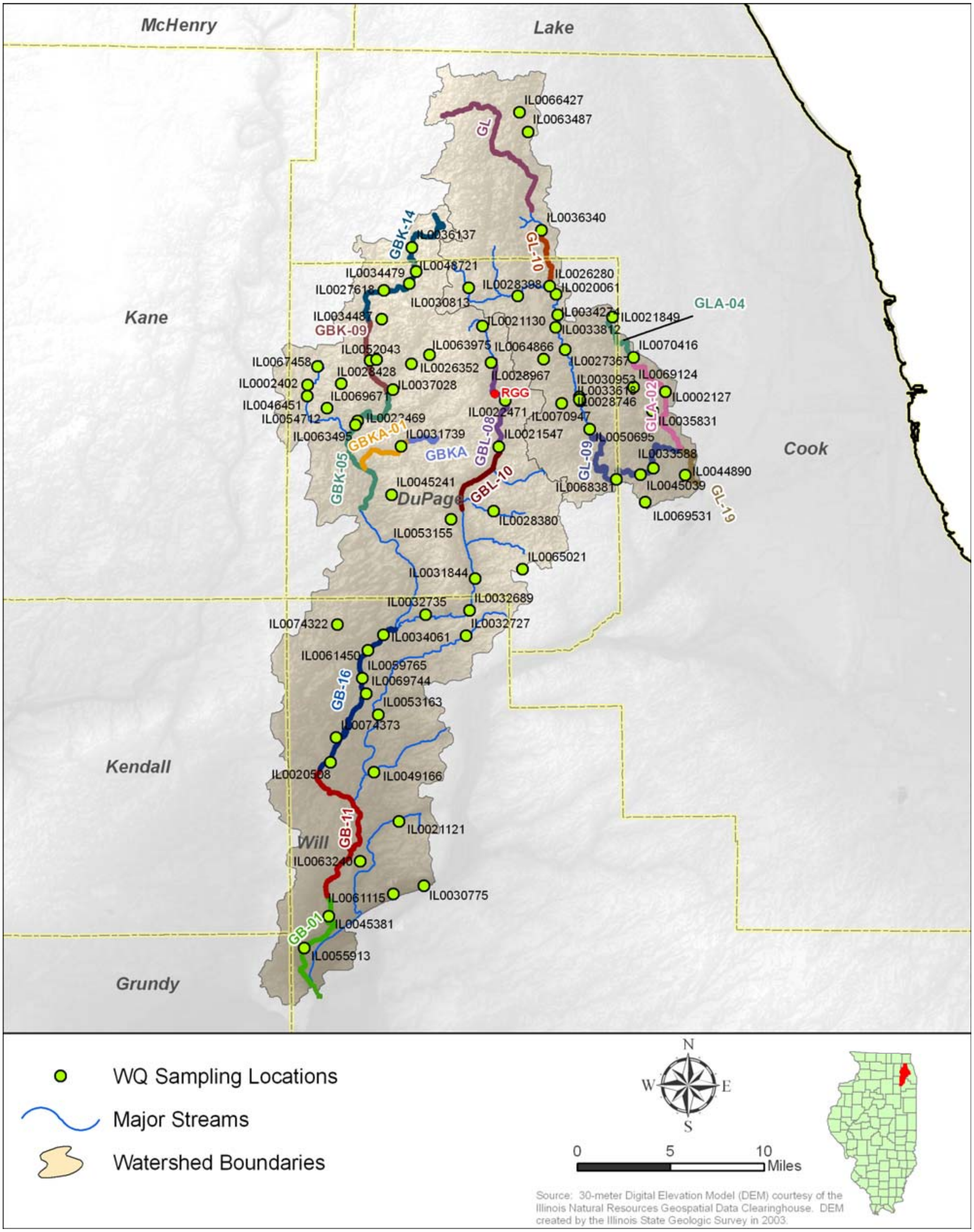
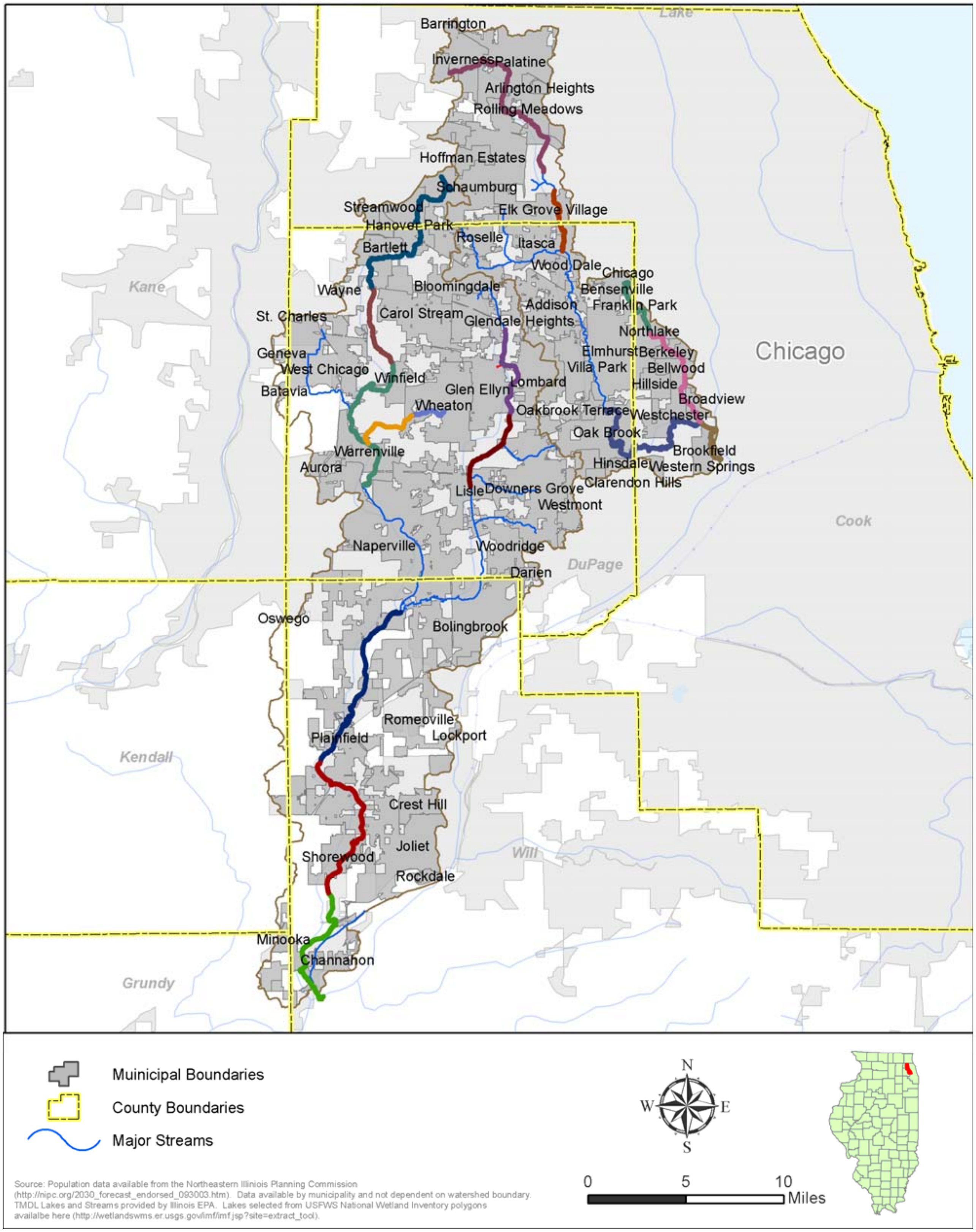


Figure 5-16: Municipal Separate Storm Sewer Systems in the DuPage River/Salt Creek Watershed



5.3 Non-Point Sources

The DuPage River/Salt Creek watershed is dominated by urban growth; current land use is approximately 65% urban. Further, over 20% of the remaining land use is considered agricultural, a primary source of non-point source pollution in waterbodies. To properly manage and maintain water quality in the DuPage River/Salt Creek watershed, the impacts associated with new development and agriculture must be carefully evaluated.

Urban and suburban development can adversely impact water quality in a number of ways. During the construction phase of development, soils destabilized as a result of clearing, grading, and excavation are subject to increased erosion by wind and water. These eroded soils can be carried offsite and deposited in receiving waters such as lakes, rivers and wetlands. Adverse impacts associated with such sediment loading include increased turbidity and habitat modification, including smothering of invertebrates and covering spawning beds. Typically, the construction phase is relatively short-lived; however, the impacts to receiving waters from poorly managed construction activities may be extremely severe and the effects can endure long after the project is over.

Post-construction receiving water quality impacts may become more pronounced due to potentially dramatic changes to the area's hydrology (reduced baseflow and exaggerated peak flow volumes), and the change in land use compared to predevelopment conditions. The increase in impervious areas, such as roadways and parking lots, can often result in increased runoff rates and volumes. This can result in increased streambank erosion which can lead to increased sediment loading and its associated water quality problems. The increased runoff can also accelerate the transport of land-borne pollutants such as heavy metals, oil and grease, pesticides, fertilizers and other nutrients, and toxic organic contaminants. Increased imperviousness can also cause significant elevations in receiving water temperatures during summer months. Winter road deicing activities can contribute high levels of chlorides or sediment.

Agricultural practices in the DuPage River/Salt Creek watershed can also adversely impact water quality. The dominant crops found in the watershed are soybean (43%) and corn (38%), but other harvested crops include winter wheat, grain, and hay. Fertilizers used for such crops typically consist of nitrogen and phosphorus and are considered a potential source of nutrient enrichment in waterbodies.

Water quality impacts may be evaluated in terms of short-term impacts, and long-term impacts. Individual runoff events can cause short-term impacts to receiving waters, and are typically on a timescale of hours to days. Changes to the dry and wet weather hydrology, streambank morphology, and water chemistry of the receiving water are considered long-term impacts. Such long-term chemical impacts are most critical for those waters with longer residence times such as lakes and wetlands, and slow-moving stream segments. With regards to urban development and agriculture, pollutant concentrations are best used to evaluate short-term effects, while pollutant loadings are appropriate for assessing long-term impacts. DuPage River/Salt Creek watershed planners and developers need to understand these impacts and carefully plan in order to mitigate the negative water quality impacts of development and agriculture.

5.4 Watershed Studies and Other Watershed Information

There are a number of groups in the watershed that have collected and developed information and studies that are pertinent to this TMDL. Listed below is some of the information found for this watershed.

- **Chloride Usage Education and Reduction Program Study**

  This study was developed by the DuPage River Salt Creek Workgroup (DRSCW) in response to the Chloride TMDL previously approved. The TMDL identified road salt as a major cause of the chloride impairment. The Study evaluated the current road salting practices and recommends alternatives to reduce chloride. The report is available at the DRSCW website- http://www.drscw.org/reports/ChlorideRecomendations.Final_Report.pdf

- **Stream Dissolved Oxygen Improvement Feasibility Study for Salt Creek and East Branch DuPage River-**

  This study was developed by the DRSCW in response to the dissolved oxygen TMDL previously approved. The goal of the Study was to determine the feasibility and benefits of the removal or modification of dams, and of the construction and operation of in-stream aeration projects on improved dissolved oxygen in Salt Creek and the East Branch of the DuPage River. The first part of this study which characterized the existing conditions is available at this website- http://www.drscw.org/dostudy.htm. The final draft dissolved oxygen feasibility study was completed in June 2009.

- **Bioassessment of West and East Branch DuPage and Salt Creek Watersheds-**

  This study was developed by the DRSCW. Its objectives are to determine the extent to which biological assemblages are impaired and determine the stressors and sources that are associated with those impairments. The first stage of the study was the bioassessment plan which identifies the monitoring procedure and requirements for a watershed based biological assessment of the watersheds. This report is available at the DRSCW website- http://www.drscw.org/reports/bioassessplan.pdf. The final report that includes results of the monitoring is scheduled to be finalized in January 2009.

- **Illinois EPA 319 Funding-**

  Illinois EPA has provided Nonpoint Source Pollution Control Program 319 funding for the DRCSW. Funds were used towards a local project coordinator, the expansion of the dissolved oxygen monitoring and completions of both the bioassessment and dissolved oxygen feasibility studies.

- **Assessment of Impacts of Dams on the DuPage River-**

  This Study was done by the Conservation Foundation and the purpose was to assess the impact of man-made dams on fish passage, recreational uses and water quality. It includes and physical assessment of the dams and characterizes biological data. It indicates that dams on the DuPage River are a significant contributor to the overall degradation of native aquatic species and their habitat. It also indicates the dams might not have a significant effect on water quality, but create a safety hazard for all recreational use. This report is available at the Conservation Foundation website- http://www.theconservationfoundation.org/images/stories/pdf/wp/assessment_of_dupage_river_dams.pdf.

6.0 TMDL Approach and Data Needs

This chapter discusses the methodology that may be used for the development of TMDLs for the DuPage River/Salt Creek watershed. While a detailed watershed modeling approach can be advantageous, a simpler approach is often able to efficiently meet the requirements of a TMDL and yet still support a TMDL-guided and site-specific implementation plan. The final selection of a methodology will be determined with consultation with the Illinois EPA based on following factors:

- Fundamental requirements of a defensible and approvable TMDL
- Data availability
- Fund availability
- Public acceptance
- Complexity of waterbody

A simpler approach shall be used as long as it adequately supports the development of a defensible TMDL. If it is deemed that this approach will not suffice, a more sophisticated modeling approach will be recommended for analysis to help better establish a scientific link between the pollutant sources and the water quality indicators for the attainment of designated uses. Methodology for estimating daily loads will depend on available data as well as the selected analysis.

6.1 Recommended Modeling Approach for Fecal Coliform

Many states currently use load duration curves for fecal coliform TMDLs for its simplicity and effectiveness. Load duration curves use water quality criteria, ambient concentrations, and observed flows to estimate loading capacities for streams under various flow conditions.

The first step in this process is to obtain an appropriate stream flow record. For this TMDL, USGS gages are found throughout the watershed.

Flow duration curves are developed from streamflow records spanning multiple decades. The flow duration curve is based on flow frequency which provides a probability of meeting or exceeding of a given flow. The duration curve is broken into hydrologic categories where high flows represent a duration interval of 0-10%, moist conditions represent 10-40%, mid-range flows 40-60%, dry conditions 60-90% and low flows 90-100%.

Once the flow duration curve is established, a load duration curve can be generated by multiplying streamflow with the numerical water quality standard and a conversion factor to obtain the load per day for a given streamflow. Individual measurements can be plotted against the load duration curve to evaluate patterns of impairment. Values that fall above the load duration line indicate an exceedance of the daily load and hence, water quality standard. These data can aid in determining whether impairment occurs more frequently in one of the hydrologic categories (wet, moist, mid-range, dry or low).

The margin of safety (MOS) for duration curves can be implicit or explicit. Implicit MOS are derived from the inherent assumptions in establishing the water quality target (conservative assumptions). Explicit MOS include setting the water quality target lower than the WQS or not allocating a portion of the allowable load. For the DuPage River/Salt Creek TMDL, an implicit margin of safety is proposed. The load duration analysis performed for this TMDL will be conservative because the TMDL target (no more than 200 cfu/100 ml at any point in time) is more conservative than the more restrictive portion of the fecal coliform water quality standard (geometric mean of 200 cfu/100 ml for all samples collected May through October).

Wasteload allocations (WLA) will be based on NPDES permit limits. Average discharge flow and permit limits will be used to calculate a daily load and serve as the WLA. WLAs for NPDES-permitted stormwater discharges, including current and future Municipal Separate Storm Sewer Systems (MS4s), “Urbanized” areas, construction and industrial discharges and sanitary sewer overflows (SSOs) that do not have numerical effluent limitations will be expressed as a percent reduction instead of a numerical target. The load allocation (LA) for all non-regulated sources, including non-point sources, will also be expressed as a percent reduction. The percent reduction is based on the maximum reduction required to meet WQS plus a margin of safety under critical conditions.

The load reduction for fecal coliform can be established for each flow regime based on load duration curve analysis. Alternatively, a critical condition (worst scenario) can be established by comparing all flow regimes. It is defined as the greatest reduction needed to meet WQS among all hydrologic categories. For example, if an 89% reduction is required to meet the TMDL under wet conditions and a 50% reduction is required under dry conditions, an 89% reduction could be required under all hydrologic conditions to ensure that the TMDL is protective under in all hydrologic conditions. The appropriate method will be selected during Stage 3.

Seasonality of loading will also be evaluated. Flow duration intervals will be plotted by month to determine if there is a strong seasonal component. Although this will not change allocations, this may assist in implementation planning.

6.2 Recommended Modeling Approach for Dissolved Oxygen

QUAL-2K, a spreadsheet model that is based on the fundamental Streeter-Phelps DO sag equation, is recommended for DO TMDL development for impaired waterbodies in the DuPage River/Salt Creek watershed. QUAL-2K is a one-dimensional, steady-state model that can accommodate point and non-point source loading and is capable of modeling DO in streams and well-mixed lakes. QUAL-2K is an updated version of QUAL-2E and has been developed using a Microsoft Excel interface. QUAL-2K allows for model segmentation, the use of two forms of carbonaceous BOD (both slow and rapid oxidizing forms), and is also capable of accommodating anoxia and sediment – water interactions. While the model is simplistic in nature, it is capable of estimating critical BOD concentrations associated with in-stream DO concentrations of 5 mg/L.

6.3 Recommended Modeling Approach for Total Phosphorus

In the event that dam removal is not performed at Churchill Lagoon and the waterbody continues to be subject to WQS, ongoing sampling will provide data to be used for TMDL development. An export coefficient model linked to empirical in-lake response models will be used to determine existing loading and load reductions required to bring Churchill Lagoon into compliance with current WQS. This model, ENSR-LRM (lake response model), was developed by ENSR and has been used on more than 35 lake TMDLs.

ENSR-LRM uses export coefficients for runoff, groundwater and nutrients to estimate loading as a function of land use. Yields will be assigned to each defined parcel (sub-watershed) in the lake watershed. Loading estimates will be adjusted based on proximity to the lake, soils and major Best Management Practices (BMPs) in place. Model yields will be compared to measured data, where available. Export coefficients and attenuation factors will be adjusted such that model loading accurately reflects actual loading based on sample data and measured in-lake concentrations.

Watershed and subwatershed boundaries will be delineated based topography. Watershed land use will be determined using publically available GIS data layers from the Illinois Natural Resource Geospatial Data Clearinghouse, or similar source. ENSR-LRM will be set-up on a sub-watershed level using available land use and average annual precipitation. The spreadsheet-based export coefficient model allows the user to select watershed yield coefficients and attenuation factors from a range appropriate in the region. The model also includes direct inputs for atmospheric deposition, septic systems, point sources, waterfowl and internal loading from lake sediments.

The generated load to the lake is processed through five empirical models: Kirchner & Dillon 1975, Vollenweider 1975, Larsen & Mercier 1976, Jones & Bachmann 1976 and Reckhow 1977. These empirical models predict in-lake phosphorus concentrations based on loading and lake characteristics such as mean water depth, volume, inflow, flushing and settling rates. Predicted in-lake phosphorus is compared to measured data. An acceptable agreement between measured and predicted concentrations indicates loading estimates are appropriate for use in the preparation of a TMDL. Adjustments to the loading portion of the model are made when necessary based on best professional judgment to ensure acceptable agreement between measured and predicted concentrations. These empirical models also predict chlorophyll concentrations and water clarity (Secchi disk transparency). ENSR-LRM also includes a statistical evaluation of algal bloom probability.

Once the model has been calibrated to existing conditions, adjustments to the model can be made to determine predevelopment conditions and the load reductions necessary to meet WQS. In some instances, waterbodies are naturally eutrophic and may not achieve numerical WQS even under predevelopment conditions. In such instances, site specific criteria or maximum practical reductions have been used for TMDL targets and are proposed.

ENSR-LRM is most effective when calibrated with water quality data for the target system, but can be used with limited data. While it is a spreadsheet model with inherent limitations on applied algorithms and resultant reliability of predictions, it provides a rational means to link actual water quality data and empirical models in an approach that addresses the whole watershed and lake. ENSR-LRM is an easy and efficient method of estimating current loads to lakes as well as providing predictions on lake response under countless loading scenarios.

ENSR-LRM, as well as most simplified lake models, predicts phosphorus concentrations and estimates loading on an average annual basis. As required by the EPA, the TMDL must be expressed on a daily basis. However, there is some flexibility in how the daily loads may be expressed (US EPA, 2006). Several of these options are presented in “Options for Expressing Daily Loads in TMDLs” (US EPA, 2007). For TMDLs based on watershed load and in-lake response models providing predictions on an annual basis, the EPA offers a method for calculating the maximum daily limit based on long-term average and variability. This statistical approach is preferred since long periods of continuous simulation data and extensive flow and loading data are not available. The following expression assumes that loading data are log-normal distributed and is based on a long term average load calculated by the empirical model and an estimation of the variability in loading.

$$MDL = LTA * e^{[z\sigma - 0.5\sigma^2]}$$

Where:
MDL = maximum daily limit
LTA = long-term average
Z = z-statistic of the probability of occurrence
$\sigma^2 = \ln(CV^2 + 1)$
CV= coefficient of variation

Data from similar lakes will be used in situations where there are not enough data to determine probability of occurrence or coefficient of variation for the impaired waterbody.

MOS for phosphorus using this method is implicit. There is substantial uncertainty in concentration inputs to the models related to the timing of sampling and analytical methods, and the empirical equations used to predict in-lake phosphorus concentrations, mean and maximum chlorophyll, Secchi disk transparency, and bloom probability also introduce variability into the predictions.

WLA will be determined based on NPDES permit effluent limitations and average flow. WLAs for NPDES-permitted stormwater discharges, “Urbanized” areas, construction and industrial discharges that do not have numerical effluent limitations will be expressed as a percent reduction instead of a numerical target. WLA for MS4s will be based on their urbanized boundaries and at high flow regimes when stormwater events are expected. WLA for SSOs will be zero since these are illicit discharges and not allowed. The SSO issues should be addressed by MS4 program.

The reduction percentage for nonpoint source will be established based on LAs and existing load under critical condition. Critical conditions for lakes typically occur during the summertime, when the potential (both occurrence and frequency) for nuisance algal blooms are greatest. The loading capacity for total phosphorus is set to achieve desired water quality standards during this critical time period and also provide adequate protection for designated uses throughout the year. The target goal is based on average annual values, which is typically higher than summer time values. Therefore a LA based on average concentrations will be sufficiently low to protect designated uses in the critical summer period.

The ENSR-LRM derived TMDL takes into account seasonal variations because the allowable annual load is developed to be protective of the most sensitive (i.e., biologically responsive) time of year (summer), when conditions most favor the growth of algae. Maximum annual loads are calculated based on an overall annual average concentration. Summer epilimnetic concentrations are typically lower than the average annual concentration, so it is assumed that loads calculated in this manner will be protective of designated uses in the summer season, when most critical. It is possible that concentrations of phosphorus will be higher than the annual average during other seasons, most notably in the spring, but higher phosphorus levels at that time does not compromise uses. The proposed TMDL is expected to protect all designated uses of the impaired waterbody.

6.4 Recommended Modeling Approach for pH

QUAL-2K is also capable of estimating in-stream pH. In the modeling framework, both total inorganic carbon and alkalinity are simulated based on inputs. Using these two quantities, the model then simulates in-stream pH. These calculated values will then be the basis for recommending TMDL reductions if necessary.

6.5 Recommended Modeling Approach for Metals

Similar to fecal coliform, load duration curves are recommended for the chloride, silver, and manganese TMDLs. The duration curve will be used to estimate the percent of time that a water quality standard is exceeded. The wasteload allocations will be based on criteria concentrations which will then be converted into a distribution of allowable loads as a function of daily flow.

6.6 Data Needs

Effective TMDL development heavily relies on site-specific data. Sufficient flow and water quality data are required for the evaluation of water conditions and for model calibration. In fact, data availability often dictates the modeling approach used for various watersheds. Five types of data are crucial for the DuPage River/Salt Creek Watershed TMDL development:

- Flow data
- Meteorological data
- Water quality data
- Watershed and waterbody physical parameters
- Source characteristics data

Most necessary data are available for the TMDL with the exception of some water quality data. Available phosphorus data were limited to one year for Churchill Lagoon. Ongoing sampling will help to address the Churchill Lagoon data gaps.

Point source discharge data from all NPDES permittees within the watershed will also be necessary for the Stage 3 analysis. Individual NPDES permits, DMRs, and measured discharge data are all pertinent to TMDL development. Data will be obtained either using EPA's ECHO database or by directly contacting permittees.

Appendix A

Water Quality Data
(CD to be provided in a CD)

Appendix B

Site Photographs

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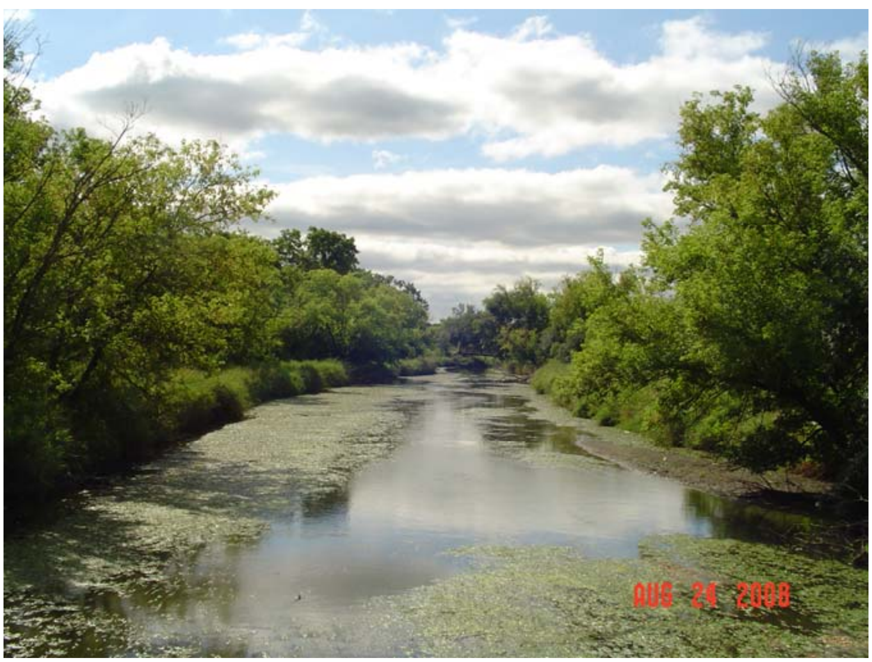
DuPage River (IL_GB-11) at Route 52



West Branch DuPage River (IL_GBK-05) at Geneva Road

West Branch DuPage River (IL_GBK-09) at Route 64

Salt Creek (IL_GL-10) at Route 19

Salt Creek (IL_GL) at Route 58

Churchill Lagoons (IL_RGG)

Appendix C

NPDES Permit Limits
(To be provided in a CD)

Appendix D

Maps of Individual Impaired Waterbody Segments

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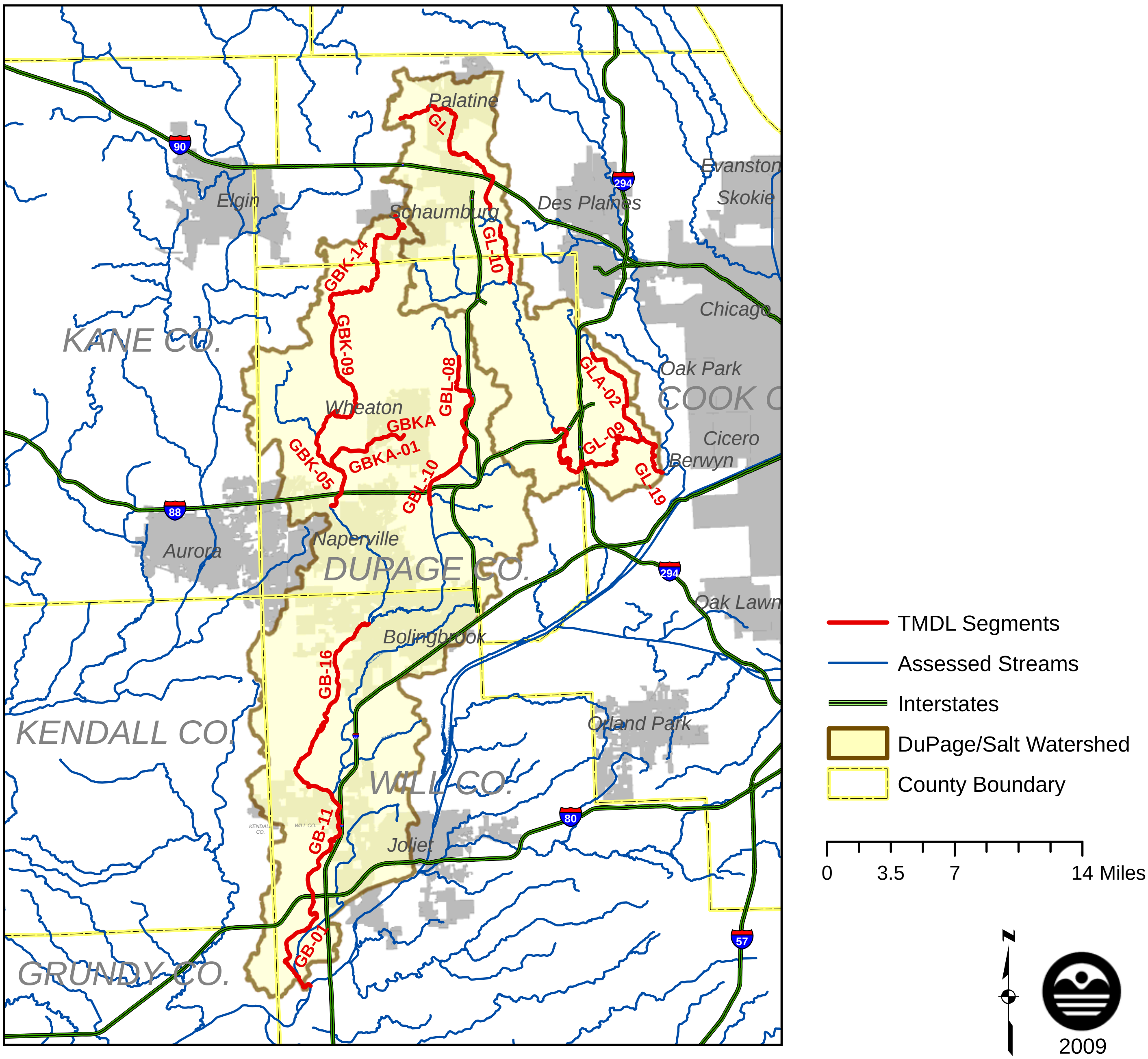
DupPage River and Salt Creek Watersheds

Individual Segment Maps

List of Figures



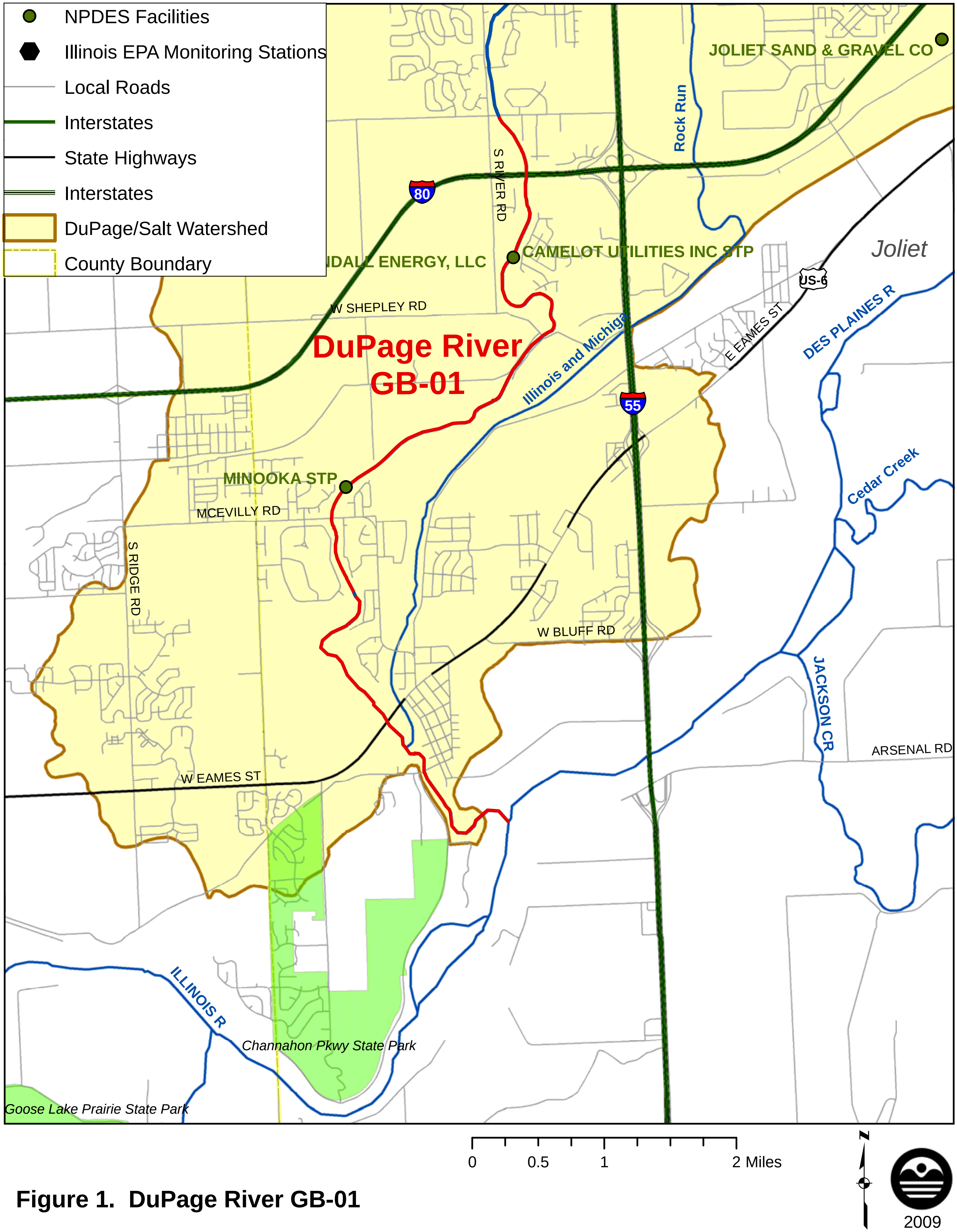


Figure 1. DuPage River GB-01

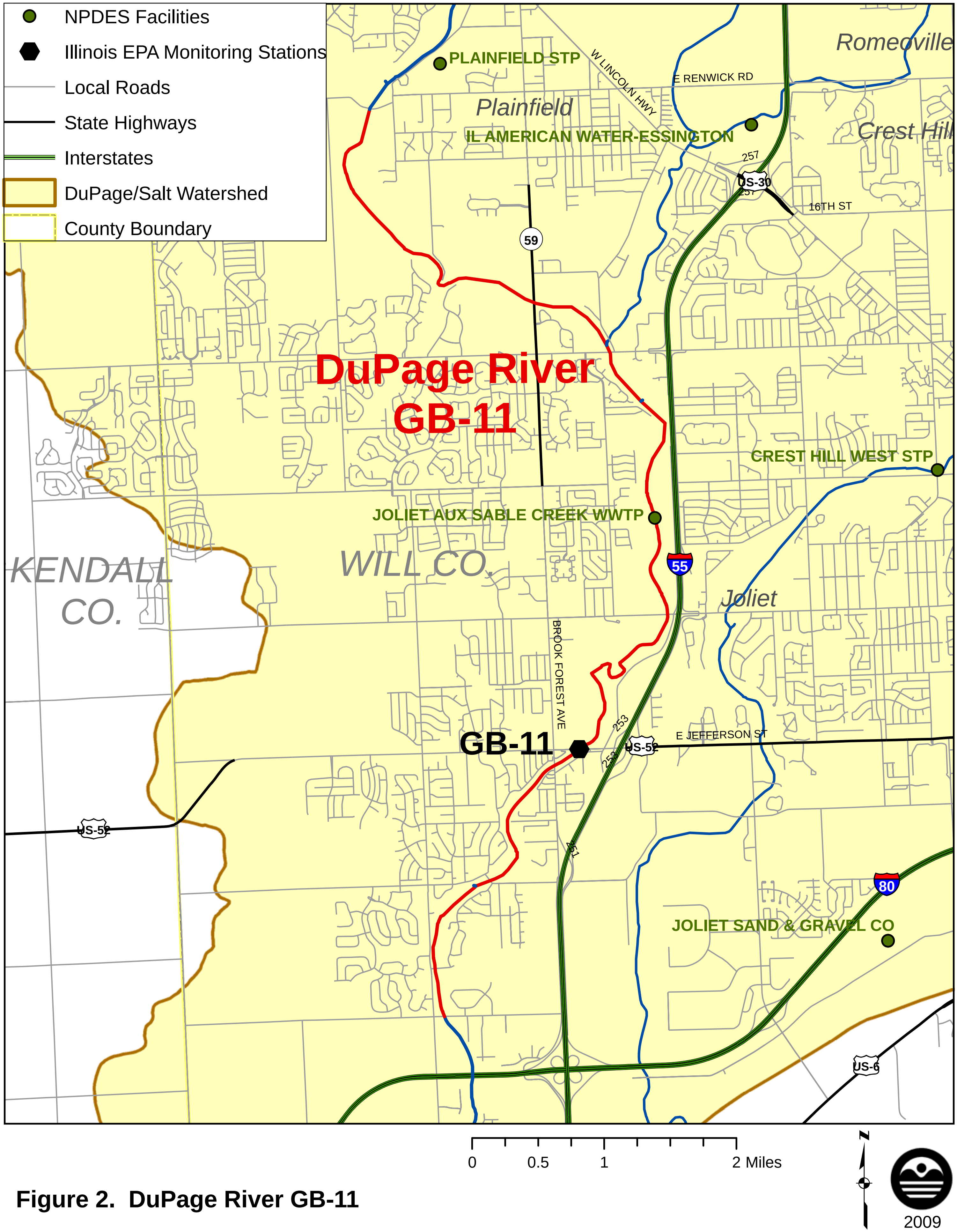


Figure 2. DuPage River GB-11

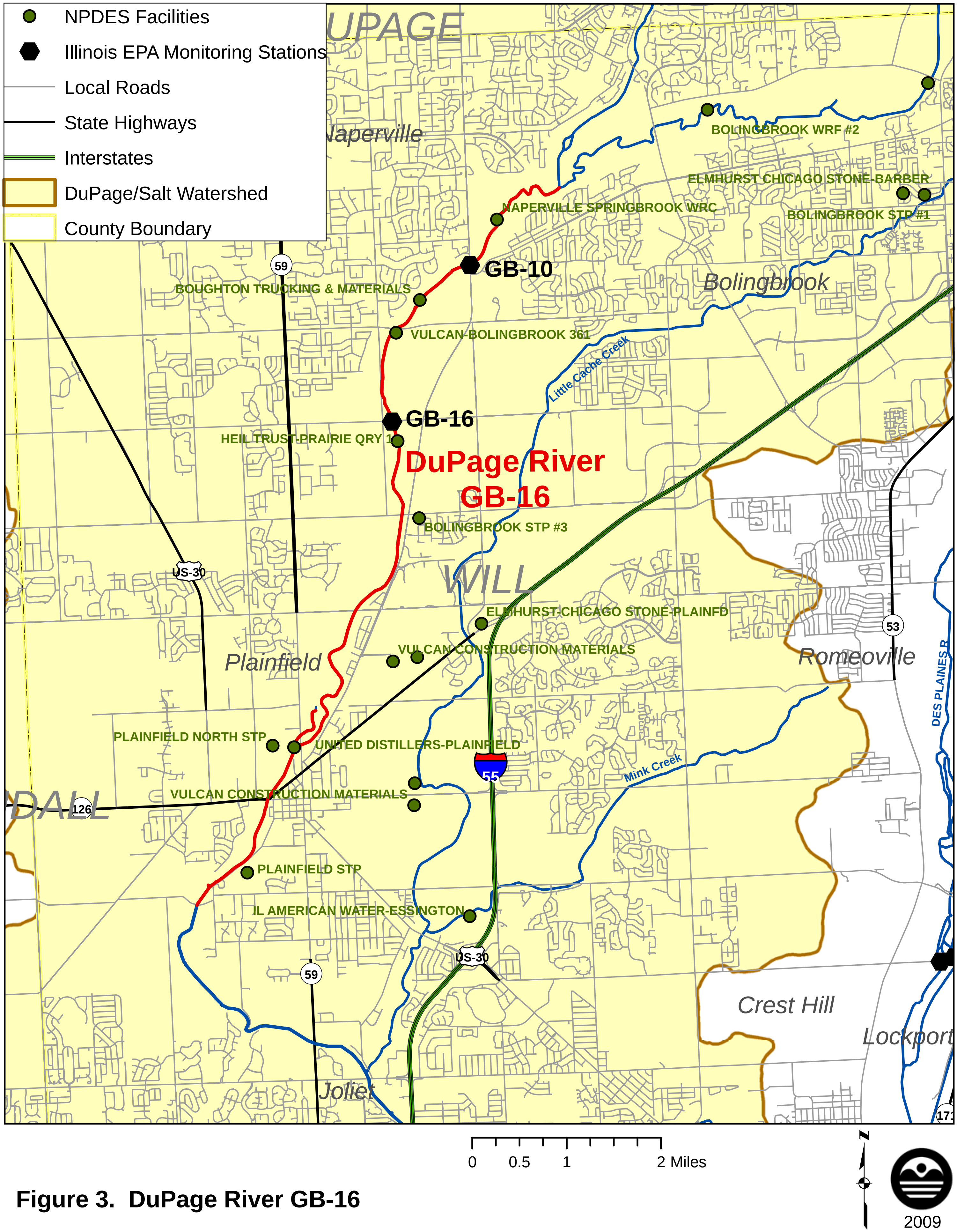


Figure 3. DuPage River GB-16

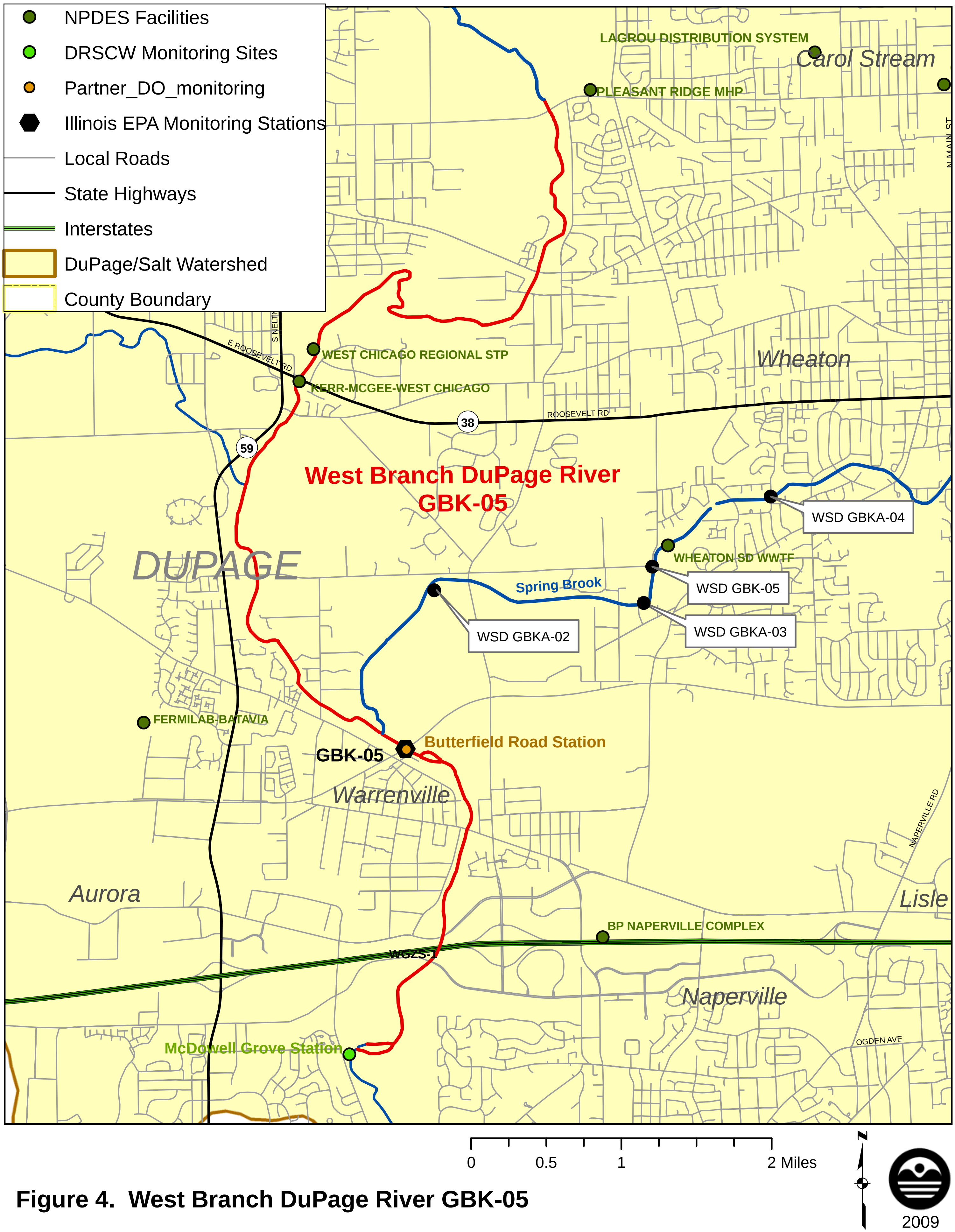


Figure 4. West Branch DuPage River GBK-05

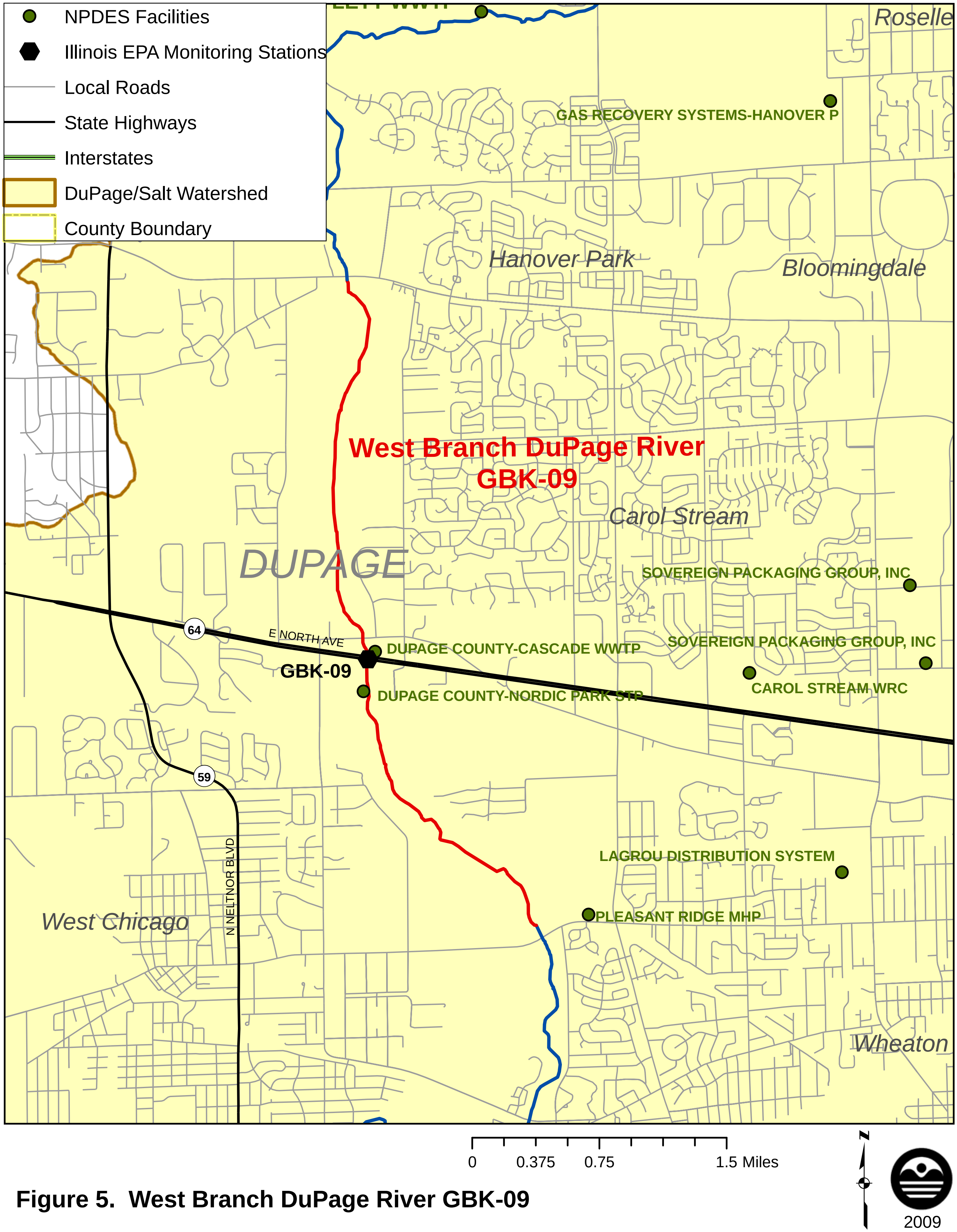


Figure 5. West Branch DuPage River GBK-09

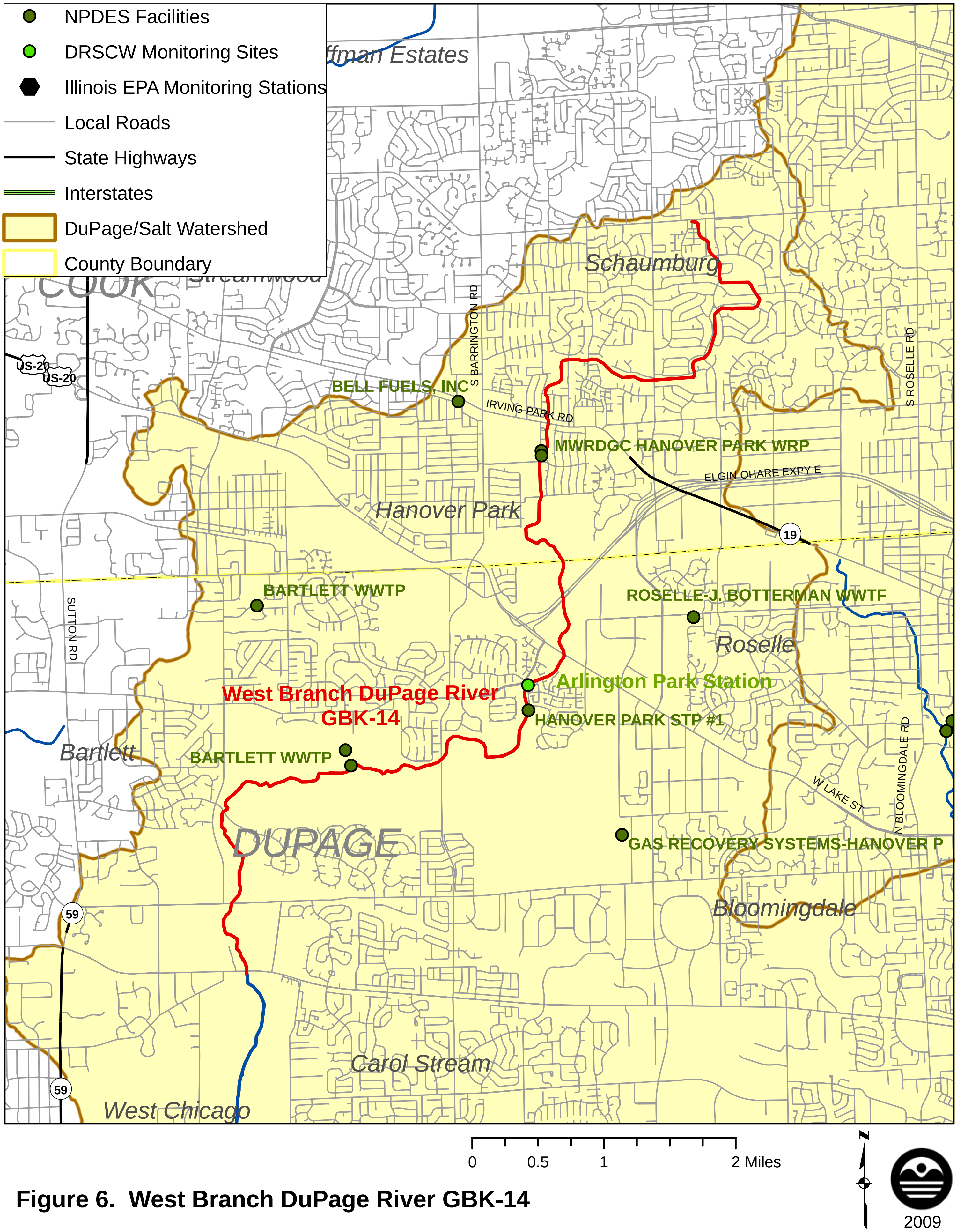


Figure 6. West Branch DuPage River GBK-14

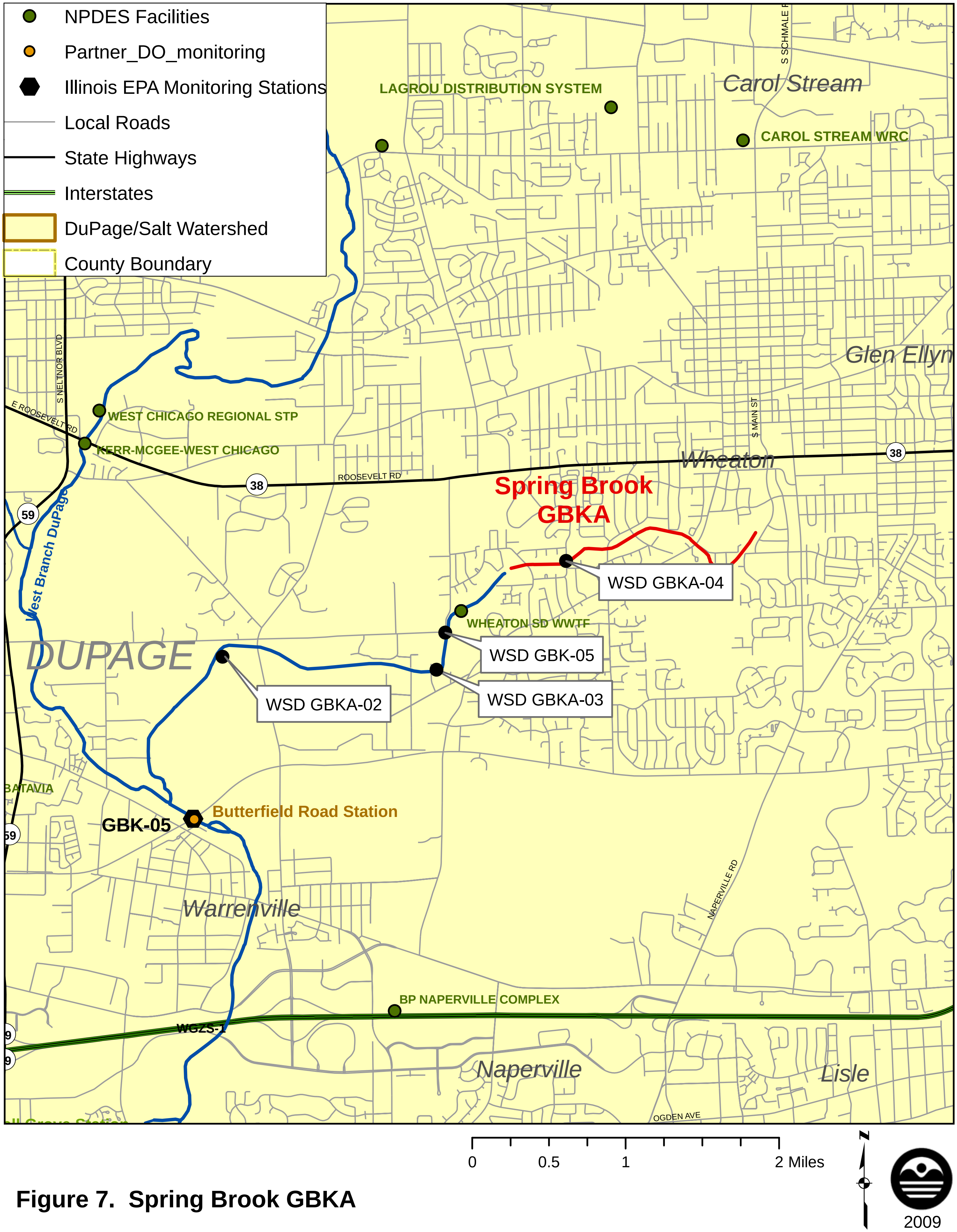


Figure 7. Spring Brook GBKA

Figure 8. Spring Brook GBKA-01

Figure 9. East Branch DuPage River GBL-08

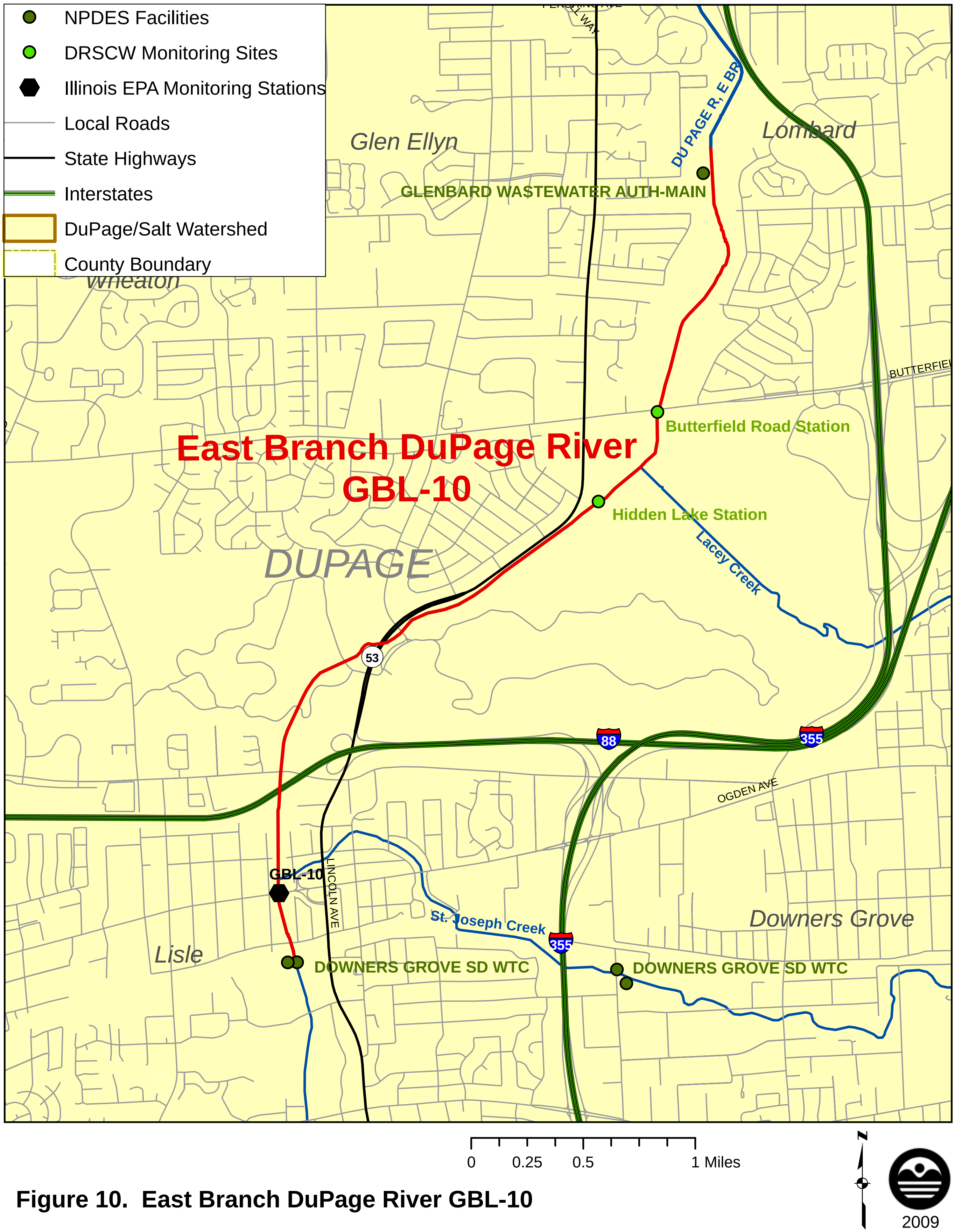


Figure 10. East Branch DuPage River GBL-10

Figure 11. Salt Creek Segment GL

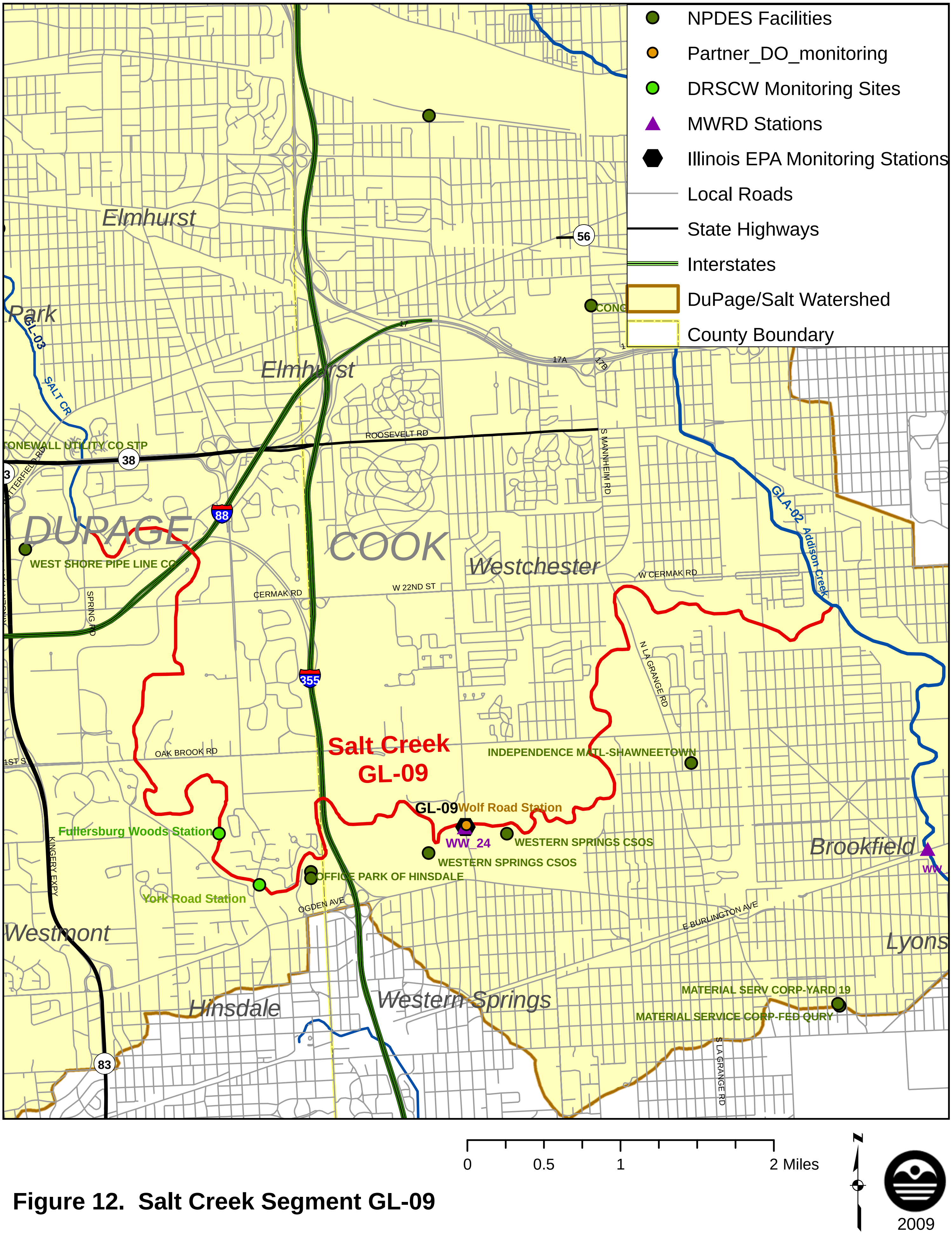


Figure 12. Salt Creek Segment GL-09

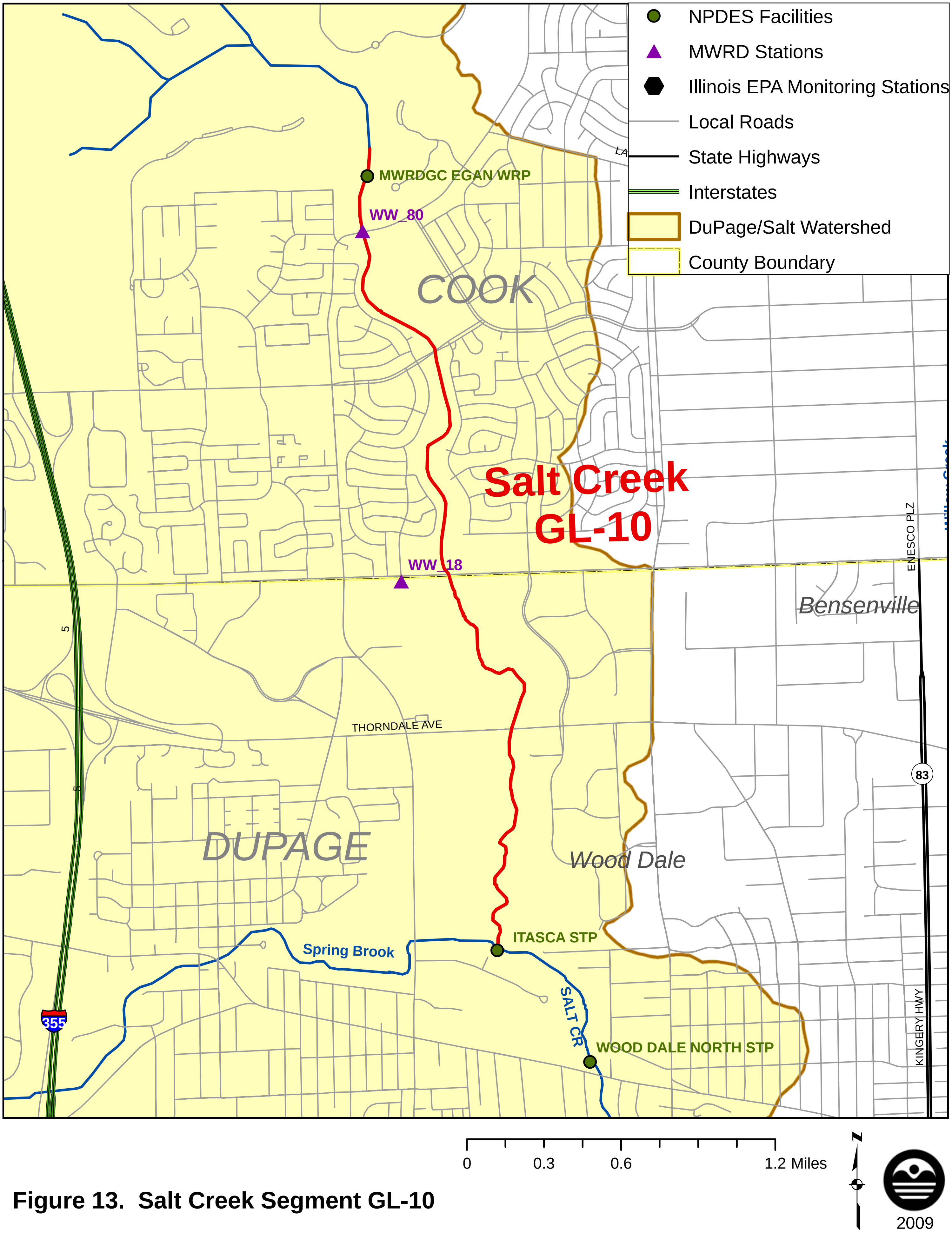


Figure 13. Salt Creek Segment GL-10

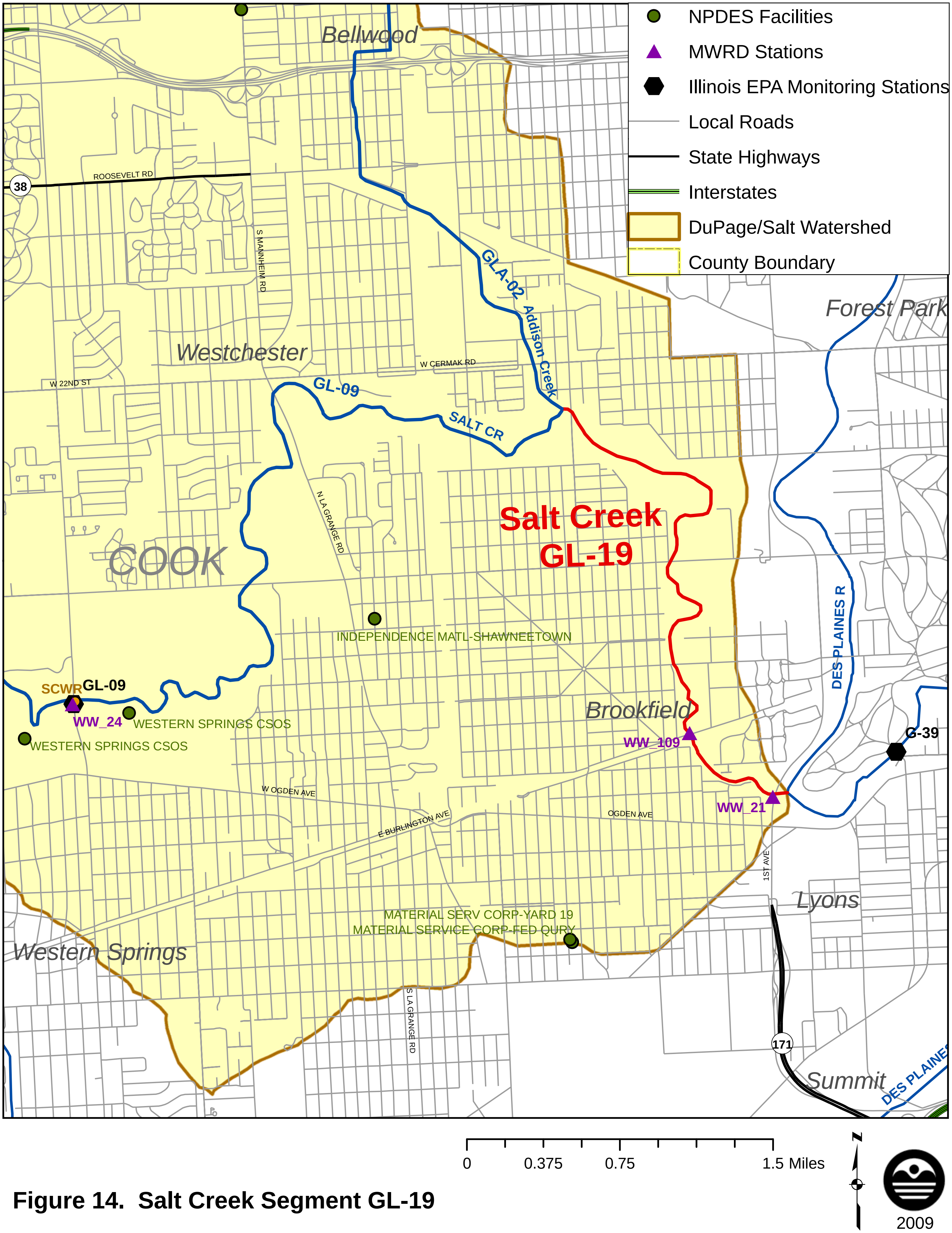


Figure 14. Salt Creek Segment GL-19

Figure 15. Salt Creek Segment GLA-02

Illinois EPA Water Quality Station Locations

STATION CODE	WATERBODY	LOCATION	COUNTY	LATD	LONGD	TOP MAP NAME	MONITORING TYPE
GB-10	DUPAGE RIVER	PLAINFIELD-NAPERVILLE RD	WILL	41.69024	-88.16624	NORMANTOWN	STREAM AMBIENT
GB-11	DUPAGE RIVER	RT 52 SHOREWOOD	WILL	41.52157	-88.19483	PLAINFIELD	STREAM AMBIENT
GB-16	DUPAGE RIVER	119TH, FURGUSON RD, WEST OF NAPERVILLE	WILL	41.666336	-88.182736	NORMANTOWN	STREAM AMBIENT
GBK-05	W BR DUPAGE RIVER	RT 56 BR WARRENVILLE	DUPAGE	41.82539	-88.17936	NAPERVILLE	STREAM AMBIENT
GBK-09	W BR DUPAGE RIVER	ST CHARLES RD N WEST CHICAGO	DUPAGE	41.91105	-88.17906	WEST CHICAGO	STREAM AMBIENT
GBL-10	E BR DUPAGE RIVER	US 34 BR, 0.2 MI W OF SR 53, LISLE	DUPAGE	41.8006	-88.08141	WHEATON	STREAM AMBIENT
GL-09	SALT CREEK	WOLF RD, 0.5 MI N OF OGDEN AVE (SR34), WESTERN SPRINGS	COOK	41.8257	-87.90021	HINSDALE	STREAM AMBIENT
GLA-02	ADDISON CREEK	WASHINGTON BLVD IN BELLWOOD	COOK	41.88185	-87.86896	RIVER FOREST	STREAM AMBIENT

Appendix E

Stage 1 Responsiveness Summary

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Appendix E: Stage One Responsiveness Summary

This responsiveness summary responds to substantive questions and comments received during the public comment period from January 16, 2009 through April 17, 2009 postmarked, including those from the January 28, 2009 public meeting discussed below.

What is a TMDL?

A Total Maximum Daily Load (TMDL) is the sum of the allowable amount of a pollutant that a water body can receive from all contributing sources and still meet water quality standards or designated uses. This TMDL is for the DuPage River/Salt Creek watersheds. In Illinois, developing a TMDL is a three stage process and this is a stage one report which contains the watershed characteristics, impairments and potential sources. After the stage one report, stage two and stage three will proceed. Stage two would include additional monitoring and stage three is the required modeling, allocations and reductions for each TMDL impairment and would also include an implementation plan.

Background

The DuPage River and Salt Creek watersheds drain approximately 332,600 acres and lies mainly in Cook, DuPage and Will counties. Land use in the DuPage River watershed is 65% urban, 21% agriculture and 10% forest while in Salt Creek it is 85% urban and 12% forest. Waters impaired in this watershed are DuPage River, East Branch DuPage, West Branch DuPage, Spring Brook, Salt Creek, Addison Creek and Churchill Lagoon. The DuPage River is listed on the Illinois EPA 2008 Section 303(d) List as being impaired for chloride, fecal coliform, dissolved oxygen and silver. East Branch is impaired for fecal coliform and pH. West Branch is impaired for dissolved oxygen, fecal coliform, silver, manganese and pH. Spring Brook is impaired for dissolved oxygen and fecal coliform. Salt Creek is impaired for fecal coliform and pH. Churchill Lagoon is impaired for phosphorus. The Clean Water Act and USEPA regulations require that states develop TMDLs for waters on the Section 303(d) List. Illinois EPA develops TMDLs allocations for impairments with numeric water quality standards, but some non-numeric standards may be addressed through the implementation plan. Best Management Practices (BMPs) put in place for TMDL impairments may reduce other parameters associated with it.

Public Meetings

A stage one public meeting was held in Elmhurst on January 28, 2009. The Illinois EPA provided public notices for all meetings by placing an ad in the local newspapers in the watershed; the Chicago Daily Herald, The Will-South DuPage Report and the Central Cook Suburban. These notices gave the date, time, location, and purpose of the meetings. It also provided references to obtain additional information about this specific site, the TMDL Program and other related issues. Individuals and organizations were also sent the public notice by first class mail. An additional stakeholder meeting was held March 31, 2009 in Plainfield, IL. The draft TMDL Report was available for review at the Elmhurst City Hall and on the Agency's web page at http://www.epa.state.il.us/water/tmdl .

The first public meeting on January 28, 2009 started at 6:00 p.m. and was attended by approximately 50 people. The second stakeholder meeting on March 31, 2009, started at 10:00 am and was attended by 20 people. The meeting record remained open until midnight, April 17, 2009.

There will be a public meeting for the stage three TMDL report in the future and a responsiveness summary will be developed for this meeting also.

Questions and Comments

1. The stakeholders in the watershed were not given the opportunity to provide input on how the stage 1 report was to be conducted. Many of the same issues discovered in the first TMDLs are also appearing in this report. Why were we not given the opportunity to provide input in the early stages of planning and conducting the report?

   Response
   The Illinois EPA published the Illinois Integrated Water Quality Report and Section 303(d) List- 2006 in June of 2006. This document lists all the waters for TMDL development in the next two years. All of the segments for this TMDL were listed in Table C-29 of the Integrated Report. The Illinois EPA holds the first public meeting at the beginning of the TMDL process- in stage one. The basic watershed information is completed in this stage and presented to the public. This is also the stage we request any other relevant data in the watershed and public input. Illinois EPA also participates in the DuPage River Salt Creek Workgroup and keeps the Workgroup updated on TMDL issues.

2. The water quality standard for fecal coliform is “based on a minimum five samples taken over a 30 day period”. However, Illinois EPA does not have the appropriate number of samples and therefore has elected to use an alternative water quality standard. Illinois EPA should obtain the necessary data to use the more preferred standard for assessment purposes.

   Response
   Illinois EPA does sample at the frequency required by one part of the standard. Stations that are assessed for primary contact in this watershed are sampled approximately monthly. If available, five years of data are used for the primary contact assessments. For this TMDL, most of the assessments were based on data that were received from outside sources. From those stations sampled by outside sources, Illinois EPA will accept sampling at the correct frequency when the standard is applied- May through October. If their data become available this year, they will be used for the TMDL. The DRSC Workgroup is developing a sampling plan for this watershed as part of the implementation process.

3. The report does not state how the effect of animals on fecal coliform will be addressed. Illinois EPA stated in the public meeting that they would try to use some data that have been gathered in other states but the data may not be comparable to this watershed and therefore assumptions may have to be made. This will greatly decrease the reliability of the modeling and ultimately the wasteload allocations and TMDL. Therefore, it is imperative that Illinois EPA obtain the appropriate data and perform the necessary studies to properly account for the effect of wildlife on fecal coliform.

   Response
   Illinois EPA will be addressing the bacteria impairments using the load duration curve analysis. Bacteria data and flow data are the basis of this analysis. Loads are ranked per flow and one can which flow periods in which there are exceedences of fecal coliform bacteria. By using this approach, sources can be tracked by the flow period. For example, if point sources are causing the majority of the problem, exceedences will be seen even in low flow periods when there is no precipitation causing runoff. If the main problem is runoff related, exceedences will be seen in high and medium flow periods only. The analysis also shows the exceedences that are due to storm flows. Exceedences due to wildlife would be expected in high to high-medium flows. Illinois EPA is not aware of any livestock facilities in this watershed and does not have adequate estimates of wildlife populations in this area. If anyone is aware of these data, Illinois EPA would like to obtain this information.

4. Through studies performed by DRSCW, it has been clearly shown that sediment oxygen demand (SOD) has a profound effect on the QUAL-2K model for DO. This model is very sensitive to SOD and therefore SOD monitoring data are critical when modeling for DO. Illinois EPA must obtain the required SOD data in order to properly perform water quality modeling for DO.

   Response
   In response to suggestions made at the Stage One Public Meeting, Illinois EPA will be obtaining SOD samples from the West Branch DuPage River.

5. Illinois EPA is going to use monthly monitoring reports from publicly owned treatment works (POTWs) to provide data for the QUAL-2K model when studying the DO parameter. However, Illinois EPA should use actual data that are readily available.

   Response
   Illinois EPA typically uses the designed average flow (DAF) for NPDES facilities discharging in the watershed. It was brought to our attention at the meeting that this may over-estimate loads from these sources and flow data obtained from the individual facilities would best represent loads in the model. NPDES facilities are not required to give Illinois EPA this flow information, but Illinois EPA will work with facilities to obtain it.

6. The Report does not state how it will address wet weather flow. Illinois EPA should obtain the necessary wet weather data to determine how they are going to address wet weather flows.

   Response
   See response to question 4 for information on how the load duration curves determine wet weather exceedance events. See response to question 4 for information on how the load duration curves determine wet weather exceedance events. The QUAL-2K model assumes steady and non-uniform flow, which means that flow doesn't change over time. However, the QUAL-2K can be run under various flow conditions, for example, dry and wet condition, provided that the pollutant loads are available for these flow conditions. The representative wet weather flows can be used in QUAL-2K to evaluate how a waterbody responds to pollutant loads induced by stormwater runoff.

7. There was very limited data for manganese, with only two violations out of forty-five observations. One violation was extremely high indicating a possible faulty test. What efforts were taken after the sample was analyzed to ensure accuracy and reliability of the results? Are forty-five observations enough to be statistically significant?

   Response
   Illinois EPA did look at the manganese data for West Branch DuPage River (segment GBK-14) and found the extremely high data sample was magnesium which was then deleted from the dataset. There is still one exceedance of manganese which violates the water quality standard and requires a TMDL. According to the water quality standard for manganese, it is a toxic pollutant and one exceedance will result in a listing of impairment for a waterbody (refer to Table C-3 in the 2008 Integrated Report).

8. The DRSCW has monitored chlorides last year and these data shows more violations then Illinois EPA's data. Illinois EPA should include the chloride data in their assessment and in future modeling.

   Response
   Illinois EPA has received these data and will be using it as it applies to stream assessments and in the TMDL model.

9. The report does not state how it will account for naturally occurring phosphorus in the modeling. Illinois EPA should obtain the appropriate local data and perform the necessary studies that properly account for phosphorus as it naturally occurs in this watershed rather than basing it on non-comparable studies and assumptions.

   Response
   The only waterbody that we are doing a phosphorus TMDL on is Churchill Lagoon. Illinois EPA gives TMDL allocations to parameters with numeric water quality standards. Phosphorus as it applies to all lakes has a standard of 0.05 mg/L and takes into account background concentrations. As it turns out, there is a possibility that the dam might be removed for this waterbody. Therefore, the standard would not apply to this water and a TMDL would not be applied since no phosphorus standard has been adopted for streams. We will have more information in stage three of the TMDL process.

10. Instituting TMDLs, if done properly, should improve the water chemistry of our streams. However, they will do very little in improving the aquatic and wildlife habitat without making other improvements like streambank restorations, dam removals, wetland or riparian creation, etc. Instituting TMDLs will shift limited municipal resources towards compliance in meeting TMDL requirements, away from stream corridor improvements. This will have a substantial impact in our ability to make meaningful improvements to our lakes and streams.

    Response
    The outcome of TMDLs is allocations and can result in reductions from point sources and nonpoint sources. Through the NPDES permit program, the TMDL can reduce limits on point sources, but Illinois EPA does not have regulatory authority to make an entity or person apply nonpoint source Best Management Practices (BMPs) on their land. The TMDL recommends BMPs that can be established in the watershed to reduce pollutant loads and we recommend stakeholders begin watershed planning to see where it is feasible for BMPs to be installed. There are some watersheds that already have stakeholder groups formed (e.g., DRSCW) and are ready for planning to begin and there are other watersheds that use the TMDL to begin the process of planning. One tool the agency has is the 319 Nonpoint Source Program in which groups can get funding for watershed planning. There will be more information in the stage 3 implementation plan.

11. Page ES-1 reads, "Waterbodies included on the 303(d) list require Total Maximum Daily Load (TMDL) development." This statement is not entirely true. For example, an impaired water could be deemed to be impaired as the result of a natural cause, such as being classified into Category 4C.

    Response
    The 303(d) List is considered Category 5 in the Integrated Report. All Category 5 impairments require a TMDL. 4c is separate category and a TMDL will not be developed for these.

12. Should TSS and Sedimentation/siltation be included in Table 1-4, as no water quality standard criteria exist for those parameters?

    Response
    Yes, these parameters had TMDLs developed previously. The Agency no longer develops TMDLs for any parameter lacking a numeric standard. The Agency believes parameters with numeric standards have been through a rigorous approval process and wasteload allocations can apply.

13. While DuPage County recognizes the limited data complications present during this TMDL development process and how these pose difficulties in determining the geometric mean, the County has strong objection to changing the single sample maximum criterion (SSM) from 400 colony forming units (cfu) to 200 cfu. Making such a change would alter the risk level from 0.8% to approximately 0.55%. While

the proposed SSM criterion change is stated to be an implicit margin of safety (MOS), the change goes far beyond the MOS and completely changes the bacteria criterion against which the bacteria data are being assessed. A more appropriate reference to the implicit MOS would be to simply reference the load duration analysis itself, particularly that the percent reduction will be required from the greatest difference between recorded bacteria data and bacteria loads, calculated from flow data. The model should also provide calculated post-reduction daily bacteria levels, which would allow one to verify if the GM, theoretically, is being met.

Response
Illinois EPA is not changing the assessment methodology for fecal coliform. It is still assessed using the geometric mean of 200 cfu/100ml and a single sample maximum of 400 cfu/100ml. The allocations for NPDES wasteloads will be based on the permit limit of 400 cfu/100ml. If the facility is meeting their permit limit, no change will be required. We are required by USEPA to use the 200 cfu/100 ml for fecal coliform as the target load for the stream water quality. The post reduction bacteria levels are required to be under this target.

14. It is not clear to DuPage County why IEPA is pursuing a TMDL that includes the chloride, manganese, and silver parameters. Table C-3 in the IL 2008 Integrated Assessment (page 59) states that for toxic parameters, including these three, the "most recent consecutive three years of data are used." Looking at the data for the chloride and silver parameters, it is obvious that there are ten or more observations for each of the two parameters. Therefore, again referencing Table C-3, even a moderate impairment would require that two or more observations in the most recent consecutive three years of data exceed the applicable acute toxicity standard. Based on these data which indicate only one excursion in the applicable time period, the assessment units should not be impaired for chloride and silver and these parameters should not be included in the TMDL report.

    Response
    Chloride, manganese and silver are all three toxic parameters and one exceedance of the water quality standard indicates moderate impairment (refer to Table C-3 in the 2008 Integrated Report).

15. There are concerns over the way in which IEPA prioritizes its watersheds for TMDL development. While it is certainly important for public water supply areas to be addressed initially, the fact that IEPA bases prioritization on a sum of the total impairments with numerical criteria is questionable. More attention should be given to the available data (focusing on both quality and quantity of the data) and localized groups in the watershed seeking to enact the implementation plan included in a developed TMDL report rather than simply seeking to produce a report that includes all impairments for all assessment units within a single watershed. Again, single parameter TMDL reports should be considered if the existing data at the time of development are only sufficient enough for that particular parameter. Such a limitation allows for more focused analysis and implementation on that particular parameter for which a reliable TMDL report has been developed.

    Response
    As part of our prioritization effort, we are required to rank impaired waters by the severity of pollution. Severity of pollution is determined by summing the impairments in the waterbodies. The watersheds with more impairment were identified and listed with higher priority than those listed with fewer causes of impairment. Illinois EPA, along with many other states and following the recommendations of USEPA, develops TMDLs on a watershed basis. Implementation can take place on a single water segment or on a larger scale. Those decisions would be made by local stakeholders.

16. It does not seem logical that waste load allocations are going to be assigned for the phosphorus impairment at Churchill Lagoon. There are active plans to restore the lagoon into a free flowing stream, meaning that the phosphorus standard will no longer be applicable at this site. DuPage County

recommends that IEPA pursue moving that assessment unit into category 4B next assessment cycle, as measures taken will allow the waterway to meet applicable water quality standards within a reasonable period of time without the need for a TMDL report.

Response
As stated in the response to comment 9, if the lake standard for phosphorus will no longer be applicable to the waterbody, the TMDL will not proceed. The water will be assessed using the stream methodology.

17. Page 6-2 reads, "Stormwater dischargers are required to meet the percentage reduction or the existing in-stream standard for the pollutant of concern, whichever is less restrictive." Where is this requirement stated? References attached to statements such as this one would be appreciated.

    Response
    The statement is removed to the report since it is not applicable to the State of Illinois.

18. Page 1-8, Table 1-2. "Potential source(s)" of fecal coliform should include waterfowl. These animals have been shown to be significant sources of FC in lakes and streams (see *Characterization of E.coli Levels at 63rd Street Beach*, R. L. Whitman, et al, USGS, 2001 and *Effect of Waterfowl on Indicator Bacteria Populations in a Recreational Lake in Madison*, WI, J.H. Standridge, et al., Applied and Environmental Microbiology, September 1979). This is especially important in reach GBK-14 which has nearly stagnant flow during dry weather periods and is frequented by Canada Geese and other waterfowl. DNA fingerprinting of FC should be conducted in FC impaired reaches to determine if the impairment is from a human source, and if not, the impairment should be attributed to background conditions. If conducted following the TMDL, bacteria source tracking should precede any actions required to meet a wasteload allocation (WLA).

    Response
    Bacteria source tracking uses genetic and/or phenotypic test to identify bacteria strains that are host specific so that the host animal and source of the fecal contamination can be identified. The disadvantage is that a reference library of genetic or phenotypic fingerprints for bacteria isolated from known sources (sewage, livestock and wildlife) is needed to identify the sources. This is a very time consuming and expensive component of the study. Without a large reference library the tracking is very unreliable. Illinois EPA will not include source tracking in the TMDL process, but local stakeholders could use this as part of their watershed plans and/or implementation process.

19. Do all monitoring entities collecting data in the DuPage River/Salt Creek watershed have Quality Assurance Project Plans (QAPPs) and Standard Operating Procedures (SOPs) for their monitoring programs?

    Response
    Yes, data from DRSCW, Lake County Health Department, MWRGDC, Sierra Club, and Wheaton Sanitary District have QAPPs and SOPs. Data from these entities are used for water quality assessments and therefore require both.

20. What is meant by the phrase "….compliance was measured at the surface of the stream….?" Were all water quality constituents, including dissolved oxygen, measured at the surface? At what depth were the samples collected?

Response
Dissolved oxygen is measured at one foot below the surface of the water using a sonde unit probe. Water is collected for other parameters using a grab sample that is collected uniformly from the bottom to the top of the water.

21. Monitoring stations WW_109 and WW_21 in segment GL-19 are listed incorrectly on the map. The District does not have an ambient monitoring location identified as WW_21. Monitoring station WW_21 should be identified as WW_24 and is located at the point on the map where WW_109 is indicated. Monitoring station WW_24 is located where WW_21 is indicated.

Response
Illinois EPA used latitude and longitude information from the MWRDGC website. If these are incorrect, new location information needs to be obtained. Illinois EPA received data from MWRDGC with monitoring data for station WW_21 (Salt Creek at First Avenue) from January 2001 until April 2002. WW-24 (Salt Creek at Wolf Road) has data from January 2001 until May 2007. WW_109 (Salt at Brookfield Road) has data from July 2002 until May 2007.

22. TMDL segments need to be better defined. It is practically impossible to determine from the maps where the segments begin and end. Segments should be defined by geographical features or, preferably, latitude and longitude coordinates.

Response
Illinois EPA will be more specific in the final stage 1 draft report. Individual maps of each impaired segment will be included along with a table that includes latitude and longitude coordinates for each monitoring station.

23. Despite the fact that the Illinois EPA identified the West Branch DuPage River as impaired due to zinc concentrations, no TMDL will be developed for this pollutant. The text of the report does not discuss the issue of zinc impairment of the West Branch DuPage River. This issue is only addressed as a footnote to Table 1-1. Based upon the identification of zinc impairment, the Illinois EPA has begun to place zinc limits in NPDES permits for municipal plants discharging to this river including the Village of Hanover Park Sewage Treatment Plant. Without conducting the formal TMDL process for zinc, there can be no assurance that the Illinois EPA's strategy will eliminate zinc impairment of the West Branch DuPage River. After extensive sampling and investigation of zinc concentrations within the Hanover Park sewer service area, it has been determined that the domestic concentrations of zinc are nearly the same as the industrial discharge concentrations. The domestic sewage accounts for roughly 80% of the WWTP flow while industry discharge only accounts for 20%. Even if industry is limited to zero discharge of zinc, the effluent would not meet the monthly zinc effluent limit of 0.046 mg/L. The technology to remove zinc and the cost associated with such an upgrade are significant. There is a concern that scarce tax dollars will be spent on point source control of zinc without solving the impairment.

Response
Domestic and industrial discharges are both considered point sources. The NPDES program has been established for control of point source discharges. This program is relied upon for reductions if there are impairments only due to point sources.

24. There is a single exceedance of manganese for segment GBK-14. That exceedance occurs during a period of relatively high sampling (4 year period accounting for perhaps 30 of the sample points). It would be of interest to know what the flow rates were when the outlier was sampled and see what proportion of the samples were collected under similar flow regimes. With one exceedance, the parameter does not meet the guideline for an impairment set out in the 2008 Integrated Assessment Report. In addition, it is our information that the standard for manganese is being revised for the State of

Illinois. In our assessment with the new standard, there is no exceedance. The TMDL for this parameter should be suspended.

Response
According to our assessment methodology (2008 Integrated Report on page 59, Table C-3) for aquatic life designated use, a single exceedance violates the chronic toxic standard for manganese. Once this standard is violated, the water body is impaired. Illinois EPA is in the process of developing new manganese standards, but this is in the initial stages. The Illinois Pollution Control Board must review and approve any changes to water quality standards before they can be utilized in Illinois EPA water quality assessments. In regards to flow analysis, as part of the stage 3 development a load duration curve will be utilized and this takes into account flow at the time each sample was taken. This can determine the flow regime in which violations take place and sources that attribute at that flow regime.

25. The two exceedences for chloride do not meet the standards set out in the 2008 Integrated Report for an impairment. However, there is DRSCW data that shows multiple exceedences for multiple sites and violations were correlated to storms. In addition, the Bioassessment plan found TDS higher than 1000 mg/L in several tributaries during summer months; chloride is most likely the bulk of these dissolved ions. We are satisfied that chloride levels are exceeded across the program area during winter months but also in a more limited area, warm weather periods, and that the principle source is winter de-icing compounds. Since you had poor data and there are de-icing operation already underway in the upper DuPage and Salt, a TMDL should not be completed for chloride. It is unlikely that such a development will contain more detailed analysis or recommendations than the 2007 DRSCW Chloride Usage Education and Reduction Study which was a completed due to the chloride TMDL allocations on the West and East Branches of DuPage.

    Response
    Please refer to the response for comment 14. Chloride is also a toxic chemical and falls under the same assessment as manganese. As required by the Clean Water Act, Illinois EPA will develop a TMDL. As with manganese, load duration curves will be utilized for chloride. Illinois EPA will have information in the implementation plan on the de-icing program/ chloride reduction study.

26. The silver data presented do not meet the standard set out in the Integrated Report. The Bioassessment study looked at 19 sites of the West Branch DuPage and all sites exceeded threshold levels, but did not exceed the probably effects levels as did PCBs found in sediment. Silver may be a problem, but not a priority at this time.

    Response
    Please refer to the response for comment 14. Silver is also a toxic chemical and falls under the same assessment protocol as manganese. Illinois EPA will not be developing a TMDL for PCBs in sediment as there are no standards for this parameter in sediment.

27. While agriculture may be an important source of nutrient loading, in terms of the Upper DuPage and Salt Creek the small proportion of the area with agriculture use means its effect should not be exaggerated. A more important source of nutrient loading is residential landscaping areas that are the dominant land use management practice in the areas and may produce up to 41% of the NPS phosphorus loadings in tributary watersheds (loadings in tributary watersheds Upper DuPage River Watershed Plan Update). This land use is ignored in chapter 5.3.

    Response
    While the Salt Creek watershed has only twelve percent agriculture land use, the DuPage River as over twenty percent. Residential areas are not ignored in the analysis. Urban Low/Medium Density which

represents residential areas comprise 30 percent in the DuPage River watershed and almost 47 percent in Salt Creek watershed.

28. Non-point source impairments are strong concerns for the ultimate health of the watershed. Wastewater plants in the region have already reached the point of cost effective treatment for these parameters. Significant investment in wastewater treatment will produce minimal benefit to the watershed. If additional improvements are required at wastewater plants, their carbon footprints are likely to increase thereby adversely affecting the quality of air in the region. We would highly encourage focusing on non-point sources.

    Response
    The TMDL will focus on all sources of pollutants and Illinois EPA is required to have allocations for both point and non-point sources in the watershed.

29. There has been substantial modification of the cross section of the West Branch of the DuPage River over the last few years, and additional modifications are anticipated over the next two or three years. During construction, the entire river flow is pumped around the construction site. It is well documented that when the water is inside pipes, organics remove DO from the water. This means that lower than normal DO levels should be occurring in the River whenever bypass pumping is being conducted on the River. In addition, a multi-year thorium removal project is expected to require two or three more years to complete. As a result, DO sampling of the river during this period will not be representative of the River's natural DO level after the work has been completed. IN addition, the dam in McDowell Woods Forest Preserve was removed in fall of 2008, and the dam in Warrenville is scheduled for removal in 2009. Removal of the dams is expected to increase DO levels in the previously impounded sections as well as downstream.

    Response:
    Regular monitoring of these waterways will continue and this includes DO. Assessment of the results should help focus the need and nature of any BMPs needed.

30. Based on a recent study on Salt Creek, significant phosphorus reductions in the Egan Plant's effluent did not have a measurable impact on either the algae biomass or DO. Egan supplies approximately 50% of the effluent received by Salt Creek. Studies have found a very strong correlation between habitat and diversity in fish and macro-invertebrate populations, suggesting that, at this time, habitat is the primary limiter in our streams and rivers. Therefore, we believe that a focus on habitat, rather than phosphorus removal, would be the most cost effective approach for improving aquatic life in local waterways.

    Response:
    As we are only in the water characterization stage, Illinois EPA has not done a source analysis. The stage 3 modeling will look at the permitted facilities and see if reductions need to be made by nonpoint and/or point sources. The TMDL Implementation Plan will be utilizing the biological study that was developed for this watershed and habitat improvement BMPs (best management practices) will be discussed.

31. Copper was identified as a municipal point source impairment for Spring Brook. We must ask that this be removed. Effluent sampling from the municipal point source that discharges to it does not show impairment. Please note that the January 4, 2006 data point was off by a factor of 10. That datum should have been recorded as 0.011 mg/L instead of 0.11 mg/L.

    Response:
    The municipal point source provided data for this assessment and the correction was made for the sampling data for January 4, 2006. According to these data, there was a sample from July 6, 2005 that

exceeded the chronic standard of 0.020 mg/L. According to our copper standard, this exceedance indicates moderate impairment in the stream.

32. Does the regular dissolved oxygen standard apply to all waters or does the enhanced protection standard apply to some of the waters in this watershed?

Response:
Language has been added to the report on waters with enhanced dissolved oxygen protection. Basically DuPage River segments GB-11, GB-16 and West Branch DuPage River segment GBK-02 are waters with enhanced protection for dissolved oxygen. These waters were assessed using the more stringent enhanced protection standard. Segment GB-16 is the only segment that is impaired for dissolved oxygen according to the enhanced protection standard.

Appendix B

Stage 2 Report

West Branch and Mainstem DuPage River Stage 2 TMDL—Sediment Oxygen Demand Monitoring, December 2009

CDM

Illinois Environmental
Protection Agency

West Branch and Mainstem DuPage River Stage 2 TMDL – Sediment Oxygen Demand Monitoring

December 2009

Final Report

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Contents

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Figures

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Tables

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Section 1
Introduction

The Illinois Environmental Protection Agency (Illinois EPA) has a three-stage approach to total maximum daily load (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 data collection associated with Stage 2 TMDL development for the Salt Creek/DuPage River watershed. Stage 1 has been completed by ENSR and is available for review at: http://www.epa.state.il.us/water/tmdl/report-status.html.

Sediment oxygen demand (SOD) monitoring was completed based on the recommendations presented in Section 6 of the Stage 1 TMDL report. The Stage 2 data will supplement existing data collected and assessed as part of Stage 1 of TMDL development and will support the development of TMDLs under Stage 3 of the process. SOD monitoring was recommended to lend confidence to dissolved oxygen modeling.

The remaining sections of this report contain:

- **Section 2 Field Activities** includes information on sampling locations as well as methodology and field measurements
- **Section 3 Data Analysis and Results** presents the collected data and formulas used to determine SOD rates

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Section 2
Field Activities

2.1 Sampling Locations

The West Branch DuPage River and mainstem DuPage River were sampled by CDM during the fall of 2009 to collect data needed to support water quality modeling and TMDL development. Five sites (see Figure 2-1) were selected based on model reaches identified by ENSR during Stage 1 of TMDL development along with stakeholder input, accessibility, and streambed composition. The West Branch DuPage River sites were monitored in late August and the mainstem site was monitored in late September. Table 2-1 contains site location information and data collection dates. Sampling was conducted in accordance with the QAPP by CDM personnel at each of the below locations. The mainstem monitoring at Naperville was postponed until September 27 due to elevated stream flows and access issues the week of August 25. Photographs from each site are available at the end of this section.

Table 2-1: Stage 2 Data Collection Sites and Field Dates

Monitoring Location	Monitoring Date (2009)	Stream Location
Hanover Park	8/25	Approximately 50 feet upstream of WWTP discharge
West Chicago	8/25	100 yards upstream of WWTP discharge
McDowell Forest Preserve	8/26	200 feet upstream of dam
Knoch Knolls Park	8/26	300 yards downstream of parking lot
Naperville	9/27	100 yards upstream of WWTP discharge

2.2 Methodology

SOD testing was performed during periods of low-flow at five wadeable sites on the West Branch and mainstem DuPage River. Prior to sampling, three SOD chambers were constructed by CDM for use in the field. CDM designed and built the chambers using the Murphy and Hicks (1986) reference as guidance. Figure 2-2 shows the Murphy and Hicks chamber diagram used for design purposes and a graphic representation of CDM's constructed chambers. Figure 2-3 shows a photograph of the actual chambers deployed for this sampling event. The SOD chambers were constructed out of heavy plastic 55-gallon drums that were sized down and left with a cutting edge for the live chambers and capped with an air-tight seal for the blank chamber. Bilge pumps hooked up to a car battery and plastic tubing were used to circulate water through the chambers. A hole with an air-tight seal was left in the top of each chamber to accommodate water quality measurement instruments. In-situ Inc. 9055 Professional Trolls were used for this sampling event.

All three chambers were deployed at each site in areas with suitable sediment, from downstream to upstream . Once in place, the chambers were left for a minimum of 15 minutes so that any suspended sediments could settle before measurements were started. Chamber flow recirculation was established using the pumps to approximately mimic stream bottom flows. A multi-parameter water quality meter was used to take chamber measurements. DO and temperature measurements were logged at 1- minute intervals over at least an hour and a half. While the tests were proceeding, the water quality monitors were regularly checked to monitor test validity.

Simultaneously, a dark bottle filled with ambient bottom water was deployed for incubation during the course of the SOD experiments. The water column respiration values obtained from the dark bottles were recorded in the field book and were measured as an available back up to blank chamber experiments in case of chamber failure.

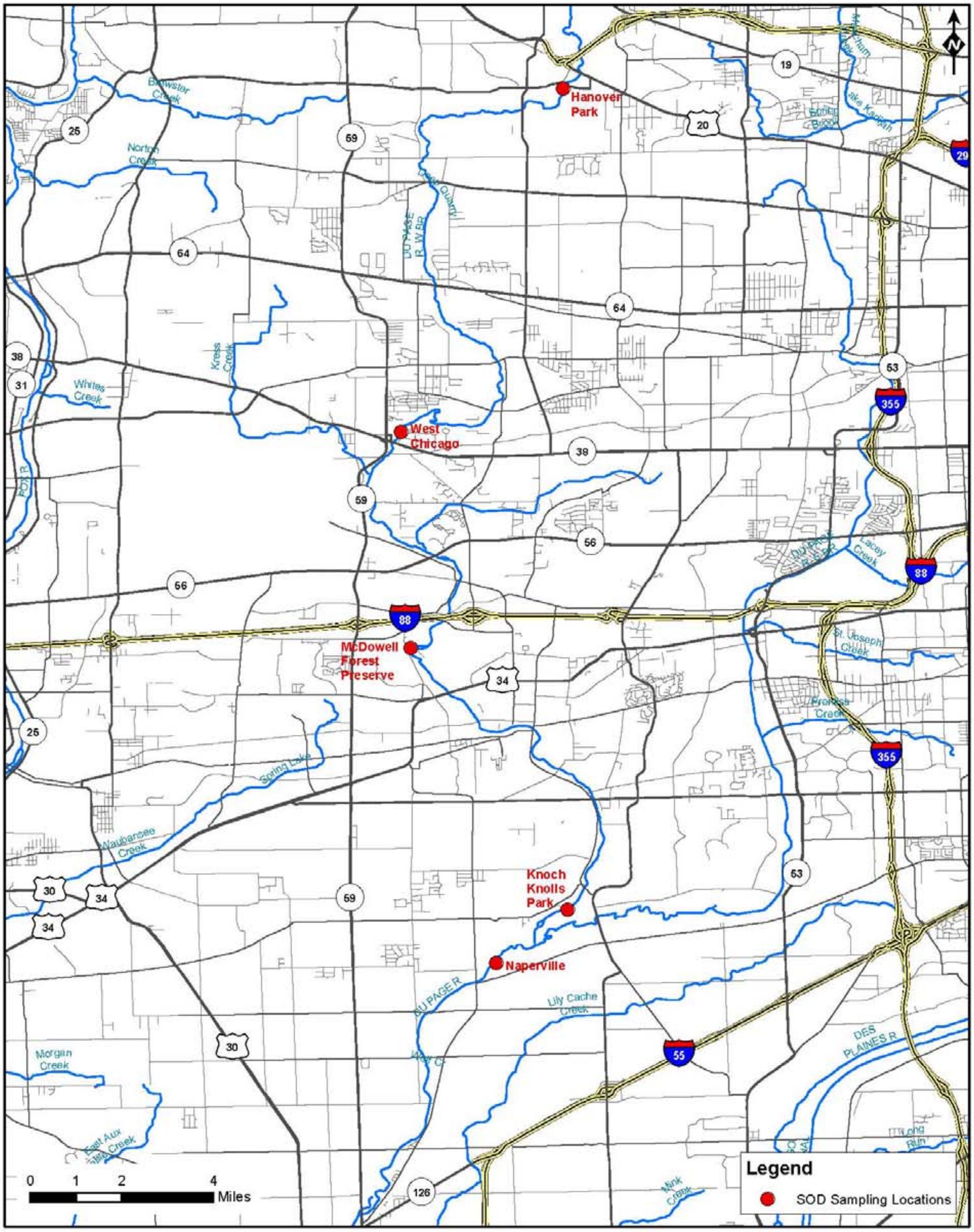

Figure 2-1
SOD Sampling Locations

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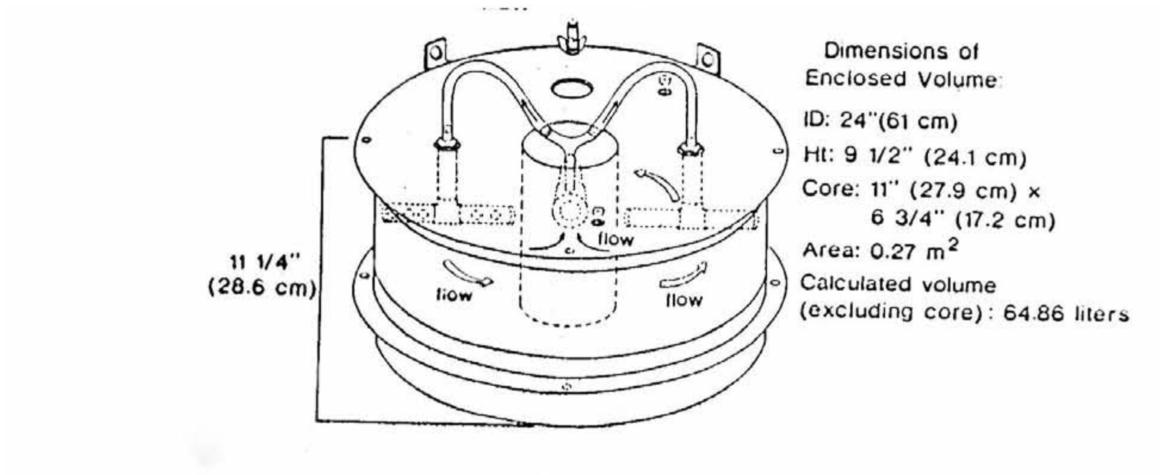
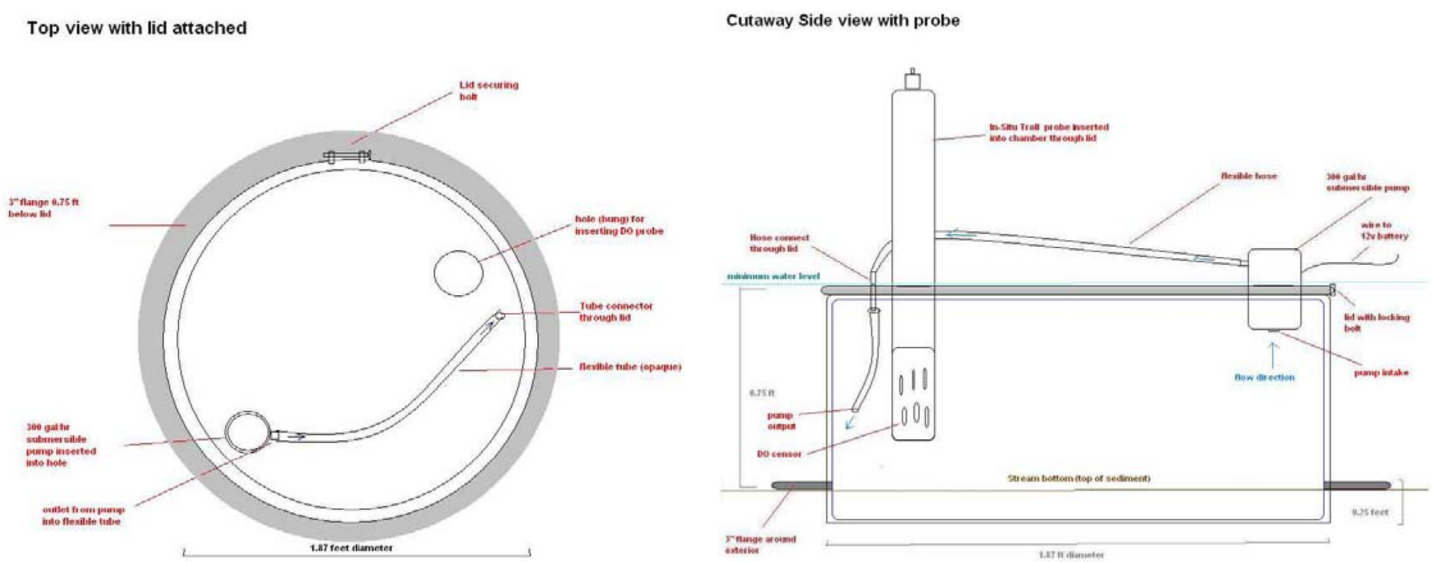


(Notes: ID = inner diameter, Ht = height, " = inches, cm = centimeter, m = meter)

MURPHY AND HICKS (1986) SOD CHAMBER GUIDANCE DIAGRAM



CDM CONSTRUCTED SOD CHAMBER

Figure 2-2
SOD Chamber Diagrams

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Figure 2-3
CDM Constructed SOD Chambers

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SITE PHOTOGRAPHS

HANOVER PARK

WEST CHICAGO

MCDOWELL FOREST PRESERVE

KNOCK KNOLLS

NAPERVILLE

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Section 3
Data Analysis and Results

3.1 Data Analysis

As discussed in Section 2, water quality data were logged with In-Situ, Inc 9055 Professional Trolls. In-Situ, Inc software was used to download the files which were then transferred to Microsoft Excel. Data files are available in Appendix A. Dissolved oxygen data were plotted versus time to determine a rate of change of DO concentrations in each of the chambers. Figures 3-1 through 3-5 show the plotted data used for calculations at each site (refer to Figure 2-1 for sampling location information).

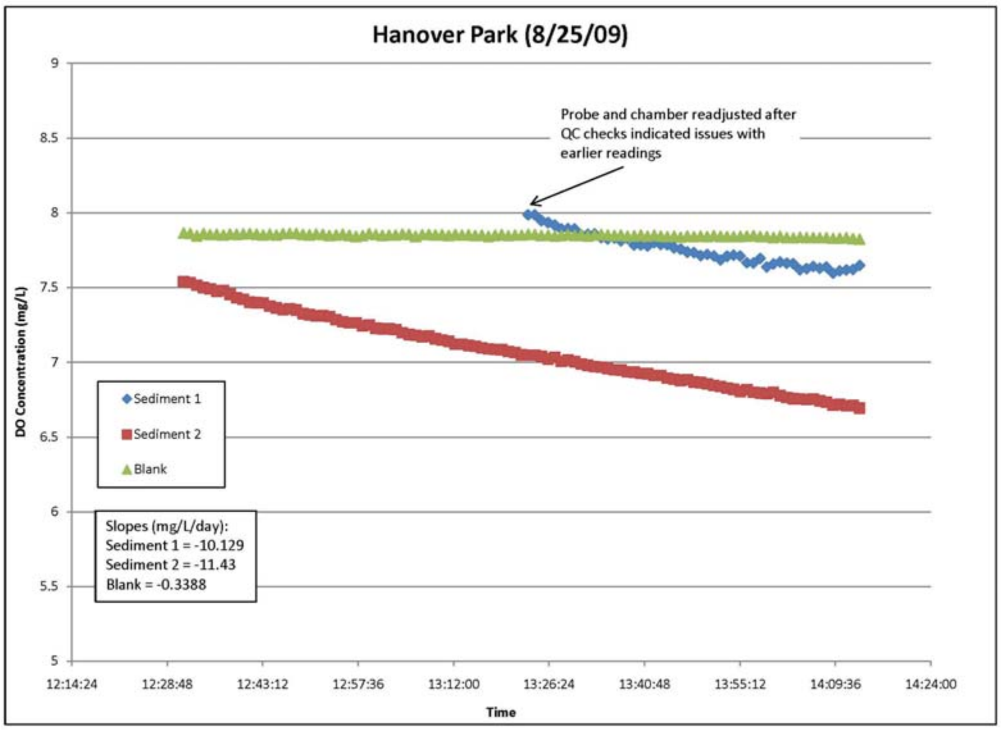
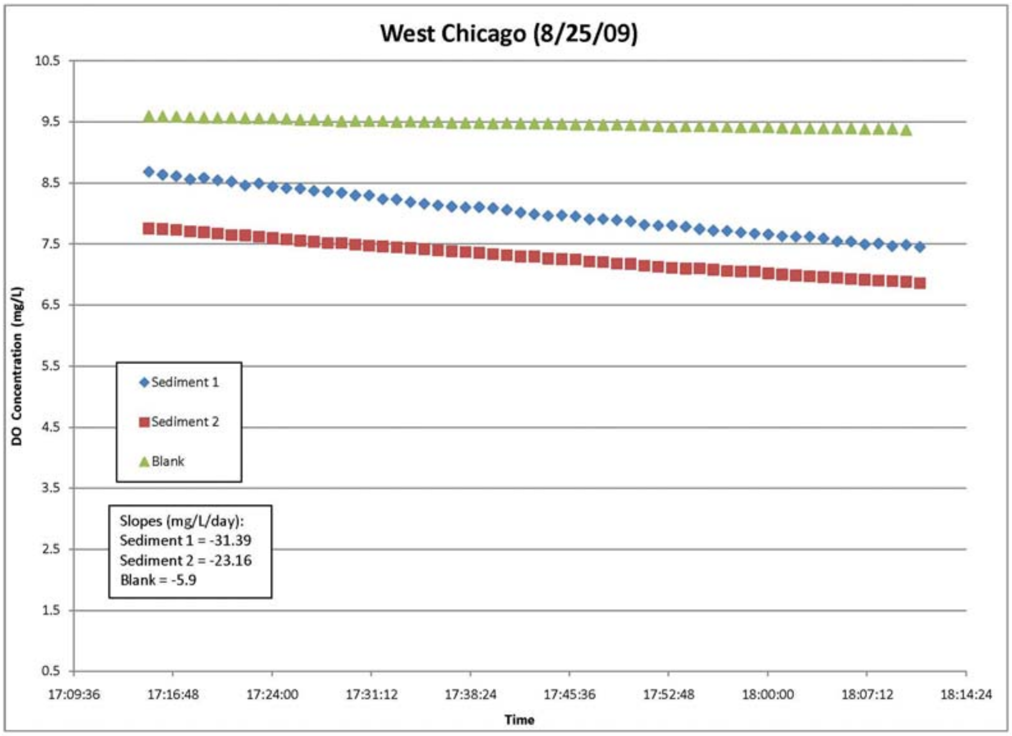


Figure 3-1
DO Data Collected at Hanover Park on 8/25/09



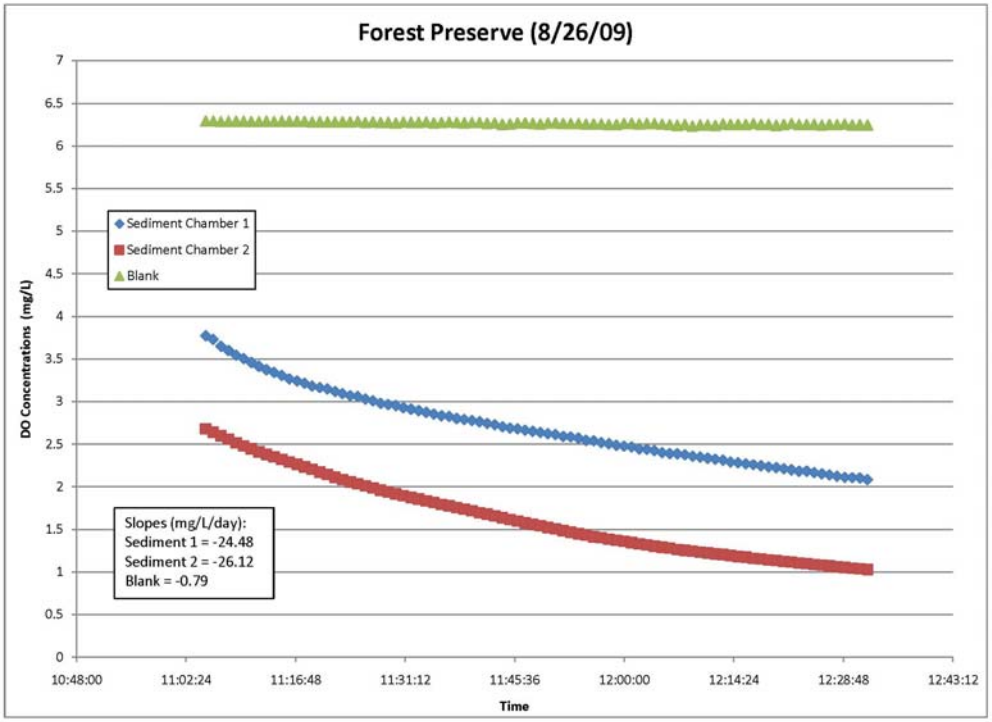


Figure 3-3
DO Data Collected at McDowell Forest Preserve on 8/26/09

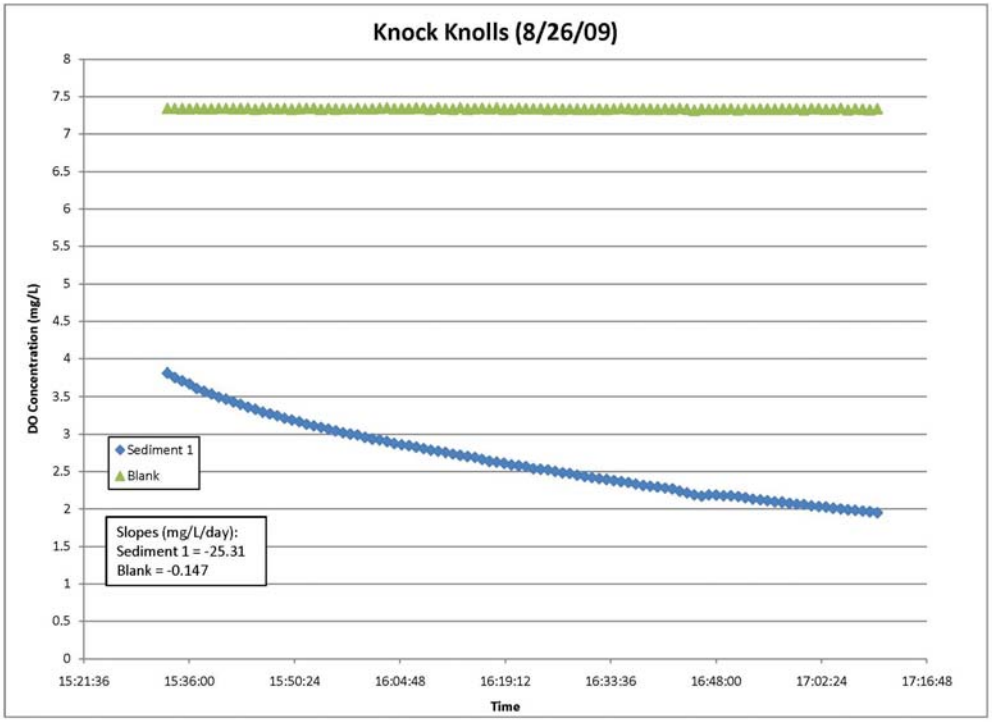


Figure 3-4
DO Data Collected at Knock Knolls on 8/26/09

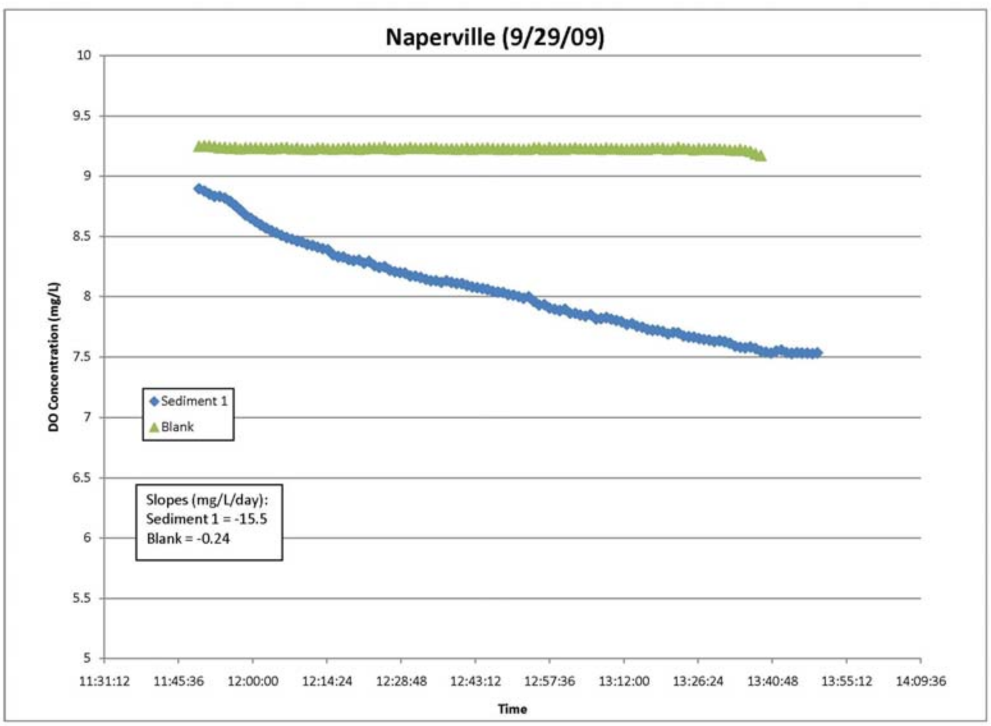


Figure 3-5
DO Data Collected at Naperville on 9/29/09

As shown in Figure 3-1, only a portion of the data collected from sediment chamber 1 was used for SOD calculations. Manual checks of the DO readings in the field indicated that sediment chamber 1 was not operating properly (all field notes are available in Appendix B). Adjustments were made during the test to reset the chamber and probe. Data that were logged after these field adjustments were used for calculations.

As shown in Figures 3-4 and 3-5, data from sediment chamber 2 were thrown out due to erratic DO readings throughout the monitoring.

Downloaded data from each site were then used to calculate SOD rates using the following equation:

$SOD = (V/A) \times (b_1 - b_2) / 1000$

Where SOD = sediment oxygen demand rate (grams/meter^2/day)
b_1 = rate of change of DO concentration in the SOD chamber (milligram/Liter/day)
b_2 = rate of change of DO concentration in the blank chamber (milligram/Liter/day)
V = volume of the chamber (Liters)
A = area of the chamber (meter^2)

When data were available from both sediment chambers, the average rate of change was used for calculating SOD rates. Each blank chamber functioned properly, therefore dark bottle readings were not needed for backup. The dark bottle readings are available in the field notes found in Appendix B.

SOD data were then adjusted to a base water temperature of 20 degrees C for reporting purposes. The Arhenius temperature equation was used to adjust rates to a 20 degrees C ambient water temperature.

$SOD(t) = SOD(20) \times \Theta^{(T-20)}$
$SOD(20) = SOD(t)/\Theta^{(T-20)}$

Where SOD(t) = sediment oxygen demand at temperature T
SOD(20) = sediment oxygen demand at temperature 20 degrees C
Θ = temperature correction coefficient, 1.08

3.2 Data Results

Table 3-1 contains the data used for calculation at each site and the calculated SOD rates. Differences between calculated SOD rates for both sediment chambers varied only slightly at Hanover Park and McDowell Forest Preserve. The West Chicago site had a larger difference which may indicate varied sediment composition at the site. Again, averages were used when both sediment chambers' data were available.

Table 3-1: Data used for calculation and calculated SOD rates

Station	Slope (mg/L/d)			SOD (g/m²/d)			Average Temp (C)		SOD - Temp Corrected to 20 C (g/m²/d)		
	Sediment 1	Sediment 2	Blank	Sediment 1	Sediment 2	Average	Sediment 1	Sediment 2	Sediment 1	Sediment 2	Average
Hanover Park	10.13	11.43	0.34	2.38	2.52	2.45	22.50	22.30	1.96	2.11	2.04
West Chicago	31.39	23.16	5.90	8.47	3.92	6.19	24.97	24.92	5.78	2.68	4.23
Forest Preserve	24.48	26.12	0.79	5.74	5.75	5.74	23.00	22.99	4.55	4.57	4.56
Knoch Knolls Park	25.31	*	0.15	5.78	-	5.78	22.19	-	4.88	-	4.88
Naperville	15.50	*	0.24	3.57	-	3.57	14.22	-	5.58	-	5.58

* Data not used due to chamber failure
Volume (L) = 58.3282
Area (m^2) = 0.25688

As shown in Table 3-1 above, SOD rates at ambient temperatures ranged from 2.45 g/m^2/day at Hanover Park (the upstream sampling location on the West Branch DuPage River) to 6.19 g/m^2/day at West Chicago. When temperature were corrected to 20 degrees C, rates increased from upstream (2.04 g/m^2/day at Hanover Park on the West Branch DuPage Rive) to downstream (5.58 g/m^2/day at Naperville on the mainstem DuPage River).

Previous SOD monitoring conducted in 2008 on the East Branch DuPage River yielded results that ranged from 1.13 to 3.61 g/m^2/day. This sampling effort indicates that SOD rates are higher on the West Branch than on the East Branch. Because SOD is the sum of all biological and chemical processes in sediment that utilize oxygen, this could mean that the West Branch has more anaerobic (low-oxygen) chemical compounds in the sediments and particulate biological oxygen demand (BOD) (including algae and other sources of organic matter) settling out of the water column.

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Appendix A
SOD Monitoring Data

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Hanover Park
Sediment Probe 1

In-Situ Inc. Troll 9000 Pro XP

Report generated: 8/27/2009 13:56:12
Report from file: ...\SN48381 2009-08-25 120016 sod5-2.bin
Win-Situ® Version 4.58.14.0

Serial number: 48381
Firmware Version 2.13
Unit name: MP Troll 9000

Test name: sod5-2

Test defined on: 8/25/2009 11:59:57
Test started on: 8/25/2009 12:00:16
Test stopped on: 8/25/2009 14:14:16

Data gathered using Linear testing
Time between data points: 60.0 Seconds.
Number of data samples: 134

TOTAL DATA SAMPLES 134

Date	Time	ET (sec)	Chan[1] Temperature Fahrenheit	Chan[3] Barometric Inches Hg	Chan[5] Battery Volts	Chan[11] ORP millivolts	Chan[12] pH pH	Chan[37] Rugged DO micrograms/L	Chan[37] Rugged DO Sat %Saturation	Chan[45] Conductivity microSiemens/cm Actual Conductivity	Notes
--------	--------	------------	---------------	---------------	---------------	---------------	---------------	---------------	---------------	---------------	---------------
8/25/2009	12:00:16	0	88.99	29.192	2.968	140	6.75	6047	84.4575	1.32	Test Started - Chambers settling
8/25/2009	12:01:16	60	90.54	29.287	2.968	140	6.72	5901	83.3437	1.32	
8/25/2009	12:02:16	120	88.49	29.317	2.968	143	6.72	5753	79.6212	1.79	
8/25/2009	12:03:16	180	88.16	29.366	2.968	151	6.62	5710	78.6322	1.32	
8/25/2009	12:04:16	240	88.62	29.393	2.968	152	6.62	5635	77.8696	1.32	
8/25/2009	12:05:16	300	89.03	29.425	2.941	152	6.57	5617	77.8336	1.32	
8/25/2009	12:06:16	360	89.2	29.454	2.941	142	6.73	5603	77.6831	1.32	
8/25/2009	12:07:16	420	89.27	29.5	2.941	143	6.7	5574	77.2104	1.32	
8/25/2009	12:08:16	480	88.97	29.518	2.941	145	6.7	5603	77.3348	1.32	
8/25/2009	12:09:16	540	89.04	29.519	2.968	145	6.68	5589	77.2015	1.32	
8/25/2009	12:10:16	600	88.99	29.548	2.968	145	6.7	5489	75.696	1.42	
8/25/2009	12:11:16	660	89.07	29.58	2.889	144	6.7	5417	74.674	1.82	
8/25/2009	12:12:16	720	87	29.565	2.941	175	6.63	5939	80.3203	1.32	
8/25/2009	12:13:16	780	81.97	29.568	2.968	228	5.73	7114	91.6174	5.58	
8/25/2009	12:14:16	840	72.28	29.183	2.968	158	7.52	7782	92.1942	778.92	Probe Inserted
8/25/2009	12:15:16	900	72.06	29.184	2.941	146	7.65	7866	92.9798	783.27	
8/25/2009	12:16:16	960	72.13	29.182	2.968	139	7.72	7891	93.3408	783.11	
8/25/2009	12:17:16	1020	72.22	29.179	2.889	134	7.77	7954	94.1955	783.64	
8/25/2009	12:18:16	1080	72.3	29.181	2.968	131	7.79	7955	94.2833	784.87	
8/25/2009	12:19:16	1140	72.4	29.176	2.941	129	7.8	7947	94.3037	785.54	
8/25/2009	12:20:16	1200	72.51	29.176	2.889	127	7.82	7968	94.6557	787.35	
8/25/2009	12:21:16	1260	71.27	29.263	2.968	134	7.71	8001	93.2831	1.32	Probe Adjusted
8/25/2009	12:22:16	1320	68.79	29.248	2.889	153	7.51	8178	92.859	1.79	
8/25/2009	12:23:16	1380	71.07	29.234	2.968	133	7.84	7808	91.1461	769.28	
8/25/2009	12:24:16	1440	70.93	29.159	2.941	131	7.83	7693	89.9226	768.17	
8/25/2009	12:25:16	1500	70.88	29.086	2.968	129	7.82	7536	88.2576	767.32	
8/25/2009	12:26:16	1560	70.89	29.022	2.968	128	7.82	7458	87.5565	767.42	
8/25/2009	12:27:16	1620	70.9	28.968	2.941	126	7.82	7444	87.564	767.65	
8/25/2009	12:28:16	1680	70.92	28.922	2.941	125	7.82	7413	87.3675	767.75	
8/25/2009	12:29:16	1740	70.95	28.882	2.968	124	7.82	7417	87.5527	767.86	
8/25/2009	12:30:16	1800	70.98	29.198	2.968	122	7.81	7383	86.214	768.77	
8/25/2009	12:31:16	1860	71.01	29.18	2.968	121	7.81	7370	86.1589	768.88	
8/25/2009	12:32:16	1920	71.05	29.181	2.968	120	7.81	7376	86.2547	769	
8/25/2009	12:33:16	1980	71.09	29.18	2.968	119	7.81	7344	85.9132	769.38	
8/25/2009	12:34:16	2040	71.12	29.181	2.889	118	7.81	7320	85.661	769.64	
8/25/2009	12:35:16	2100	71.15	29.18	2.968	118	7.81	7345	85.9873	769.9	
8/25/2009	12:36:16	2160	71.17	29.182	2.941	117	7.81	7338	85.9241	770.02	
8/25/2009	12:37:16	2220	71.19	29.181	2.889	117	7.81	7330	85.8488	770.41	
8/25/2009	12:38:16	2280	71.23	29.18	2.968	116	7.81	7349	86.1005	770.54	
8/25/2009	12:39:16	2340	71.26	29.181	2.889	115	7.82	7339	86.0207	770.94	
8/25/2009	12:40:16	2400	71.29	29.18	2.941	115	7.81	7330	85.9373	771.07	
8/25/2009	12:41:16	2460	71.33	29.181	2.968	114	7.81	7338	86.0603	771.61	
8/25/2009	12:42:16	2520	71.37	29.183	2.941	114	7.82	7375	86.525	771.87	
8/25/2009	12:43:16	2580	71.41	29.183	2.889	114	7.82	7361	86.4037	772.14	
8/25/2009	12:44:16	2640	71.45	29.185	2.941	113	7.82	7345	86.2543	772.41	
8/25/2009	12:45:16	2700	71.48	29.186	2.941	113	7.82	7355	86.3906	772.82	
8/25/2009	12:46:16	2760	71.5	29.186	2.968	112	7.82	7320	86.0017	772.81	
8/25/2009	12:47:16	2820	71.53	29.187	2.968	112	7.82	7363	86.5255	773.22	
8/25/2009	12:48:16	2880	71.56	29.186	2.889	112	7.82	7379	86.7464	773.63	
8/25/2009	12:49:16	2940	71.6	29.185	2.968	111	7.82	7382	86.8227	773.91	
8/25/2009	12:50:16	3000	71.65	29.184	2.968	111	7.82	7412	87.2316	774.18	

8/25/2009	12:51:16	3060	71.68	29.183	2.941	111	7.82	7366	86.7118	774.46	
8/25/2009	12:52:16	3120	71.7	29.184	2.968	111	7.82	7382	86.9216	774.46	
8/25/2009	12:53:16	3180	71.73	29.183	2.968	110	7.82	7375	86.8753	775.15	
8/25/2009	12:54:16	3240	71.77	29.183	2.889	110	7.82	7400	87.1974	775.42	
8/25/2009	12:55:16	3300	71.79	29.183	2.968	110	7.82	7395	87.1572	775.56	
8/25/2009	12:56:16	3360	71.84	29.184	2.941	109	7.82	7406	87.3306	775.98	
8/25/2009	12:57:16	3420	71.87	29.183	2.941	109	7.83	7417	87.4847	776.11	
8/25/2009	12:58:16	3480	71.9	29.184	2.968	109	7.83	7397	87.2862	776.39	
8/25/2009	12:59:16	3540	71.94	29.183	2.968	109	7.83	7425	87.6519	777.09	
8/25/2009	13:00:16	3600	71.96	29.183	2.941	108	7.83	7418	87.5965	777.23	
8/25/2009	13:01:16	3660	72	29.183	2.889	108	7.83	7443	87.9209	777.64	
8/25/2009	13:02:16	3720	72.03	29.182	2.941	108	7.83	7458	88.1378	778.06	
8/25/2009	13:03:16	3780	72.08	29.181	2.941	108	7.83	7455	88.147	778.48	
8/25/2009	13:04:16	3840	72.11	29.182	2.968	108	7.83	7428	87.8511	779.04	
8/25/2009	13:05:16	3900	72.15	29.181	2.941	108	7.83	7436	87.9845	779.04	
8/25/2009	13:06:16	3960	72.19	29.181	2.941	107	7.83	7434	87.9982	779.18	
8/25/2009	13:07:16	4020	72.22	29.182	2.941	107	7.83	7478	88.541	779.74	
8/25/2009	13:08:16	4080	72.26	29.185	2.968	107	7.83	7453	88.2822	780.03	
8/25/2009	13:09:16	4140	72.29	29.184	2.968	107	7.83	7406	87.7611	780.45	
8/25/2009	13:10:16	4200	72.33	29.183	2.941	107	7.84	7417	87.9183	781.01	
8/25/2009	13:11:16	4260	72.36	29.183	2.968	107	7.84	7485	88.759	781.29	
8/25/2009	13:12:16	4320	72.41	29.183	2.941	106	7.84	7449	88.3825	781.72	
8/25/2009	13:13:16	4380	72.45	29.183	2.968	106	7.84	7502	89.051	782.42	
8/25/2009	13:14:16	4440	72.5	29.183	2.968	106	7.84	7489	88.937	782.56	
8/25/2009	13:15:16	4500	72.53	29.183	2.968	106	7.85	7533	89.4929	782.85	
8/25/2009	13:16:16	4560	72.57	29.183	2.968	106	7.85	7573	90.0131	783.56	
8/25/2009	13:17:16	4620	72.61	29.181	2.941	106	7.85	7574	90.0661	783.84	
8/25/2009	13:18:16	4680	72.65	29.18	2.968	105	7.85	7573	90.0883	784.27	
8/25/2009	13:19:16	4740	72.55	29.183	2.941	112	7.78	7665	90.8607	1.32	Probe Readjusted
8/25/2009	13:20:16	4800	72.48	29.181	2.941	120	7.83	8192	97.0438	1.32	
8/25/2009	13:21:16	4860	73.06	29.172	2.941	116	7.86	8260	98.4779	1.45	
8/25/2009	13:22:16	4920	73.01	29.185	2.968	111	7.91	8183	97.6967	787.96	Data used for analysis
8/25/2009	13:23:16	4980	73.01	29.182	2.968	109	7.9	7986	95.3693	788.83	
8/25/2009	13:24:16	5040	73.05	29.178	2.941	108	7.89	7986	95.4143	788.7	
8/25/2009	13:25:16	5100	73.06	29.176	2.968	107	7.89	7947	94.9623	788.85	
8/25/2009	13:26:16	5160	73.07	29.174	2.968	107	7.89	7934	94.8178	789.15	
8/25/2009	13:27:16	5220	73.09	29.174	2.968	107	7.89	7918	94.6541	789.29	
8/25/2009	13:28:16	5280	73.1	29.174	2.941	107	7.89	7891	94.3431	789.44	
8/25/2009	13:29:16	5340	73.12	29.175	2.941	106	7.88	7894	94.3949	789.58	
8/25/2009	13:30:16	5400	73.13	29.175	2.968	106	7.88	7892	94.3701	789.73	
8/25/2009	13:31:16	5460	73.16	29.175	2.863	106	7.88	7852	93.9279	790.16	
8/25/2009	13:32:16	5520	73.18	29.176	2.968	105	7.88	7856	93.9997	790.31	
8/25/2009	13:33:16	5580	73.19	29.175	2.941	105	7.88	7859	94.042	790.45	
8/25/2009	13:34:16	5640	73.21	29.174	2.968	105	7.88	7833	93.7562	790.74	
8/25/2009	13:35:16	5700	73.24	29.173	2.968	105	7.88	7825	93.6972	790.88	
8/25/2009	13:36:16	5760	73.26	29.174	2.968	105	7.88	7831	93.7805	791.03	
8/25/2009	13:37:16	5820	73.27	29.172	2.968	105	7.88	7813	93.5735	791.32	
8/25/2009	13:38:16	5880	73.3	29.174	2.941	104	7.88	7827	93.779	791.46	
8/25/2009	13:39:16	5940	73.32	29.173	2.941	105	7.88	7784	93.2879	791.75	
8/25/2009	13:40:16	6000	73.33	29.172	2.941	104	7.88	7784	93.2957	791.75	
8/25/2009	13:41:16	6060	73.35	29.173	2.941	104	7.88	7777	93.2353	791.9	
8/25/2009	13:42:16	6120	73.37	29.172	2.941	104	7.87	7799	93.5162	792.19	
8/25/2009	13:43:16	6180	73.38	29.171	2.941	104	7.88	7788	93.4035	792.33	
8/25/2009	13:44:16	6240	73.4	29.171	2.968	104	7.88	7787	93.4136	792.62	
8/25/2009	13:45:16	6300	73.43	29.171	2.941	104	7.88	7766	93.1875	792.77	
8/25/2009	13:46:16	6360	73.46	29.172	2.968	104	7.88	7757	93.1032	792.91	
8/25/2009	13:47:16	6420	73.46	29.173	2.968	103	7.88	7737	92.8609	793.2	
8/25/2009	13:48:16	6480	73.48	29.175	2.941	103	7.88	7734	92.83	793.21	
8/25/2009	13:49:16	6540	73.49	29.175	2.968	103	7.88	7713	92.588	793.5	
8/25/2009	13:50:16	6600	73.52	29.175	2.968	103	7.87	7721	92.7162	793.64	
8/25/2009	13:51:16	6660	73.54	29.173	2.941	103	7.87	7711	92.6271	793.79	
8/25/2009	13:52:16	6720	73.54	29.172	2.968	103	7.87	7684	92.306	794.08	
8/25/2009	13:53:16	6780	73.56	29.171	2.941	103	7.88	7709	92.633	794.22	
8/25/2009	13:54:16	6840	73.58	29.171	2.889	103	7.87	7716	92.7276	794.37	
8/25/2009	13:55:16	6900	73.61	29.173	2.968	103	7.87	7711	92.6873	794.66	
8/25/2009	13:56:16	6960	73.64	29.175	2.941	103	7.87	7666	92.1737	794.66	
8/25/2009	13:57:16	7020	73.64	29.174	2.941	103	7.87	7664	92.1546	794.96	
8/25/2009	13:58:16	7080	73.66	29.174	2.968	102	7.87	7694	92.533	794.96	
8/25/2009	13:59:16	7140	73.67	29.174	2.941	103	7.87	7637	91.8582	795.39	
8/25/2009	14:00:16	7200	73.68	29.174	2.968	103	7.87	7658	92.1249	795.54	
8/25/2009	14:01:16	7260	73.71	29.176	2.968	102	7.87	7671	92.2961	795.69	
8/25/2009	14:02:16	7320	73.72	29.173	2.968	102	7.87	7663	92.2282	795.83	
8/25/2009	14:03:16	7380	73.75	29.173	2.968	102	7.87	7659	92.201	796.13	
8/25/2009	14:04:16	7440	73.76	29.173	2.941	102	7.87	7618	91.7205	796.27	
8/25/2009	14:05:16	7500	73.79	29.173	2.889	102	7.87	7626	91.8497	796.57	
8/25/2009	14:06:16	7560	73.81	29.173	2.941	102	7.87	7641	92.0375	796.71	
8/25/2009	14:07:16	7620	73.82	29.171	2.941	102	7.87	7629	91.9078	796.86	
8/25/2009	14:08:16	7680	73.84	29.17	2.941	102	7.87	7637	92.0349	797.01	
8/25/2009	14:09:16	7740	73.85	29.168	2.968	102	7.87	7596	91.558	797.3	
8/25/2009	14:10:16	7800	73.88	29.167	2.941	102	7.87	7612	91.7779	797.45	
8/25/2009	14:11:16	7860	73.89	29.165	2.889	102	7.87	7617	91.8567	797.45	
8/25/2009	14:12:16	7920	73.92	29.165	2.941	102	7.87	7620	91.9269	797.74	
8/25/2009	14:13:16	7980	73.94	29.164	2.968	102	7.87	7648	92.2845	797.89	

Hanover Park
Sediment Probe 2

In-Situ Inc. Troll 9000 Pro XP

Report generated: 8/27/2009 13:24:43
Report from file: ...\SN48193 2009-08-25 115145 sod5-1.bin
Win-Situ® Version 4.58.14.0

Serial number: 48193
Firmware Version 2.13
Unit name: MP Troll 9000

Test name: sod5-1

Test defined on: 8/25/2009 8:49:51
Test started on: 8/25/2009 11:51:45
Test stopped on: 8/25/2009 14:14:39

Data gathered using Linear testing
Time between data points: 60.0 Seconds.
Number of data samples: 143

TOTAL DATA SAMPLES 143

Date	Time	ET (sec)	Chan[1] Temperature Fahrenheit	Chan[3] Barometric Inches Hg	Chan[5] Battery Volts	Chan[11] ORP millivolts	Chan[12] pH pH	Chan[37] Rugged DO micrograms/l	Chan[37] Rugged DO Sat %Saturation	Chan[45] Conductivity microSiemens/ cm Actual Conductivity	Notes
8/25/2009	11:51:45	0	80.6	29.259	3.147	157	7.31	7603	97.6496	1.3	Test started
8/25/2009	11:52:45	60	80.39	29.253	3.117	167	7.17	7652	98.1098	21.89	
8/25/2009	11:53:45	120	80.84	29.253	3.117	161	7.26	7824	100.7578	52.51	
8/25/2009	11:54:45	180	82.01	29.25	3.117	395	1.59	7664	99.857	1.3	
8/25/2009	11:55:45	240	83.47	29.365	3.147	1013	-9.08	7689	101.2262	1.3	
8/25/2009	11:56:45	300	83.8	29.427	3.147	157	7.3	7647	100.7759	1.3	
8/25/2009	11:57:45	360	84.47	29.434	3.088	153	7.32	7083	93.9323	1.3	
8/25/2009	11:58:45	420	85.37	29.466	3.117	151	7.36	6842	91.4228	1.3	
8/25/2009	11:59:45	480	86.38	29.484	3.117	338	3.72	6714	90.5333	1.3	
8/25/2009	12:00:45	540	87.39	29.504	3.147	319	5.23	6526	88.7858	1.3	
8/25/2009	12:01:45	600	88.21	29.521	3.147	261	5.87	6528	89.4518	1.3	
8/25/2009	12:02:45	660	88.89	29.535	3.117	146	7.42	6547	90.2459	1.3	
8/25/2009	12:03:45	720	89.58	29.549	3.147	145	7.42	6510	90.2778	1.3	
8/25/2009	12:04:45	780	89.89	29.559	3.088	145	7.42	6575	91.4083	1.3	
8/25/2009	12:05:45	840	90.03	29.569	3.147	145	7.42	6597	91.806	1.3	
8/25/2009	12:06:45	900	89.39	29.575	3.147	142	7.47	6499	89.8816	1.3	
8/25/2009	12:07:45	960	90.36	29.603	3.147	131	7.71	6554	91.3691	1.3	
8/25/2009	12:08:45	1020	90.37	29.612	3.117	131	7.71	6560	91.4372	1.3	
8/25/2009	12:09:45	1080	90.46	29.631	3.147	130	7.77	6608	92.1274	1.3	
8/25/2009	12:10:45	1140	90.73	29.636	3.117	130	7.81	6758	94.4363	1.3	
8/25/2009	12:11:45	1200	91.49	29.612	3.088	132	7.73	6851	96.4951	1.3	
8/25/2009	12:12:45	1260	82.57	29.634	3.147	566	-5.04	6467	83.5852	1.3	
8/25/2009	12:13:45	1320	73.43	29.634	3.147	167	7.67	6392	75.459	795.21	Probe inserted
8/25/2009	12:14:45	1380	72.45	29.257	3.088	154	7.85	7955	94.1804	800.18	
8/25/2009	12:15:45	1440	72.43	29.243	3.147	149	7.88	8000	94.7363	807.03	
8/25/2009	12:16:45	1500	72.42	29.239	3.117	148	7.87	8000	94.7466	802.04	
8/25/2009	12:17:45	1560	72.35	29.24	3.088	146	7.89	8050	95.2586	800.01	
8/25/2009	12:18:45	1620	72.53	29.242	3.117	145	7.89	8075	95.7299	803.59	
8/25/2009	12:19:45	1680	72.65	29.241	3.147	143	7.89	8064	95.7238	807.98	
8/25/2009	12:20:45	1740	72.66	29.241	3.147	142	7.9	8054	95.6207	806.88	
8/25/2009	12:21:45	1800	70.3	29.36	3.147	-1007	27.52	8228	94.6122	1.3	probe adjusted
8/25/2009	12:22:45	1860	71.12	29.331	3.147	143	7.9	8176	95.1811	784.53	
8/25/2009	12:23:45	1920	71.01	29.253	3.088	143	7.85	7956	92.7697	782.19	
8/25/2009	12:24:45	1980	71.01	29.176	3.147	142	7.84	7761	90.7416	782.06	
8/25/2009	12:25:45	2040	71.02	29.112	3.117	140	7.83	7656	89.7209	782.13	
8/25/2009	12:26:45	2100	71.04	29.056	3.117	139	7.83	7631	89.6199	782.2	
8/25/2009	12:27:45	2160	71.05	29.009	3.147	138	7.83	7605	89.4822	782.26	
8/25/2009	12:28:45	2220	71.07	28.97	3.147	137	7.83	7584	89.3641	782.5	
8/25/2009	12:29:45	2280	71.09	28.936	3.117	136	7.83	7569	89.3249	782.38	
8/25/2009	12:30:45	2340	71.11	28.904	3.147	135	7.82	7557	89.2966	782.61	Data used for analysis
8/25/2009	12:31:45	2400	71.12	28.877	3.147	135	7.82	7539	89.1882	782.65	
8/25/2009	12:32:45	2460	71.14	28.853	3.117	134	7.82	7532	89.1915	782.88	
8/25/2009	12:33:45	2520	71.15	28.833	3.117	134	7.82	7516	89.0868	782.91	
8/25/2009	12:34:45	2580	71.18	29.245	3.117	134	7.82	7500	87.6376	783.13	

Hanover Park
Sediment Probe 2

8/25/2009	12:35:45	2640	71.19	29.275	3.147	133	7.81	7491	87.4466	783.9	
8/25/2009	12:36:45	2700	71.21	29.256	3.147	132	7.81	7475	87.341	784.11	
8/25/2009	12:37:45	2760	71.23	29.244	3.147	132	7.81	7481	87.4671	784.13	
8/25/2009	12:38:45	2820	71.25	29.234	3.147	131	7.81	7455	87.2022	784.52	
8/25/2009	12:39:45	2880	71.27	29.228	3.117	131	7.8	7432	86.9808	784.53	
8/25/2009	12:40:45	2940	71.28	29.225	3.147	131	7.8	7422	86.882	784.53	
8/25/2009	12:41:45	3000	71.31	29.224	3.117	131	7.79	7402	86.6752	784.54	
8/25/2009	12:42:45	3060	71.32	29.223	3.088	131	7.79	7399	86.6503	784.92	
8/25/2009	12:43:45	3120	71.34	29.22	3.117	130	7.79	7397	86.6562	785.11	
8/25/2009	12:44:45	3180	71.36	29.216	3.117	130	7.79	7375	86.4173	785.3	
8/25/2009	12:45:45	3240	71.38	29.215	3.088	130	7.8	7363	86.3035	785.49	
8/25/2009	12:46:45	3300	71.39	29.213	3.117	131	7.8	7352	86.194	785.68	
8/25/2009	12:47:45	3360	71.42	29.211	3.147	130	7.79	7359	86.3034	785.68	
8/25/2009	12:48:45	3420	71.43	29.21	3.147	130	7.79	7349	86.207	785.87	
8/25/2009	12:49:45	3480	71.45	29.208	3.147	130	7.79	7326	85.9564	786.24	
8/25/2009	12:50:45	3540	71.46	29.207	3.117	129	7.79	7318	85.8741	786.24	
8/25/2009	12:51:45	3600	71.48	29.207	3.147	129	7.79	7309	85.7919	786.62	
8/25/2009	12:52:45	3660	71.51	29.206	3.088	129	7.79	7312	85.8475	786.8	
8/25/2009	12:53:45	3720	71.53	29.208	3.147	129	7.79	7306	85.7954	786.99	
8/25/2009	12:54:45	3780	71.55	29.206	3.117	129	7.79	7286	85.5989	786.99	
8/25/2009	12:55:45	3840	71.58	29.205	3.088	129	7.79	7271	85.4459	787.17	
8/25/2009	12:56:45	3900	71.59	29.206	3.117	129	7.79	7265	85.3819	787.36	
8/25/2009	12:57:45	3960	71.61	29.205	3.117	129	7.79	7264	85.3874	787.55	
8/25/2009	12:58:45	4020	71.63	29.204	3.088	129	7.79	7243	85.1583	787.55	
8/25/2009	12:59:45	4080	71.65	29.204	3.117	129	7.79	7250	85.2626	787.92	
8/25/2009	13:00:45	4140	71.68	29.204	3.147	129	7.79	7228	85.0264	788.1	
8/25/2009	13:01:45	4200	71.7	29.205	3.088	129	7.79	7224	84.9977	788.29	
8/25/2009	13:02:45	4260	71.71	29.205	3.117	129	7.79	7224	84.9988	788.48	
8/25/2009	13:03:45	4320	71.73	29.206	3.147	129	7.79	7218	84.9504	788.66	
8/25/2009	13:04:45	4380	71.75	29.207	3.117	130	7.79	7198	84.7397	788.85	
8/25/2009	13:05:45	4440	71.78	29.208	3.117	129	7.79	7186	84.6102	789.22	
8/25/2009	13:06:45	4500	71.8	29.209	3.117	129	7.79	7181	84.5701	789.41	
8/25/2009	13:07:45	4560	71.81	29.211	3.117	129	7.79	7171	84.4559	789.6	
8/25/2009	13:08:45	4620	71.83	29.213	3.117	129	7.79	7175	84.5175	789.78	
8/25/2009	13:09:45	4680	71.86	29.219	3.117	129	7.79	7157	84.3168	789.97	
8/25/2009	13:10:45	4740	71.9	29.221	3.088	129	7.79	7150	84.2642	790.15	
8/25/2009	13:11:45	4800	71.92	29.224	3.117	129	7.79	7140	84.1438	790.53	
8/25/2009	13:12:45	4860	71.93	29.226	3.117	129	7.78	7121	83.93	790.53	
8/25/2009	13:13:45	4920	71.96	29.229	3.117	129	7.78	7122	83.963	790.9	
8/25/2009	13:14:45	4980	71.97	29.233	3.117	129	7.78	7113	83.8524	791.09	
8/25/2009	13:15:45	5040	72	29.235	3.088	129	7.78	7108	83.8138	791.27	
8/25/2009	13:16:45	5100	72.03	29.236	3.117	129	7.78	7097	83.7051	791.46	
8/25/2009	13:17:45	5160	72.05	29.239	3.117	129	7.78	7089	83.6273	791.83	
8/25/2009	13:18:45	5220	72.08	29.241	3.117	129	7.78	7086	83.6121	791.83	
8/25/2009	13:19:45	5280	72.11	29.244	3.117	129	7.78	7084	83.608	792.21	
8/25/2009	13:20:45	5340	72.13	29.244	3.088	129	7.78	7073	83.4955	792.58	
8/25/2009	13:21:45	5400	72.16	29.246	3.117	129	7.78	7066	83.423	792.58	
8/25/2009	13:22:45	5460	72.2	29.249	3.117	129	7.78	7049	83.2516	792.96	
8/25/2009	13:23:45	5520	72.21	29.253	3.117	129	7.78	7047	83.2315	793.15	
8/25/2009	13:24:45	5580	72.23	29.258	3.088	130	7.78	7048	83.2503	793.33	
8/25/2009	13:25:45	5640	72.26	29.261	3.117	130	7.78	7039	83.1583	793.52	
8/25/2009	13:26:45	5700	72.28	29.264	3.117	130	7.78	7022	82.9655	793.71	
8/25/2009	13:27:45	5760	72.32	29.266	3.088	130	7.78	7034	83.1298	794.09	
8/25/2009	13:28:45	5820	72.32	29.269	3.117	130	7.78	7006	82.7972	794.46	
8/25/2009	13:29:45	5880	72.36	29.273	3.088	130	7.78	7014	82.909	794.46	
8/25/2009	13:30:45	5940	72.39	29.275	3.117	131	7.78	7004	82.8078	794.84	
8/25/2009	13:31:45	6000	72.4	29.277	3.088	130	7.78	6989	82.6425	795.03	
8/25/2009	13:32:45	6060	72.44	29.279	3.117	130	7.78	6980	82.5674	795.22	
8/25/2009	13:33:45	6120	72.47	29.282	3.088	130	7.78	6971	82.4725	795.59	
8/25/2009	13:34:45	6180	72.49	29.285	3.117	130	7.78	6968	82.4559	795.78	
8/25/2009	13:35:45	6240	72.52	29.287	3.088	130	7.78	6959	82.3646	795.97	
8/25/2009	13:36:45	6300	72.55	29.29	3.117	130	7.78	6951	82.2859	796.16	
8/25/2009	13:37:45	6360	72.58	29.295	3.088	130	7.78	6948	82.2656	796.54	
8/25/2009	13:38:45	6420	72.61	29.295	3.088	130	7.78	6936	82.1479	796.73	
8/25/2009	13:39:45	6480	72.62	29.297	3.117	130	7.78	6934	82.128	797.11	
8/25/2009	13:40:45	6540	72.66	29.299	3.117	130	7.78	6925	82.042	797.29	
8/25/2009	13:41:45	6600	72.67	29.301	3.117	130	7.78	6924	82.0426	797.48	
8/25/2009	13:42:45	6660	72.7	29.303	3.088	130	7.78	6911	81.9075	797.86	
8/25/2009	13:43:45	6720	72.74	29.307	3.117	130	7.77	6911	81.9309	798.05	
8/25/2009	13:44:45	6780	72.76	29.31	3.117	130	7.77	6895	81.7392	798.24	
8/25/2009	13:45:45	6840	72.78	29.313	3.088	130	7.77	6888	81.6712	798.43	
8/25/2009	13:46:45	6900	72.81	29.316	3.117	130	7.77	6879	81.5774	798.81	
8/25/2009	13:47:45	6960	72.84	29.32	3.088	130	7.77	6883	81.6433	798.81	
8/25/2009	13:48:45	7020	72.87	29.322	3.088	130	7.77	6868	81.4843	799.19	
8/25/2009	13:49:45	7080	72.89	29.325	3.088	131	7.77	6864	81.4548	799.38	
8/25/2009	13:50:45	7140	72.92	29.325	3.117	131	7.77	6856	81.3846	799.57	
8/25/2009	13:51:45	7200	72.95	29.327	3.088	131	7.77	6845	81.2667	799.96	
8/25/2009	13:52:45	7260	72.96	29.329	3.088	131	7.77	6839	81.2014	800.15	
8/25/2009	13:53:45	7320	72.98	29.329	3.117	131	7.77	6829	81.1012	800.34	
8/25/2009	13:54:45	7380	73	29.331	3.088	131	7.77	6820	81.0024	800.53	
8/25/2009	13:55:45	7440	73.03	29.33	3.088	131	7.77	6806	80.8708	800.91	

Hanover Park
Sediment Probe 2

8/25/2009	13:56:45	7500	73.04	29.332	3.117	131	7.77	6818	81.0105	801.1	
8/25/2009	13:57:45	7560	73.08	29.334	3.117	131	7.77	6800	80.8206	801.29	
8/25/2009	13:58:45	7620	73.1	29.336	3.088	131	7.77	6795	80.7866	801.48	
8/25/2009	13:59:45	7680	73.14	29.339	3.117	132	7.77	6789	80.7278	801.67	
8/25/2009	14:00:45	7740	73.15	29.341	3.088	131	7.77	6801	80.8876	802.06	
8/25/2009	14:01:45	7800	73.19	29.343	3.088	131	7.77	6778	80.6306	802.06	
8/25/2009	14:02:45	7860	73.21	29.345	3.117	131	7.77	6766	80.502	802.44	
8/25/2009	14:03:45	7920	73.24	29.348	3.117	131	7.77	6757	80.4144	802.64	
8/25/2009	14:04:45	7980	73.24	29.351	3.117	131	7.77	6754	80.3765	803.02	
8/25/2009	14:05:45	8040	73.28	29.35	3.088	131	7.77	6751	80.3688	803.21	
8/25/2009	14:06:45	8100	73.31	29.351	3.117	131	7.77	6754	80.4212	803.4	
8/25/2009	14:07:45	8160	73.34	29.351	3.117	131	7.77	6743	80.3165	803.6	
8/25/2009	14:08:45	8220	73.35	29.354	3.117	132	7.77	6733	80.202	803.79	
8/25/2009	14:09:45	8280	73.36	29.354	3.088	132	7.77	6714	79.9901	803.98	
8/25/2009	14:10:45	8340	73.39	29.355	3.117	132	7.77	6718	80.0588	804.17	
8/25/2009	14:11:45	8400	73.4	29.358	3.088	132	7.77	6709	79.9531	804.37	
8/25/2009	14:12:45	8460	73.44	29.358	3.088	132	7.76	6712	80.0096	804.56	
8/25/2009	14:13:45	8520	73.45	29.36	3.117	132	7.77	6694	79.8093	804.75	

Hanover Park
Blank Chamber

In-Situ Inc. Troll 9000 Pro XP

Report generated: 8/27/2009 13:46:38
Report from file: ...\SN48396 2009-08-25 111052 sod5-blank.bin
Win-Situ® Version 4.58.14.0

Serial number: 48396
Firmware Version 2.13
Unit name: MP Troll 9000

Test name: sod5-blank

Test defined on: 8/25/2009 11:10:40
Test started on: 8/25/2009 11:10:52
Test stopped on: 8/25/2009 13:34:43

Data gathered using Linear testing
Time between data points: 60.0 Seconds.
Number of data samples: 144

TOTAL DATA SAMPLES 144

Date	Time	ET (sec)	Chan[1] Temperature Fahrenheit	Chan[3] Barometric Inches Hg	Chan[5] Battery Volts	Chan[11] ORP millivolts	Chan[12] pH pH	Chan[37] Rugged DO micrograms/L	Chan[37] Rugged DO Sat %Saturation	Chan[45] Conductivity microSiemens /cm Actual Conductivity	Notes
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8/25/2009	12:10	0	88.67	27.702	2.968	-1	6.31	5510	81.0609	1.26	Test started
8/25/2009	12:11	60	89.86	27.918	2.941	3	6.24	5472	80.7875	164.12	
8/25/2009	12:12	120	87.76	27.948	2.968	-6	6.31	5465	78.9765	1.26	
8/25/2009	12:13	180	72.59	28.102	2.941	16	6.79	6989	86.3737	790.64	Probe in chamber
8/25/2009	12:14	240	72.63	28.289	2.941	-43	7.31	7942	97.5184	796.1	
8/25/2009	12:15	300	72.55	28.427	2.941	-58	7.46	7930	96.8044	797.63	
8/25/2009	12:16	360	72.54	28.538	2.941	-64	7.54	7961	96.7846	798.39	
8/25/2009	12:17	420	72.51	28.64	2.941	-66	7.59	7974	96.5541	797.77	
8/25/2009	12:18	480	72.53	28.714	2.889	-68	7.63	7970	96.2756	798.23	
8/25/2009	12:19	540	72.57	28.778	2.968	-69	7.64	7978	96.1897	798.68	
8/25/2009	12:20	600	72.68	28.829	2.968	-70	7.66	7958	95.8892	799.91	
8/25/2009	12:21	660	69.89	28.833	2.941	-56	7.71	8240	96.0979	1.26	Probe adjusted
8/25/2009	12:22	720	70.86	28.836	2.941	-66	7.76	8124	95.9738	779.33	
8/25/2009	12:23	780	70.75	28.789	2.915	-75	7.74	7852	92.8104	779.18	
8/25/2009	12:24	840	70.83	28.727	2.968	-77	7.73	7842	92.976	779.61	
8/25/2009	12:25	900	70.85	28.669	2.968	-78	7.74	7857	93.3643	779.75	
8/25/2009	12:26	960	70.87	28.618	2.968	-79	7.74	7852	93.4918	780.04	
8/25/2009	12:27	1020	70.89	28.575	2.968	-79	7.74	7855	93.6995	780.18	
8/25/2009	12:28	1080	70.93	28.539	2.968	-80	7.74	7855	93.8549	780.46	
8/25/2009	12:29	1140	70.93	28.509	2.968	-80	7.74	7861	94.0396	780.6	
8/25/2009	12:30	1200	70.96	28.479	2.915	-81	7.74	7865	94.2099	780.6	Data used for analysis
8/25/2009	12:31	1260	70.99	28.452	2.941	-81	7.74	7861	94.2842	781.03	
8/25/2009	12:32	1320	71.01	28.43	2.968	-82	7.75	7845	94.1941	781.32	
8/25/2009	12:33	1380	71.03	28.412	2.941	-82	7.75	7860	94.4488	781.32	
8/25/2009	12:34	1440	71.04	28.397	2.968	-83	7.75	7854	94.4382	781.75	
8/25/2009	12:35	1500	71.08	28.377	2.968	-83	7.75	7856	94.576	781.75	
8/25/2009	12:36	1560	71.11	28.361	2.915	-84	7.75	7850	94.5876	782.19	
8/25/2009	12:37	1620	71.13	28.35	2.941	-84	7.75	7858	94.7406	782.48	
8/25/2009	12:38	1680	71.15	28.342	2.968	-85	7.75	7856	94.7665	782.62	
8/25/2009	12:39	1740	71.17	28.335	2.968	-84	7.75	7859	94.8473	782.62	
8/25/2009	12:40	1800	71.19	28.328	2.968	-85	7.75	7861	94.92	782.91	
8/25/2009	12:41	1860	71.21	28.325	2.968	-85	7.75	7856	94.8919	783.21	
8/25/2009	12:42	1920	71.26	28.322	2.941	-86	7.75	7850	94.8785	783.5	
8/25/2009	12:43	1980	71.28	28.316	2.968	-86	7.75	7857	94.9987	783.8	
8/25/2009	12:44	2040	71.29	28.313	2.968	-86	7.75	7850	94.9343	783.79	
8/25/2009	12:45	2100	71.32	28.311	2.968	-87	7.75	7860	95.106	784.24	
8/25/2009	12:46	2160	71.35	28.309	2.915	-87	7.75	7860	95.1319	784.39	
8/25/2009	12:47	2220	71.38	28.31	2.915	-88	7.75	7861	95.1782	784.68	
8/25/2009	12:48	2280	71.41	28.312	2.968	-88	7.75	7855	95.1226	784.98	
8/25/2009	12:49	2340	71.43	28.312	2.968	-88	7.75	7852	95.1114	785.13	
8/25/2009	12:50	2400	71.44	28.313	2.941	-89	7.75	7857	95.1799	785.42	
8/25/2009	12:51	2460	71.46	28.314	2.915	-89	7.75	7854	95.1518	785.72	
8/25/2009	12:52	2520	71.49	28.317	2.968	-90	7.75	7847	95.0965	785.72	
8/25/2009	12:53	2580	71.52	28.318	2.968	-90	7.75	7852	95.1791	786.17	

Hanover Park
Blank Chamber

8/25/2009	12:54	2640	71.54	28.315	2.941	-91	7.75	7856	95.2606	786.31	
8/25/2009	12:55	2700	71.58	28.311	2.915	-91	7.75	7849	95.2222	786.61	
8/25/2009	12:56	2760	71.61	28.312	2.968	-92	7.75	7842	95.1677	786.76	
8/25/2009	12:57	2820	71.62	28.308	2.968	-92	7.75	7847	95.2577	786.91	
8/25/2009	12:58	2880	71.64	28.302	2.968	-92	7.75	7860	95.4635	787.21	
8/25/2009	12:59	2940	71.67	28.297	2.968	-92	7.75	7853	95.4206	787.51	
8/25/2009	13:00	3000	71.69	28.293	2.915	-93	7.75	7848	95.3947	787.66	
8/25/2009	13:01	3060	71.73	28.289	2.968	-93	7.75	7850	95.463	787.81	
8/25/2009	13:02	3120	71.75	28.286	2.889	-93	7.75	7851	95.5133	788.26	
8/25/2009	13:03	3180	71.79	28.286	2.915	-93	7.75	7858	95.6356	788.41	
8/25/2009	13:04	3240	71.79	28.284	2.968	-94	7.75	7855	95.5997	788.71	
8/25/2009	13:05	3300	71.82	28.284	2.968	-94	7.75	7842	95.4864	788.86	
8/25/2009	13:06	3360	71.84	28.283	2.941	-94	7.75	7853	95.6429	789.01	
8/25/2009	13:07	3420	71.89	28.279	2.941	-94	7.75	7854	95.7144	789.31	
8/25/2009	13:08	3480	71.91	28.274	2.968	-94	7.75	7851	95.7242	789.61	
8/25/2009	13:09	3540	71.93	28.272	2.941	-95	7.75	7852	95.7627	789.91	
8/25/2009	13:10	3600	71.95	28.27	2.968	-94	7.75	7848	95.7316	790.21	
8/25/2009	13:11	3660	71.98	28.27	2.968	-94	7.75	7855	95.846	790.36	
8/25/2009	13:12	3720	72	28.269	2.968	-95	7.75	7850	95.8209	790.51	
8/25/2009	13:13	3780	72.02	28.269	2.941	-95	7.75	7852	95.8603	790.81	
8/25/2009	13:14	3840	72.07	28.27	2.941	-95	7.75	7847	95.846	790.96	
8/25/2009	13:15	3900	72.07	28.271	2.968	-95	7.75	7850	95.8752	791.42	
8/25/2009	13:16	3960	72.12	28.273	2.968	-96	7.75	7842	95.8294	791.57	
8/25/2009	13:17	4020	72.14	28.275	2.889	-96	7.75	7849	95.9251	791.87	
8/25/2009	13:18	4080	72.18	28.275	2.968	-96	7.75	7854	96.0244	792.02	
8/25/2009	13:19	4140	72.19	28.273	2.968	-97	7.75	7846	95.9482	792.32	
8/25/2009	13:20	4200	72.21	28.272	2.968	-97	7.75	7850	96.0269	792.63	
8/25/2009	13:21	4260	72.25	28.271	2.941	-97	7.75	7850	96.0723	792.78	
8/25/2009	13:22	4320	72.26	28.272	2.968	-97	7.75	7855	96.127	792.93	
8/25/2009	13:23	4380	72.29	28.273	2.968	-97	7.75	7855	96.1535	793.38	
8/25/2009	13:24	4440	72.31	28.274	2.968	-97	7.74	7847	96.0824	793.38	
8/25/2009	13:25	4500	72.35	28.272	2.968	-97	7.75	7851	96.1761	793.84	
8/25/2009	13:26	4560	72.38	28.272	2.968	-97	7.75	7845	96.1274	793.99	
8/25/2009	13:27	4620	72.38	28.273	2.915	-97	7.75	7847	96.1601	794.3	
8/25/2009	13:28	4680	72.41	28.275	2.915	-97	7.75	7855	96.2748	794.45	
8/25/2009	13:29	4740	72.45	28.275	2.915	-97	7.75	7848	96.2298	794.6	
8/25/2009	13:30	4800	72.48	28.279	2.968	-98	7.75	7855	96.3283	794.91	
8/25/2009	13:31	4860	72.49	28.28	2.968	-98	7.75	7844	96.2017	795.21	
8/25/2009	13:32	4920	72.51	28.283	2.968	-98	7.75	7850	96.2901	795.52	
8/25/2009	13:33	4980	72.55	28.284	2.915	-98	7.75	7853	96.3623	795.82	
8/25/2009	13:34	5040	72.57	28.287	2.968	-98	7.75	7851	96.3514	795.97	
8/25/2009	13:35	5100	72.6	28.289	2.968	-99	7.75	7848	96.3385	796.28	
8/25/2009	13:36	5160	72.62	28.29	2.968	-99	7.75	7851	96.3991	796.59	
8/25/2009	13:37	5220	72.64	28.294	2.968	-99	7.75	7844	96.3088	796.74	
8/25/2009	13:38	5280	72.67	28.297	2.968	-99	7.75	7845	96.3425	797.05	
8/25/2009	13:39	5340	72.71	28.299	2.968	-99	7.75	7851	96.4538	797.2	
8/25/2009	13:40	5400	72.74	28.301	2.968	-99	7.75	7844	96.3847	797.66	
8/25/2009	13:41	5460	72.75	28.306	2.968	-99	7.75	7851	96.4727	797.81	
8/25/2009	13:42	5520	72.8	28.311	2.941	-99	7.75	7843	96.4039	798.12	
8/25/2009	13:43	5580	72.84	28.316	2.915	-99	7.75	7840	96.3801	798.43	
8/25/2009	13:44	5640	72.84	28.322	2.968	-99	7.75	7844	96.419	798.58	
8/25/2009	13:45	5700	72.89	28.328	2.915	-99	7.75	7837	96.3644	799.04	
8/25/2009	13:46	5760	72.91	28.334	2.968	-99	7.75	7845	96.4525	799.2	
8/25/2009	13:47	5820	72.95	28.343	2.889	-99	7.75	7840	96.4093	799.51	
8/25/2009	13:48	5880	72.98	28.349	2.941	-100	7.75	7843	96.4551	799.66	
8/25/2009	13:49	5940	73.01	28.355	2.915	-99	7.75	7840	96.4386	800.12	
8/25/2009	13:50	6000	73.04	28.36	2.968	-99	7.75	7846	96.5182	800.59	
8/25/2009	13:51	6060	73.08	28.367	2.941	-100	7.75	7842	96.4807	800.74	
8/25/2009	13:52	6120	73.09	28.374	2.941	-100	7.75	7840	96.4383	801.05	
8/25/2009	13:53	6180	73.12	28.376	2.941	-101	7.75	7839	96.4549	801.36	
8/25/2009	13:54	6240	73.15	28.379	2.915	-100	7.75	7842	96.5107	801.52	
8/25/2009	13:55	6300	73.18	28.38	2.968	-101	7.75	7844	96.5653	801.83	
8/25/2009	13:56	6360	73.22	28.385	2.968	-101	7.75	7846	96.6155	802.14	
8/25/2009	13:57	6420	73.25	28.393	2.941	-101	7.75	7841	96.5583	802.6	
8/25/2009	13:58	6480	73.27	28.398	2.968	-101	7.75	7840	96.5423	802.6	
8/25/2009	13:59	6540	73.3	28.407	2.941	-101	7.75	7835	96.4815	803.07	
8/25/2009	14:00	6600	73.35	28.416	2.941	-101	7.75	7842	96.5855	803.23	
8/25/2009	14:01	6660	73.37	28.426	2.915	-101	7.75	7834	96.4698	803.69	
8/25/2009	14:02	6720	73.4	28.434	2.968	-101	7.75	7832	96.4509	803.85	
8/25/2009	14:03	6780	73.43	28.443	2.968	-101	7.75	7836	96.5005	804.16	
8/25/2009	14:04	6840	73.47	28.449	2.968	-101	7.75	7834	96.4923	804.47	
8/25/2009	14:05	6900	73.48	28.449	2.915	-101	7.75	7834	96.5049	804.79	
8/25/2009	14:06	6960	73.52	28.451	2.968	-101	7.75	7832	96.5162	804.94	
8/25/2009	14:07	7020	73.54	28.45	2.889	-101	7.75	7834	96.5627	805.25	
8/25/2009	14:08	7080	73.59	28.451	2.968	-102	7.75	7829	96.54	805.57	
8/25/2009	14:09	7140	73.6	28.455	2.968	-101	7.75	7829	96.552	805.88	
8/25/2009	14:10	7200	73.63	28.459	2.968	-101	7.75	7833	96.6059	806.04	
8/25/2009	14:11	7260	73.64	28.464	2.941	-101	7.75	7826	96.525	806.35	
8/25/2009	14:12	7320	73.68	28.468	2.968	-101	7.75	7822	96.4996	806.51	

Hanover Park
Blank Chamber

8/25/2009	14:13	7380	73.71	28.47	2.941	-101	7.75	7824	96.5451	806.98	
8/25/2009	14:14	7440	73.73	28.473	2.968	-101	7.75	7832	96.6473	806.98	
8/25/2009	14:15	7500	73.77	28.473	2.889	-102	7.75	7830	96.6703	807.45	
8/25/2009	14:16	7560	73.77	28.501	2.968	-104	7.76	7824	96.509	808.08	
8/25/2009	14:17	7620	73.81	28.581	2.968	-105	7.76	7819	96.1976	808.08	
8/25/2009	14:18	7680	73.83	28.674	2.889	-107	7.76	7817	95.8703	808.71	
8/25/2009	14:19	7740	73.85	28.695	2.968	-106	7.76	7814	95.7831	808.71	
8/25/2009	14:20	7800	73.87	28.696	2.941	-106	7.76	7819	95.8549	808.87	
8/25/2009	14:21	7860	73.9	28.771	2.915	-106	7.75	7817	95.6091	809.18	
8/25/2009	14:22	7920	73.93	28.796	2.968	-107	7.76	7808	95.4535	809.82	
8/25/2009	14:23	7980	73.96	28.798	2.968	-108	7.76	7804	95.4223	809.82	
8/25/2009	14:24	8040	73.96	28.799	2.915	-108	7.76	7808	95.4687	809.98	
8/25/2009	14:25	8100	73.98	28.802	2.968	-108	7.76	7781	95.1406	810.13	
8/25/2009	14:26	8160	73.98	28.803	2.941	-108	7.76	7757	94.8502	809.98	
8/25/2009	14:27	8220	73.99	28.801	2.968	-107	7.76	7753	94.8166	810.13	
8/25/2009	14:28	8280	74	28.804	2.968	-108	7.76	7731	94.5511	810.45	
8/25/2009	14:29	8340	74	28.808	2.968	-107	7.76	7719	94.3794	810.29	
8/25/2009	14:30	8400	74	28.805	2.941	-107	7.76	7717	94.3714	810.61	
8/25/2009	14:31	8460	74.01	28.837	2.968	-106	7.76	7805	95.3564	810.13	
8/25/2009	14:32	8520	74.03	28.874	2.968	-106	7.76	7772	94.8433	810.13	
8/25/2009	14:33	8580	74.02	28.915	2.968	-106	7.76	7781	94.8032	810.61	

West Chicago
Sediment Probe 1

In-Situ Inc. Troll 9000 Pro XP

Report generated: 8/27/2009 13:57:01
Report from file: ...\SN48381 2009-08-25 162103 wchicago-sed1.bin

Win-Situ® Version 4.58.14.0

Serial number: 48381
Firmware Version 2.13
Unit name: MP Troll 9000

Test name: wchicago-sed1

Test defined on: 8/25/2009 16:20:53
Test started on: 8/25/2009 16:21:03
Test stopped on: 8/25/2009 18:11:41

Data gathered using Linear testing
Time between data points: 60.0 Seconds.
Number of data samples: 111

TOTAL DATA SAMPLES 111

Date	Time	ET (sec)	Chan[1] Temperature Fahrenheit	Chan[3] Barometric Inches Hg	Chan[5] Battery Volts	Chan[11] ORP millivolts	Chan[12] pH pH	Chan[37] Rugged DO micrograms/L	Chan[37] Rugged DO Sat %Saturation	Chan[45] Conductivity microSiemens/cm Actual Conductivity	Notes
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8/25/2009	16:21:03	0	85.52	29.205	2.889	117	7.71	7922	106.9836	1.32	Test started
8/25/2009	16:22:03	60	85.52	29.204	2.889	111	7.79	7887	106.5266	1.32	
8/25/2009	16:23:03	120	86.03	29.203	2.941	109	7.81	7872	106.8527	1.32	
8/25/2009	16:24:03	180	86.72	29.195	2.941	109	7.69	7902	107.9912	1.32	
8/25/2009	16:25:03	240	88.03	29.343	2.941	108	7.78	7814	107.5712	1.32	
8/25/2009	16:26:03	300	88.67	29.37	2.968	106	7.79	7817	108.1603	1.32	
8/25/2009	16:27:03	360	84.44	29.393	2.941	129	7.57	7330	97.3109	1.32	
8/25/2009	16:28:03	420	81.28	29.417	2.941	189	6.42	7616	97.9406	2.6	
8/25/2009	16:29:03	480	76.99	29.431	2.941	218	6.21	7773	95.6779	1.32	
8/25/2009	16:30:03	540	77.17	29.434	2.941	258	5.91	7676	94.6444	1.32	
8/25/2009	16:31:03	600	78.85	29.443	2.968	269	6.1	7819	98.0308	1.32	
8/25/2009	16:32:03	660	80.72	29.443	2.941	270	6.11	7757	99.1058	1.33	
8/25/2009	16:33:03	720	80.04	29.445	2.941	257	6.18	7645	97.0032	1.32	
8/25/2009	16:34:03	780	79.87	29.442	2.941	241	6.27	7633	96.7045	1.32	
8/25/2009	16:35:03	840	79.96	29.437	2.889	247	6.15	7591	96.2731	1.32	
8/25/2009	16:36:03	900	80.16	29.433	2.968	261	5.88	7547	95.928	1.32	
8/25/2009	16:37:03	960	79.6	29.429	2.968	261	5.93	7470	94.4252	1.32	
8/25/2009	16:38:03	1020	79.65	29.424	2.941	263	5.92	7431	93.9924	1.32	
8/25/2009	16:39:03	1080	79.63	29.421	2.915	264	5.91	7455	94.2872	1.32	
8/25/2009	16:40:03	1140	79.55	29.414	2.941	262	5.93	7452	94.193	1.32	
8/25/2009	16:41:03	1200	79.73	29.409	2.968	266	5.88	7453	94.3887	1.32	
8/25/2009	16:42:03	1260	79.41	29.403	2.941	267	5.95	7448	94.0485	1.32	
8/25/2009	16:43:03	1320	79.45	29.397	2.968	278	5.82	7406	93.5841	1.32	
8/25/2009	16:44:03	1380	79.19	29.391	2.968	286	5.75	7448	93.8898	1.32	
8/25/2009	16:45:03	1440	79.16	29.383	2.863	283	5.87	7445	93.8449	1.32	
8/25/2009	16:46:03	1500	79.32	29.365	2.968	315	5.55	7475	94.4347	1.32	
8/25/2009	16:47:03	1560	79.57	29.368	2.941	314	5.52	7511	95.1057	1.32	
8/25/2009	16:48:03	1620	79.65	29.359	2.941	330	5.42	7495	95.02	1.32	
8/25/2009	16:49:03	1680	78.8	29.35	2.915	330	6.18	7638	96.0309	1.32	
8/25/2009	16:50:03	1740	77.25	29.344	2.941	203	8.22	9840	122.1472	950.4	Probe inserted in chamber
8/25/2009	16:51:03	1800	77.46	29.301	2.941	191	8.25	9911	123.4778	951.42	
8/25/2009	16:52:03	1860	77.36	29.26	2.941	184	8.27	9862	122.9263	951.19	
8/25/2009	16:53:03	1920	76.98	29.227	2.941	174	8.23	9885	122.8679	949.08	
8/25/2009	16:54:03	1980	77.01	29.198	2.941	164	8.24	9652	120.1358	947.81	
8/25/2009	16:55:03	2040	76.98	29.172	2.941	157	8.22	9613	119.7187	947.36	
8/25/2009	16:56:03	2100	76.97	29.15	2.941	151	8.21	9559	119.1293	947.53	
8/25/2009	16:57:03	2160	76.96	29.132	2.941	145	8.21	9464	118.0181	946.87	
8/25/2009	16:58:03	2220	76.95	29.118	2.941	140	8.2	9360	116.7616	946.63	
8/25/2009	16:59:03	2280	76.96	29.105	2.915	135	8.19	9315	116.2631	946.4	
8/25/2009	17:00:03	2340	76.95	29.094	2.941	131	8.19	9244	115.4052	946.78	
8/25/2009	17:01:03	2400	76.95	29.086	2.915	127	8.19	9213	115.0544	946.35	
8/25/2009	17:02:03	2460	76.94	29.079	2.941	123	8.18	9147	114.2531	946.53	
8/25/2009	17:03:03	2520	76.95	29.072	2.915	119	8.18	9140	114.2028	946.3	
8/25/2009	17:04:03	2580	76.94	29.066	2.915	116	8.18	9087	113.5444	946.29	
8/25/2009	17:05:03	2640	76.95	29.062	2.915	112	8.18	9025	112.8019	946.27	
8/25/2009	17:06:03	2700	76.96	29.059	2.941	110	8.17	8990	112.3874	946.05	
8/25/2009	17:07:03	2760	76.95	29.055	2.968	107	8.17	8963	112.0603	946.04	
8/25/2009	17:08:03	2820	76.95	29.053	2.941	104	8.17	8941	111.7887	946.03	
8/25/2009	17:09:03	2880	76.95	29.207	2.915	102	8.16	8851	110.0567	948.49	
8/25/2009	17:10:03	2940	76.96	29.206	2.889	99	8.16	8865	110.2516	948.28	
8/25/2009	17:11:03	3000	76.96	29.204	2.915	97	8.15	8790	109.3398	948.49	

West Chicago
Sediment Probe 1

8/25/2009	17:12:03	3060	76.97	29.203	2.941	95	8.15	8757	108.9301	948.28	
8/25/2009	17:13:03	3120	76.95	29.207	2.941	93	8.15	8778	109.1565	948.28	
8/25/2009	17:14:03	3180	76.96	29.206	2.863	91	8.15	8730	108.5766	948.28	
8/25/2009	17:15:03	3240	76.97	29.205	2.941	90	8.14	8686	108.0406	948.07	Data used for analysis
8/25/2009	17:16:03	3300	76.96	29.207	2.968	88	8.14	8636	107.4013	948.07	
8/25/2009	17:17:03	3360	76.96	29.204	2.941	87	8.14	8611	107.0963	948.27	
8/25/2009	17:18:03	3420	76.96	29.204	2.968	85	8.14	8560	106.4746	948.06	
8/25/2009	17:19:03	3480	76.98	29.203	2.915	84	8.13	8584	106.7851	948.27	
8/25/2009	17:20:03	3540	76.97	29.205	2.941	83	8.13	8544	106.273	948.48	
8/25/2009	17:21:03	3600	76.98	29.203	2.941	82	8.13	8523	106.0277	948.06	
8/25/2009	17:22:03	3660	76.97	29.204	2.968	81	8.13	8461	105.2469	948.27	
8/25/2009	17:23:03	3720	76.96	29.204	2.915	80	8.12	8492	105.6308	948.06	
8/25/2009	17:24:03	3780	76.99	29.204	2.941	79	8.12	8443	105.0378	948.06	
8/25/2009	17:25:03	3840	76.99	29.203	2.941	78	8.12	8416	104.7135	948.06	
8/25/2009	17:26:03	3900	76.98	29.205	2.941	77	8.12	8409	104.6118	948.47	
8/25/2009	17:27:03	3960	76.98	29.203	2.941	77	8.11	8372	104.1553	948.27	
8/25/2009	17:28:03	4020	76.97	29.202	2.915	76	8.11	8356	103.9479	948.27	
8/25/2009	17:29:03	4080	76.97	29.204	2.941	75	8.11	8341	103.7498	948.06	
8/25/2009	17:30:03	4140	76.96	29.202	2.941	75	8.11	8298	103.2154	948.89	
8/25/2009	17:31:03	4200	76.98	29.202	2.941	74	8.1	8296	103.2106	949.09	
8/25/2009	17:32:03	4260	76.95	29.202	2.941	74	8.1	8236	102.4436	948.68	
8/25/2009	17:33:03	4320	76.96	29.204	2.941	73	8.1	8232	102.3955	948.89	
8/25/2009	17:34:03	4380	76.97	29.2	2.915	73	8.1	8188	101.8578	948.68	
8/25/2009	17:35:03	4440	76.96	29.201	2.968	73	8.1	8159	101.4946	948.68	
8/25/2009	17:36:03	4500	76.96	29.202	2.941	72	8.1	8134	101.1765	948.89	
8/25/2009	17:37:03	4560	76.97	29.199	2.941	72	8.09	8114	100.9439	949.09	
8/25/2009	17:38:03	4620	76.96	29.198	2.941	72	8.09	8101	100.7731	949.3	
8/25/2009	17:39:03	4680	76.95	29.2	2.915	71	8.09	8105	100.8108	949.51	
8/25/2009	17:40:03	4740	76.95	29.198	2.941	71	8.09	8088	100.6111	949.51	
8/25/2009	17:41:03	4800	76.97	29.198	2.941	71	8.09	8060	100.2875	949.71	
8/25/2009	17:42:03	4860	76.96	29.199	2.941	71	8.08	8015	99.7041	949.51	
8/25/2009	17:43:03	4920	76.96	29.197	2.941	70	8.08	7987	99.3627	949.51	
8/25/2009	17:44:03	4980	76.95	29.197	2.941	70	8.08	7959	99.0072	949.51	
8/25/2009	17:45:03	5040	76.96	29.197	2.941	70	8.08	7970	99.1452	948.88	
8/25/2009	17:46:03	5100	76.97	29.199	2.915	70	8.08	7952	98.9279	948.88	
8/25/2009	17:47:03	5160	76.96	29.197	2.941	70	8.07	7906	98.3509	948.68	
8/25/2009	17:48:03	5220	76.96	29.196	2.941	70	8.07	7907	98.3777	948.68	
8/25/2009	17:49:03	5280	76.97	29.2	2.915	70	8.07	7892	98.1731	948.67	
8/25/2009	17:50:03	5340	76.96	29.196	2.941	69	8.07	7872	97.9407	948.67	
8/25/2009	17:51:03	5400	76.96	29.196	2.941	69	8.06	7812	97.1871	948.88	
8/25/2009	17:52:03	5460	76.96	29.196	2.915	69	8.06	7801	97.0576	949.09	
8/25/2009	17:53:03	5520	76.95	29.196	2.941	69	8.06	7804	97.0873	949.09	
8/25/2009	17:54:03	5580	76.96	29.195	2.941	69	8.06	7781	96.806	948.67	
8/25/2009	17:55:03	5640	76.94	29.194	2.941	69	8.06	7744	96.3315	948.88	
8/25/2009	17:56:03	5700	76.95	29.194	2.941	69	8.05	7718	96.0147	948.67	
8/25/2009	17:57:03	5760	76.93	29.196	2.941	69	8.05	7714	95.9408	948.88	
8/25/2009	17:58:03	5820	76.96	29.194	2.915	69	8.05	7689	95.6652	948.67	
8/25/2009	17:59:03	5880	76.95	29.196	2.941	69	8.05	7668	95.3933	948.46	
8/25/2009	18:00:03	5940	76.94	29.196	2.941	69	8.05	7658	95.2562	948.67	
8/25/2009	18:01:03	6000	76.94	29.196	2.863	69	8.04	7625	94.8414	948.87	
8/25/2009	18:02:03	6060	76.93	29.199	2.941	69	8.04	7620	94.7614	949.08	
8/25/2009	18:03:03	6120	76.93	29.197	2.941	69	8.04	7618	94.7461	948.67	
8/25/2009	18:04:03	6180	76.92	29.196	2.941	69	8.04	7591	94.4058	948.87	
8/25/2009	18:05:03	6240	76.92	29.199	2.941	69	8.04	7544	93.8086	949.08	
8/25/2009	18:06:03	6300	76.92	29.197	2.941	69	8.03	7538	93.7449	948.87	
8/25/2009	18:07:03	6360	76.92	29.199	2.915	69	8.03	7495	93.1922	949.08	
8/25/2009	18:08:03	6420	76.91	29.201	2.915	69	8.03	7508	93.3429	949.29	
8/25/2009	18:09:03	6480	76.91	29.199	2.941	69	8.03	7465	92.8182	949.29	
8/25/2009	18:10:03	6540	76.91	29.199	2.915	69	8.03	7485	93.0655	949.29	
8/25/2009	18:11:03	6600	76.91	29.203	2.889	69	8.02	7452	92.6379	949.08	

West Chicago
Sediment Probe 2

In-Situ Inc. Troll 9000 Pro XP

Report generated: 8/27/2009 13:28:47
Report from file: ...\SN48193 2009-08-25 162324 wchicago-s2.bin

Win-Situ® Version 4.58.14.0

Serial number: 48193
Firmware Version 2.13
Unit name: MP Troll 9000

Test name: wchicago-s2

Test defined on: 8/25/2009 16:23:17
Test started on: 8/25/2009 16:23:24
Test stopped on: 8/25/2009 18:14:42

Data gathered using Linear testing
Time between data points: 60.0 Seconds.
Number of data samples: 112

TOTAL DATA SAMPLES 112

Date	Time	ET (sec)	Chan[1] Temperature Fahrenheit	Chan[3] Barometric Inches Hg	Chan[5] Battery Volts	Chan[11] ORP millivolts	Chan[12] pH pH	Chan[37] Rugged DO micrograms/L	Chan[37] Rugged DO Sat %Saturation	Chan[45] Conductivity microSiemens/cm Actual Conductivity	Notes
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8/25/2009	16:23:24	0	86.73	29.272	3.147	808	-4.2	7766	105.8674	1.3	Test Started
8/25/2009	16:24:24	60	87.08	29.4	3.088	655	-2.11	7703	104.865	1.3	
8/25/2009	16:25:24	120	87.42	29.433	3.088	1415	-15.35	7639	104.2128	1.3	
8/25/2009	16:26:24	180	87.64	29.463	3.147	1375	-14.57	7569	103.3752	1.3	
8/25/2009	16:27:24	240	82.36	29.504	3.117	184	7.54	7184	93.0919	1.3	
8/25/2009	16:28:24	300	77.6	29.517	3.117	161	6.83	7643	94.3947	61.08	
8/25/2009	16:29:24	360	79.12	29.511	3.088	174	6.72	7709	96.7037	60.59	
8/25/2009	16:30:24	420	80.09	29.52	3.117	174	6.83	7818	99.0044	59.99	
8/25/2009	16:31:24	480	79.77	29.5	3.147	265	6.54	7906	99.8678	57.88	
8/25/2009	16:32:24	540	79.87	29.489	3.147	263	6.7	7850	99.3043	58.12	
8/25/2009	16:33:24	600	80.49	29.476	3.147	224	6.87	7804	99.3833	59.27	
8/25/2009	16:34:24	660	81.12	29.461	3.147	213	6.84	7752	99.389	58.34	
8/25/2009	16:35:24	720	81.57	29.449	3.117	207	6.83	7746	99.8085	58.07	
8/25/2009	16:36:24	780	81.93	29.437	3.117	203	6.82	7685	99.4106	58.06	
8/25/2009	16:37:24	840	82.2	29.426	3.117	202	6.86	7690	99.7782	59.17	
8/25/2009	16:38:24	900	82.45	29.416	3.117	200	6.88	7734	100.6235	58.41	
8/25/2009	16:39:24	960	82.61	29.407	3.117	201	6.9	7690	100.2454	58.63	
8/25/2009	16:40:24	1020	82.78	29.398	3.147	202	6.88	7673	100.2256	58.88	
8/25/2009	16:41:24	1080	82.88	29.389	3.147	205	6.86	7693	100.6244	58.05	
8/25/2009	16:42:24	1140	83.01	29.381	3.117	202	6.92	7700	100.8696	58.38	
8/25/2009	16:43:24	1200	83.05	29.374	3.147	216	6.8	7693	100.8427	58.47	
8/25/2009	16:44:24	1260	83.01	29.365	3.147	215	6.84	7714	101.0966	58.32	
8/25/2009	16:45:24	1320	83.07	29.356	3.147	215	6.86	7692	100.9007	58.54	
8/25/2009	16:46:24	1380	82.1	29.365	3.088	261	6.68	7793	101.2232	58.47	
8/25/2009	16:47:24	1440	81.01	29.362	3.147	295	6.26	7636	98.1304	56.51	
8/25/2009	16:48:24	1500	80.74	29.368	3.147	309	6.29	7416	95.0287	56.41	
8/25/2009	16:49:24	1560	77.21	29.35	3.117	181	8.13	8910	110.53	964.55	Probe in chamber
8/25/2009	16:50:24	1620	77.14	29.329	3.147	176	8.14	8343	103.5093	964.31	
8/25/2009	16:51:24	1680	77.09	29.299	3.088	172	8.15	8147	101.1257	963.53	
8/25/2009	16:52:24	1740	77.08	29.273	3.117	169	8.16	8149	101.2386	963.32	
8/25/2009	16:53:24	1800	77.01	29.239	3.117	166	8.14	8381	104.164	962.84	
8/25/2009	16:54:24	1860	76.98	29.215	3.117	160	8.11	8527	106.0451	962.63	
8/25/2009	16:55:24	1920	76.95	29.195	3.088	153	8.09	8407	104.5866	962.14	
8/25/2009	16:56:24	1980	76.93	29.178	3.117	149	8.08	8347	103.8882	961.93	
8/25/2009	16:57:24	2040	76.92	29.165	3.117	145	8.07	8309	103.4578	961.71	
8/25/2009	16:58:24	2100	76.91	29.154	3.117	141	8.07	8283	103.1489	961.76	
8/25/2009	16:59:24	2160	76.9	29.145	3.117	138	8.06	8244	102.6915	961.53	
8/25/2009	17:00:24	2220	76.89	29.138	3.117	135	8.05	8210	102.2763	961.57	
8/25/2009	17:01:24	2280	76.89	29.131	3.088	132	8.05	8140	101.4373	961.6	
8/25/2009	17:02:24	2340	76.88	29.126	3.088	130	8.04	8116	101.1571	961.36	
8/25/2009	17:03:24	2400	76.88	29.122	3.088	128	8.04	8089	100.8136	961.38	
8/25/2009	17:04:24	2460	76.87	29.119	3.088	126	8.04	8049	100.3311	961.41	
8/25/2009	17:05:24	2520	76.87	29.117	3.088	124	8.04	8026	100.0452	961.15	
8/25/2009	17:06:24	2580	76.88	29.114	3.147	123	8.03	7988	99.5889	961.17	
8/25/2009	17:07:24	2640	76.89	29.283	3.117	122	8.03	7965	98.7241	961.19	
8/25/2009	17:08:24	2700	76.87	29.276	3.117	121	8.03	7939	98.4113	961.48	

West Chicago
Sediment Probe 2

8/25/2009	17:09:24	2760	76.86	29.277	3.088	121	8.03	7900	97.9122	961.77	
8/25/2009	17:10:24	2820	76.85	29.274	3.117	120	8.02	7876	97.6032	961.77	
8/25/2009	17:11:24	2880	76.86	29.273	3.088	119	8.02	7844	97.2235	961.77	
8/25/2009	17:12:24	2940	76.85	29.275	3.088	118	8.02	7813	96.8261	961.77	
8/25/2009	17:13:24	3000	76.84	29.274	3.117	118	8.02	7792	96.5601	961.78	
8/25/2009	17:14:24	3060	76.84	29.275	3.088	117	8.02	7756	96.1079	961.78	
8/25/2009	17:15:24	3120	76.84	29.276	3.117	116	8.02	7746	95.9921	961.78	Data used for analysis
8/25/2009	17:16:24	3180	76.85	29.275	3.117	116	8.02	7735	95.8702	961.78	
8/25/2009	17:17:24	3240	76.85	29.275	3.088	116	8.02	7711	95.5665	961.78	
8/25/2009	17:18:24	3300	76.85	29.274	3.088	115	8.02	7694	95.3545	961.78	
8/25/2009	17:19:24	3360	76.84	29.273	3.117	115	8.01	7675	95.1125	961.78	
8/25/2009	17:20:24	3420	76.84	29.275	3.088	115	8.01	7650	94.8008	961.79	
8/25/2009	17:21:24	3480	76.85	29.275	3.088	114	8.01	7643	94.7223	962.06	
8/25/2009	17:22:24	3540	76.84	29.274	3.117	114	8.01	7622	94.4552	961.79	
8/25/2009	17:23:24	3600	76.83	29.275	3.088	114	8.01	7601	94.1838	962.06	
8/25/2009	17:24:24	3660	76.84	29.273	3.117	114	8.01	7579	93.9279	962.06	
8/25/2009	17:25:24	3720	76.84	29.275	3.117	113	8.01	7558	93.6594	961.79	
8/25/2009	17:26:24	3780	76.83	29.273	3.088	113	8.01	7539	93.4207	961.78	
8/25/2009	17:27:24	3840	76.83	29.274	3.117	113	8.01	7518	93.1606	962.06	
8/25/2009	17:28:24	3900	76.85	29.273	3.117	113	8	7519	93.1851	961.78	
8/25/2009	17:29:24	3960	76.83	29.273	3.117	113	8	7494	92.8577	961.78	
8/25/2009	17:30:24	4020	76.83	29.274	3.117	113	8	7475	92.6265	961.78	
8/25/2009	17:31:24	4080	76.83	29.272	3.117	113	8	7462	92.4632	962.06	
8/25/2009	17:32:24	4140	76.83	29.272	3.117	113	8	7447	92.2791	962.06	
8/25/2009	17:33:24	4200	76.83	29.272	3.088	113	8	7437	92.1533	962.06	
8/25/2009	17:34:24	4260	76.83	29.271	3.117	113	7.99	7420	91.9451	962.06	
8/25/2009	17:35:24	4320	76.84	29.271	3.088	113	7.99	7396	91.6548	962.06	
8/25/2009	17:36:24	4380	76.84	29.269	3.117	113	7.99	7383	91.5066	962.05	
8/25/2009	17:37:24	4440	76.83	29.269	3.117	113	7.99	7371	91.3559	962.05	
8/25/2009	17:38:24	4500	76.84	29.269	3.117	113	7.99	7358	91.2003	962.05	
8/25/2009	17:39:24	4560	76.84	29.269	3.088	113	7.99	7335	90.9108	961.78	
8/25/2009	17:40:24	4620	76.83	29.269	3.088	113	7.99	7318	90.7032	962.06	
8/25/2009	17:41:24	4680	76.84	29.267	3.088	113	7.99	7299	90.4697	962.06	
8/25/2009	17:42:24	4740	76.83	29.267	3.088	113	7.99	7297	90.4352	961.78	
8/25/2009	17:43:24	4800	76.84	29.268	3.117	113	7.98	7264	90.0306	961.78	
8/25/2009	17:44:24	4860	76.84	29.267	3.088	113	7.98	7253	89.9032	961.78	
8/25/2009	17:45:24	4920	76.83	29.267	3.088	113	7.98	7249	89.8409	961.78	
8/25/2009	17:46:24	4980	76.82	29.267	3.117	113	7.98	7213	89.3827	961.78	
8/25/2009	17:47:24	5040	76.83	29.267	3.088	113	7.98	7207	89.3197	962.06	
8/25/2009	17:48:24	5100	76.81	29.268	3.117	113	7.98	7183	89.0118	962.06	
8/25/2009	17:49:24	5160	76.82	29.266	3.117	113	7.98	7175	88.9198	961.78	
8/25/2009	17:50:24	5220	76.82	29.266	3.117	114	7.97	7146	88.5639	962.06	
8/25/2009	17:51:24	5280	76.83	29.264	3.117	115	7.97	7131	88.39	961.78	
8/25/2009	17:52:24	5340	76.82	29.265	3.088	114	7.97	7113	88.1528	961.78	
8/25/2009	17:53:24	5400	76.82	29.265	3.058	114	7.97	7098	87.9746	961.78	
8/25/2009	17:54:24	5460	76.81	29.264	3.117	114	7.97	7104	88.0476	962.06	
8/25/2009	17:55:24	5520	76.83	29.265	3.117	114	7.97	7080	87.7575	961.79	
8/25/2009	17:56:24	5580	76.82	29.265	3.117	114	7.97	7059	87.4847	961.79	
8/25/2009	17:57:24	5640	76.82	29.266	3.117	114	7.96	7051	87.3903	961.79	
8/25/2009	17:58:24	5700	76.82	29.264	3.117	115	7.96	7052	87.4081	961.79	
8/25/2009	17:59:24	5760	76.81	29.265	3.088	115	7.96	7020	86.987	961.79	
8/25/2009	18:00:24	5820	76.8	29.265	3.117	115	7.96	7004	86.7796	961.52	
8/25/2009	18:01:24	5880	76.82	29.267	3.117	115	7.96	6987	86.5837	961.52	
8/25/2009	18:02:24	5940	76.8	29.267	3.058	115	7.96	6974	86.4128	961.52	
8/25/2009	18:03:24	6000	76.8	29.267	3.117	115	7.96	6959	86.2298	961.52	
8/25/2009	18:04:24	6060	76.8	29.267	3.117	115	7.96	6946	86.0608	961.52	
8/25/2009	18:05:24	6120	76.8	29.267	3.058	115	7.96	6931	85.8677	961.52	
8/25/2009	18:06:24	6180	76.79	29.269	3.088	115	7.96	6918	85.7008	961.52	
8/25/2009	18:07:24	6240	76.78	29.268	3.117	115	7.95	6901	85.4827	961.52	
8/25/2009	18:08:24	6300	76.78	29.27	3.088	115	7.95	6895	85.4036	961.52	
8/25/2009	18:09:24	6360	76.78	29.27	3.088	116	7.95	6881	85.2288	961.25	
8/25/2009	18:10:24	6420	76.76	29.271	3.117	116	7.95	6862	84.9728	961.25	
8/25/2009	18:11:24	6480	76.76	29.269	3.117	116	7.95	6846	84.7843	961.53	
8/25/2009	18:12:24	6540	76.77	29.269	3.117	116	7.95	6827	84.5591	961.53	
8/25/2009	18:13:24	6600	76.75	29.269	3.117	116	7.95	6811	84.3361	961.53	
8/25/2009	18:14:24	6660	76.77	29.27	3.088	117	7.96	6806	84.298	960.99	

West Chicago
Blank Chamber

In-Situ Inc. Troll 9000 Pro XP

Report generated: 8/27/2009 13:47:55
Report from file: ...\SN48396 2009-08-25 151833 wchicago-blank.bin
Win-Situ®
Version 4.58.14.0

Serial number: 48396
Firmware Version 2.13
Unit name: MP Troll 9000

Test name: wchicago-blank

Test defined on: 8/25/2009 15:18:23
Test started on: 8/25/2009 15:18:33
Test stopped on: 8/25/2009 17:15:29

Data gathered using Linear testing
Time between data points: 60.0 Seconds.
Number of data samples: 117

TOTAL DATA SAMPLES 117

Date	Time	ET (sec)	Chan[1] Temperature Fahrenheit	Chan[3] Barometric Inches Hg	Chan[5] Battery Volts	Chan[11] ORP millivolts	Chan[12] pH pH	Chan[37] Rugged DO micrograms/L	Chan[37] Rugged DO Sat %Saturation	Chan[45] Conductivity microSiemens/cm Actual Conductivity	Notes
8/25/2009	16:18:33	0	85.71	29.297	2.941	-99	8	7870	106.1311	1.26	Test Started
8/25/2009	16:19:33	60	86.53	29.319	2.915	-97	8.01	7873	106.9337	1.26	
8/25/2009	16:20:33	120	87	29.347	2.889	-97	8	7908	107.7902	1.26	
8/25/2009	16:21:33	180	87.85	29.374	2.889	-96	8	7876	108.1265	1.26	
8/25/2009	16:22:33	240	88.48	29.394	2.941	-95	8	7858	108.4359	1.26	
8/25/2009	16:23:33	300	89.08	29.411	2.941	-95	7.99	7808	108.3062	1.26	
8/25/2009	16:24:33	360	90.28	29.495	2.915	-93	7.99	7641	106.8704	1.26	
8/25/2009	16:25:33	420	90.64	29.53	2.941	-93	7.99	7614	106.7099	1.26	
8/25/2009	16:26:33	480	90.92	29.559	2.941	-92	7.98	7565	106.1899	1.26	
8/25/2009	16:27:33	540	86.15	29.591	2.941	-101	8.05	6938	92.9879	1.26	
8/25/2009	16:28:33	600	78.35	29.606	2.889	-77	7.41	7787	96.5853	1.26	
8/25/2009	16:29:33	660	78.53	29.606	2.941	-67	6.92	7799	96.9191	1.26	
8/25/2009	16:30:33	720	79.31	29.596	2.889	-523	6.82	7768	97.3314	1.26	
8/25/2009	16:31:33	780	78.1	29.59	2.941	-750	6.81	7864	97.3531	1.26	
8/25/2009	16:32:33	840	79.21	29.587	2.941	-551	6.87	7800	97.6657	1.26	
8/25/2009	16:33:33	900	81.32	29.566	2.915	-331	7.12	7630	97.6406	1.26	
8/25/2009	16:34:33	960	82.45	29.551	2.889	-276	7.1	7584	98.2039	1.26	
8/25/2009	16:35:33	1020	83.17	29.537	2.889	-227	7.2	7581	98.9014	1.26	
8/25/2009	16:36:33	1080	83.52	29.524	2.915	-282	7.13	7588	99.3781	1.26	
8/25/2009	16:37:33	1140	84.53	29.512	2.968	-338	7.11	7573	100.2105	1.26	
8/25/2009	16:38:33	1200	85.05	29.5	2.941	-386	7.12	7595	101.047	1.26	
8/25/2009	16:39:33	1260	85.08	29.489	2.968	-403	7.05	7635	101.6447	1.26	
8/25/2009	16:40:33	1320	85.37	29.478	2.968	-399	7.1	7702	102.8654	1.26	
8/25/2009	16:41:33	1380	85.19	29.467	2.915	-492	7.02	7749	103.3576	1.26	
8/25/2009	16:42:33	1440	85.42	29.456	2.968	-403	7.05	7744	103.5588	1.26	
8/25/2009	16:43:33	1500	85.17	29.446	2.941	-614	6.93	7844	104.6812	1.26	
8/25/2009	16:44:33	1560	84.95	29.434	2.941	-626	6.89	7874	104.9034	1.26	
8/25/2009	16:45:33	1620	84.59	29.421	2.941	-1393	6.62	7869	104.5227	1.26	
8/25/2009	16:46:33	1680	80.33	29.412	2.941	-593	6.9	8036	102.3843	1.26	
8/25/2009	16:47:33	1740	81.29	29.408	2.889	-761	6.46	8101	104.2106	1.26	
8/25/2009	16:48:33	1800	81.83	29.398	2.968	-638	6.25	8107	104.8972	1.26	
8/25/2009	16:49:33	1860	80.64	29.391	2.968	-1393	4.83	8108	103.6996	1.26	
8/25/2009	16:50:33	1920	77.44	29.356	2.889	-16	8.23	10189	126.6754	967.12	Probe in chamber
8/25/2009	16:51:33	1980	77.34	29.308	2.941	-41	8.2	10284	127.9455	965.09	
8/25/2009	16:52:33	2040	77.4	29.261	2.941	-52	8.2	10199	127.1725	965.31	
8/25/2009	16:53:33	2100	77.38	29.225	2.889	-58	8.2	10064	125.6311	965.98	
8/25/2009	16:54:33	2160	77.28	29.186	2.941	-62	8.2	9949	124.2239	963.28	
8/25/2009	16:55:33	2220	77.17	29.154	2.915	-65	8.19	9897	123.5854	963.06	
8/25/2009	16:56:33	2280	77.16	29.127	2.889	-67	8.19	9868	123.33	963.05	
8/25/2009	16:57:33	2340	77.17	29.106	2.889	-69	8.2	9851	123.2286	963.04	
8/25/2009	16:58:33	2400	77.16	29.087	2.941	-70	8.2	9832	123.057	963.04	
8/25/2009	16:59:33	2460	77.16	29.071	2.941	-71	8.2	9815	122.9085	963.03	
8/25/2009	17:00:33	2520	77.16	29.057	2.889	-72	8.2	9797	122.7339	963.25	
8/25/2009	17:01:33	2580	77.16	29.046	2.941	-73	8.2	9779	122.5648	963.02	
8/25/2009	17:02:33	2640	77.15	29.037	2.941	-74	8.2	9774	122.5348	963.24	
8/25/2009	17:03:33	2700	77.17	29.029	2.941	-75	8.2	9757	122.3769	963.46	
8/25/2009	17:04:33	2760	77.17	29.023	2.915	-76	8.2	9746	122.2737	963.23	
8/25/2009	17:05:33	2820	77.17	29.018	2.889	-76	8.2	9729	122.0837	963.45	

West Chicago
Blank Chamber

8/25/2009	17:06:33	2880	77.17	29.014	2.941	-77	8.2	9717	121.9475	963.23	
8/25/2009	17:07:33	2940	77.18	29.008	2.941	-77	8.2	9695	121.7013	963.45	
8/25/2009	17:08:33	3000	77.18	29.003	2.941	-78	8.2	9702	121.8151	963.45	
8/25/2009	17:09:33	3060	77.18	28.999	2.941	-78	8.2	9697	121.7624	963.67	
8/25/2009	17:10:33	3120	77.17	28.997	2.915	-78	8.2	9662	121.3335	963.67	
8/25/2009	17:11:33	3180	77.17	28.994	2.941	-79	8.2	9651	121.2027	963.89	
8/25/2009	17:12:33	3240	77.18	28.992	2.941	-80	8.2	9655	121.2732	964.11	
8/25/2009	17:13:33	3300	77.19	28.992	2.941	-80	8.2	9648	121.1936	964.33	
8/25/2009	17:14:33	3360	77.19	28.992	2.941	-81	8.2	9641	121.116	964.33	
8/25/2009	17:15:33	3420	77.2	28.992	2.941	-81	8.2	9620	120.8537	965.23	Data used for analysis
8/25/2009	17:16:33	3480	77.2	28.994	2.941	-81	8.2	9610	120.7221	965.45	
8/25/2009	17:17:33	3540	77.19	28.996	2.941	-82	8.2	9613	120.7381	965.23	
8/25/2009	17:18:33	3600	77.21	28.998	2.941	-83	8.2	9608	120.6962	965.67	
8/25/2009	17:19:33	3660	77.21	29	2.941	-83	8.2	9597	120.5458	965.9	
8/25/2009	17:20:33	3720	77.2	28.999	2.941	-84	8.2	9589	120.4366	965.9	
8/25/2009	17:21:33	3780	77.22	28.998	2.941	-84	8.2	9586	120.4291	966.35	
8/25/2009	17:22:33	3840	77.2	28.995	2.889	-84	8.2	9575	120.2875	966.57	
8/25/2009	17:23:33	3900	77.21	28.992	2.941	-85	8.2	9572	120.2609	966.57	
8/25/2009	17:24:33	3960	77.2	28.987	2.915	-85	8.2	9566	120.2023	966.8	
8/25/2009	17:25:33	4020	77.21	28.982	2.941	-85	8.2	9569	120.2716	966.8	
8/25/2009	17:26:33	4080	77.21	28.977	2.941	-86	8.2	9563	120.2257	966.57	
8/25/2009	17:27:33	4140	77.22	28.973	2.941	-85	8.2	9556	120.1635	966.79	
8/25/2009	17:28:33	4200	77.21	28.969	2.941	-86	8.2	9559	120.2059	966.12	
8/25/2009	17:29:33	4260	77.22	28.965	2.941	-86	8.2	9547	120.0896	967.02	
8/25/2009	17:30:33	4320	77.22	28.964	2.941	-86	8.2	9536	119.9524	966.57	
8/25/2009	17:31:33	4380	77.22	28.964	2.941	-87	8.2	9538	119.9765	966.79	
8/25/2009	17:32:33	4440	77.21	28.964	2.968	-88	8.2	9527	119.8286	966.79	
8/25/2009	17:33:33	4500	77.22	28.965	2.941	-88	8.2	9512	119.6376	967.47	
8/25/2009	17:34:33	4560	77.23	28.964	2.915	-88	8.2	9518	119.7249	967.69	
8/25/2009	17:35:33	4620	77.22	28.963	2.941	-88	8.2	9514	119.6706	967.69	
8/25/2009	17:36:33	4680	77.22	28.961	2.941	-88	8.2	9513	119.6683	967.47	
8/25/2009	17:37:33	4740	77.21	28.958	2.889	-89	8.2	9500	119.5125	967.24	
8/25/2009	17:38:33	4800	77.22	28.956	2.941	-89	8.2	9505	119.593	967.47	
8/25/2009	17:39:33	4860	77.22	28.954	2.941	-89	8.2	9498	119.5061	967.24	
8/25/2009	17:40:33	4920	77.23	28.952	2.941	-89	8.2	9499	119.5337	967.69	
8/25/2009	17:41:33	4980	77.22	28.947	2.889	-89	8.2	9484	119.3758	970.18	
8/25/2009	17:42:33	5040	77.22	28.942	2.915	-89	8.2	9484	119.39	970.86	
8/25/2009	17:43:33	5100	77.22	28.94	2.941	-90	8.2	9484	119.3977	970.86	
8/25/2009	17:44:33	5160	77.22	28.938	2.915	-90	8.2	9474	119.2858	970.86	
8/25/2009	17:45:33	5220	77.22	28.935	2.941	-90	8.2	9481	119.3799	970.41	
8/25/2009	17:46:33	5280	77.23	28.934	2.941	-90	8.2	9475	119.3183	970.63	
8/25/2009	17:47:33	5340	77.21	28.933	2.915	-90	8.2	9472	119.2629	970.63	
8/25/2009	17:48:33	5400	77.21	28.931	2.941	-90	8.2	9475	119.3154	970.63	
8/25/2009	17:49:33	5460	77.21	28.928	2.941	-91	8.19	9468	119.2321	970.18	
8/25/2009	17:50:33	5520	77.22	28.924	2.941	-91	8.2	9458	119.1289	970.18	
8/25/2009	17:51:33	5580	77.21	28.921	2.915	-91	8.2	9455	119.0996	970.18	
8/25/2009	17:52:33	5640	77.23	28.914	2.889	-91	8.19	9451	119.105	970.18	
8/25/2009	17:53:33	5700	77.21	28.908	2.915	-91	8.19	9456	119.1608	970.86	
8/25/2009	17:54:33	5760	77.21	28.903	2.941	-91	8.2	9447	119.0693	970.86	
8/25/2009	17:55:33	5820	77.21	28.898	2.941	-91	8.19	9447	119.096	971.09	
8/25/2009	17:56:33	5880	77.21	28.894	2.941	-91	8.19	9432	118.9335	971.09	
8/25/2009	17:57:33	5940	77.22	28.891	2.889	-91	8.19	9420	118.7957	971.54	
8/25/2009	17:58:33	6000	77.22	28.889	2.889	-91	8.19	9429	118.9149	971.77	
8/25/2009	17:59:33	6060	77.2	28.889	2.941	-91	8.19	9426	118.8598	971.77	
8/25/2009	18:00:33	6120	77.21	28.888	2.941	-92	8.19	9428	118.9022	972	
8/25/2009	18:01:33	6180	77.2	28.89	2.915	-92	8.19	9418	118.7531	972	
8/25/2009	18:02:33	6240	77.22	28.892	2.889	-92	8.19	9412	118.6918	972	
8/25/2009	18:03:33	6300	77.21	28.892	2.941	-92	8.19	9421	118.792	972.22	
8/25/2009	18:04:33	6360	77.2	28.891	2.915	-92	8.19	9415	118.715	972.22	
8/25/2009	18:05:33	6420	77.2	28.889	2.941	-92	8.19	9408	118.6317	972.22	
8/25/2009	18:06:33	6480	77.2	28.887	2.941	-93	8.19	9398	118.5131	972	
8/25/2009	18:07:33	6540	77.19	28.886	2.915	-93	8.19	9395	118.478	971.77	
8/25/2009	18:08:33	6600	77.19	28.885	2.941	-93	8.19	9397	118.5048	972	
8/25/2009	18:09:33	6660	77.21	28.882	2.941	-94	8.19	9392	118.4736	972.22	
8/25/2009	18:10:33	6720	77.19	28.879	2.941	-94	8.19	9398	118.5409	972.22	
8/25/2009	18:11:33	6780	77.19	28.874	2.941	-94	8.19	9384	118.3806	972.22	
8/25/2009	18:12:33	6840	77.2	28.878	2.915	-94	8.19	9384	118.3655	972.45	
8/25/2009	18:13:33	6900	77.18	28.925	2.941	-95	8.19	9388	118.2035	974.05	
8/25/2009	18:14:33	6960	77.17	28.968	2.941	-95	8.19	9369	117.7788	974.05	

McDowell Forest Preserve
Sediment Probe 1

In-Situ Inc. Troll 9000 Pro XP

Report generated: 8/27/2009 13:57:43
Report from file: ...\SN48381 2009-08-26 100559 sod3-fp-sed1.bin
Win-Situ® Version 4.58.14.0

Serial number: 48381
Firmware Version 2.13
Unit name: MP Troll 9000

Test name: sod3-fp-sed1

Test defined on: 8/26/2009 10:05:42
Test started on: 8/26/2009 10:05:59
Test stopped on: 8/26/2009 12:40:54

Data gathered using Linear testing
Time between data points: 60.0 Seconds.
Number of data samples: 155

TOTAL DATA SAMPLES 155

Date	Time	ET (sec)	Chan[1] Temperature Fahrenheit	Chan[3] Barometric Inches Hg	Chan[5] Battery Volts	Chan[11] ORP millivolts	Chan[12] pH pH	Chan[37] Rugged DO micrograms/L	Chan[37] Rugged DO Sat %Saturation	Chan[45] Conductivity microSiemens/cm Actual Conductivity	Notes
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8/26/2009	10:05:59	0	71.42	29.276	2.915	142	7.55	8380	97.8258	1.32	Test Started
8/26/2009	10:06:59	60	71.6	29.394	2.915	143	7.54	8362	97.4072	1.32	
8/26/2009	10:07:59	120	71.77	29.401	2.941	144	7.52	8341	97.3068	1.32	
8/26/2009	10:08:59	180	71.9	29.408	2.915	145	7.52	8318	97.1496	1.32	
8/26/2009	10:09:59	240	72.03	29.412	2.941	144	7.53	8301	97.0703	1.32	
8/26/2009	10:10:59	300	72.17	29.419	2.941	144	7.53	8297	97.1436	1.32	
8/26/2009	10:11:59	360	72.29	29.426	2.915	144	7.53	8268	96.9126	1.32	
8/26/2009	10:12:59	420	72.42	29.432	2.915	144	7.53	8262	96.943	1.32	
8/26/2009	10:13:59	480	72.52	29.438	2.915	144	7.54	8244	96.8259	1.32	
8/26/2009	10:14:59	540	72.64	29.444	2.915	144	7.54	8247	96.9511	1.32	
8/26/2009	10:15:59	600	72.75	29.45	2.915	144	7.55	8231	96.8649	1.32	
8/26/2009	10:16:59	660	72.85	29.456	2.915	143	7.55	8242	97.0846	1.32	
8/26/2009	10:17:59	720	72.96	29.461	2.863	143	7.56	8216	96.8667	1.32	
8/26/2009	10:18:59	780	73.06	29.467	2.941	143	7.56	8210	96.8878	1.32	
8/26/2009	10:19:59	840	73.18	29.472	2.889	143	7.57	8198	96.8403	1.32	
8/26/2009	10:20:59	900	73.36	29.477	2.941	142	7.57	8185	96.8572	1.32	
8/26/2009	10:21:59	960	73.47	29.482	2.941	141	7.58	8163	96.684	1.32	
8/26/2009	10:22:59	1020	73.25	29.495	2.915	139	7.68	8065	95.2727	1.32	
8/26/2009	10:23:59	1080	72.9	29.51	2.837	140	7.75	8134	95.6812	1.32	
8/26/2009	10:24:59	1140	72.96	29.516	2.915	140	7.8	8150	95.906	1.32	
8/26/2009	10:25:59	1200	72.86	29.52	2.915	139	7.84	8158	95.8754	1.32	
8/26/2009	10:26:59	1260	72.58	29.522	2.915	145	7.81	8199	96.0726	1.32	
8/26/2009	10:27:59	1320	72.74	29.529	2.941	144	7.83	8235	96.6371	1.32	
8/26/2009	10:28:59	1380	72.14	29.539	2.915	149	7.77	8272	96.4168	1.32	
8/26/2009	10:29:59	1440	72.37	29.548	2.915	152	7.73	8233	96.1668	1.32	
8/26/2009	10:30:59	1500	72.42	29.552	2.889	152	7.72	8213	95.9707	1.32	
8/26/2009	10:31:59	1560	72.27	29.553	2.889	153	7.7	8209	95.7658	1.32	
8/26/2009	10:32:59	1620	71.85	29.554	2.915	152	7.7	8223	95.503	1.32	
8/26/2009	10:33:59	1680	72.14	29.554	2.941	152	7.71	8250	96.109	1.32	
8/26/2009	10:34:59	1740	72.23	29.555	2.941	152	7.72	8259	96.3067	1.32	
8/26/2009	10:35:59	1800	72.02	29.555	2.915	152	7.72	8283	96.3716	1.32	
8/26/2009	10:36:59	1860	70.52	29.546	2.889	155	7.73	8330	95.3946	2.71	
8/26/2009	10:37:59	1920	70.44	29.564	2.915	154	7.82	8378	95.8081	2.75	
8/26/2009	10:38:59	1980	73.06	29.568	2.889	142	7.96	6793	80.1177	983.02	Probe in Chamber
8/26/2009	10:39:59	2040	73.04	29.562	2.915	138	7.98	6353	74.9316	982.57	
8/26/2009	10:40:59	2100	73.14	29.414	2.889	138	7.96	6201	73.5933	983.46	
8/26/2009	10:41:59	2160	73.16	29.347	2.941	119	7.93	6070	72.2138	984.13	
8/26/2009	10:42:59	2220	73.18	29.341	2.863	98	7.94	5915	70.4069	984.35	
8/26/2009	10:43:59	2280	73.15	29.337	2.915	97	7.95	5851	69.6372	984.13	
8/26/2009	10:44:59	2340	73.17	29.335	2.915	98	7.93	5818	69.2539	984.13	
8/26/2009	10:45:59	2400	73.17	29.332	2.837	99	7.92	5822	69.3114	984.57	
8/26/2009	10:46:59	2460	73.18	29.33	2.915	99	7.92	5787	68.9051	984.57	
8/26/2009	10:47:59	2520	73.16	29.328	2.915	100	7.92	5732	68.2448	984.13	
8/26/2009	10:48:59	2580	73.17	29.327	2.941	100	7.92	5662	67.4191	984.13	
8/26/2009	10:49:59	2640	73.16	29.325	2.915	100	7.92	5604	66.7228	984.35	
8/26/2009	10:50:59	2700	73.16	29.325	2.941	101	7.92	5564	66.254	984.57	
8/26/2009	10:51:59	2760	73.15	29.323	2.889	101	7.92	5545	66.0243	984.57	
8/26/2009	10:52:59	2820	73.16	29.323	2.915	101	7.92	5546	66.0379	984.79	
8/26/2009	10:53:59	2880	73.16	29.321	2.941	101	7.92	5548	66.0661	984.57	

McDowell Forest Preserve
Sediment Probe 1

8/26/2009	10:54:59	2940	73.17	29.321	2.941	101	7.92	5529	65.8508	984.35	
8/26/2009	10:55:59	3000	73.16	29.326	2.915	-15	7.78	5088	60.5893	987.25	
8/26/2009	10:56:59	3060	73.19	29.325	2.889	-34	7.74	4660	55.5104	986.81	
8/26/2009	10:57:59	3120	73.18	29.33	2.915	-29	7.73	4430	52.7593	986.81	
8/26/2009	10:58:59	3180	73.19	29.333	2.941	-22	7.72	4304	51.2463	986.82	
8/26/2009	10:59:59	3240	73.19	29.336	2.915	-16	7.72	4189	49.8743	986.6	
8/26/2009	11:00:59	3300	73.19	29.335	2.941	-12	7.71	4112	48.965	986.83	
8/26/2009	11:01:59	3360	73.21	29.335	2.915	-9	7.7	4026	47.9478	987.5	
8/26/2009	11:02:59	3420	73.2	29.337	2.915	-8	7.69	3937	46.8806	987.51	
8/26/2009	11:03:59	3480	73.22	29.34	2.863	-6	7.68	3856	45.924	987.73	
8/26/2009	11:04:59	3540	73.22	29.343	2.915	-3	7.67	3773	44.9308	987.73	Data used for analysis
8/26/2009	11:05:59	3600	73.23	29.342	2.863	-1	7.67	3731	44.4385	987.96	
8/26/2009	11:06:59	3660	73.25	29.344	2.915	0	7.66	3649	43.4631	987.96	
8/26/2009	11:07:59	3720	73.25	29.344	2.915	2	7.66	3601	42.8931	988.19	
8/26/2009	11:08:59	3780	73.26	29.345	2.941	4	7.65	3545	42.2258	988.19	
8/26/2009	11:09:59	3840	73.29	29.347	2.915	5	7.65	3505	41.7553	988.64	
8/26/2009	11:10:59	3900	73.29	29.346	2.915	7	7.65	3460	41.2289	988.64	
8/26/2009	11:11:59	3960	73.29	29.346	2.941	8	7.65	3415	40.6902	988.87	
8/26/2009	11:12:59	4020	73.29	29.346	2.941	9	7.64	3375	40.2112	988.64	
8/26/2009	11:13:59	4080	73.31	29.344	2.941	10	7.64	3342	39.8292	988.64	
8/26/2009	11:14:59	4140	73.32	29.345	2.941	11	7.64	3307	39.4126	989.09	
8/26/2009	11:15:59	4200	73.32	29.345	2.941	12	7.64	3268	38.9514	989.32	
8/26/2009	11:16:59	4260	73.32	29.343	2.915	13	7.64	3242	38.6463	989.32	
8/26/2009	11:17:59	4320	73.34	29.345	2.941	14	7.63	3217	38.3499	989.54	
8/26/2009	11:18:59	4380	73.34	29.344	2.941	15	7.63	3183	37.9414	989.77	
8/26/2009	11:19:59	4440	73.34	29.345	2.915	15	7.63	3167	37.7516	989.77	
8/26/2009	11:20:59	4500	73.37	29.347	2.941	16	7.63	3149	37.5487	989.77	
8/26/2009	11:21:59	4560	73.36	29.345	2.941	17	7.63	3119	37.1886	989.77	
8/26/2009	11:22:59	4620	73.37	29.344	2.941	17	7.63	3094	36.9019	990	
8/26/2009	11:23:59	4680	73.37	29.346	2.915	18	7.62	3068	36.5905	990.22	
8/26/2009	11:24:59	4740	73.38	29.343	2.941	18	7.62	3061	36.5063	990.22	
8/26/2009	11:25:59	4800	73.38	29.345	2.915	19	7.62	3030	36.1356	990.45	
8/26/2009	11:26:59	4860	73.39	29.343	2.915	20	7.62	3010	35.9117	990.45	
8/26/2009	11:27:59	4920	73.38	29.344	2.915	20	7.62	2980	35.5473	990.68	
8/26/2009	11:28:59	4980	73.41	29.344	2.863	20	7.62	2966	35.3869	989.78	
8/26/2009	11:29:59	5040	73.42	29.345	2.941	21	7.62	2953	35.2283	990.68	
8/26/2009	11:30:59	5100	73.41	29.343	2.915	21	7.61	2929	34.947	990.9	
8/26/2009	11:31:59	5160	73.41	29.343	2.915	22	7.61	2913	34.759	990.9	
8/26/2009	11:32:59	5220	73.42	29.343	2.837	22	7.61	2896	34.5608	990.9	
8/26/2009	11:33:59	5280	73.44	29.343	2.837	23	7.61	2873	34.2858	991.13	
8/26/2009	11:34:59	5340	73.44	29.344	2.941	23	7.61	2854	34.0674	990.9	
8/26/2009	11:35:59	5400	73.45	29.342	2.915	23	7.61	2834	33.831	991.13	
8/26/2009	11:36:59	5460	73.45	29.342	2.915	24	7.61	2827	33.7407	991.36	
8/26/2009	11:37:59	5520	73.45	29.341	2.915	24	7.61	2802	33.443	991.13	
8/26/2009	11:38:59	5580	73.47	29.341	2.915	24	7.61	2790	33.3074	991.58	
8/26/2009	11:39:59	5640	73.45	29.341	2.915	25	7.6	2777	33.1524	991.58	
8/26/2009	11:40:59	5700	73.47	29.342	2.889	25	7.6	2765	33.0069	991.58	
8/26/2009	11:41:59	5760	73.47	29.341	2.915	25	7.6	2744	32.7576	991.58	
8/26/2009	11:42:59	5820	73.48	29.34	2.915	25	7.6	2727	32.5618	990.91	
8/26/2009	11:43:59	5880	73.49	29.341	2.915	26	7.6	2705	32.3022	991.58	
8/26/2009	11:44:59	5940	73.48	29.339	2.889	26	7.6	2689	32.1132	991.58	
8/26/2009	11:45:59	6000	73.5	29.339	2.915	26	7.6	2682	32.0298	991.81	
8/26/2009	11:46:59	6060	73.5	29.339	2.863	27	7.6	2666	31.8383	992.04	
8/26/2009	11:47:59	6120	73.51	29.341	2.915	27	7.6	2651	31.6683	992.26	
8/26/2009	11:48:59	6180	73.5	29.339	2.915	27	7.59	2637	31.4989	992.04	
8/26/2009	11:49:59	6240	73.51	29.339	2.915	27	7.59	2624	31.35	992.04	
8/26/2009	11:50:59	6300	73.51	29.339	2.915	28	7.59	2614	31.2215	992.26	
8/26/2009	11:51:59	6360	73.5	29.34	2.889	28	7.59	2592	30.9552	992.26	
8/26/2009	11:52:59	6420	73.52	29.338	2.837	28	7.59	2585	30.8849	992.49	
8/26/2009	11:53:59	6480	73.51	29.337	2.889	28	7.59	2572	30.73	992.26	
8/26/2009	11:54:59	6540	73.51	29.336	2.915	28	7.59	2546	30.4224	992.26	
8/26/2009	11:55:59	6600	73.53	29.338	2.837	28	7.59	2541	30.3646	992.49	
8/26/2009	11:56:59	6660	73.52	29.336	2.941	29	7.59	2518	30.0828	992.49	
8/26/2009	11:57:59	6720	73.53	29.336	2.863	29	7.59	2507	29.9571	992.04	
8/26/2009	11:58:59	6780	73.52	29.336	2.915	29	7.58	2488	29.7221	992.49	
8/26/2009	11:59:59	6840	73.51	29.335	2.863	29	7.58	2478	29.6011	992.71	
8/26/2009	12:00:59	6900	73.53	29.334	2.915	30	7.58	2468	29.4979	992.71	
8/26/2009	12:01:59	6960	73.52	29.335	2.889	30	7.58	2445	29.2122	992.71	
8/26/2009	12:02:59	7020	73.54	29.336	2.915	30	7.58	2440	29.1577	992.71	
8/26/2009	12:03:59	7080	73.54	29.335	2.915	30	7.58	2425	28.9781	992.94	
8/26/2009	12:04:59	7140	73.52	29.334	2.863	30	7.58	2403	28.7116	992.94	
8/26/2009	12:05:59	7200	73.54	29.335	2.837	31	7.58	2390	28.5679	992.94	
8/26/2009	12:06:59	7260	73.54	29.336	2.889	31	7.58	2388	28.534	992.71	
8/26/2009	12:07:59	7320	73.54	29.335	2.915	31	7.58	2377	28.4069	992.71	
8/26/2009	12:08:59	7380	73.54	29.335	2.915	31	7.58	2359	28.194	992.71	
8/26/2009	12:09:59	7440	73.54	29.337	2.915	31	7.58	2349	28.0745	992.71	
8/26/2009	12:10:59	7500	73.54	29.334	2.915	31	7.58	2337	27.926	992.71	
8/26/2009	12:11:59	7560	73.55	29.334	2.889	32	7.57	2324	27.7773	992.71	
8/26/2009	12:12:59	7620	73.54	29.334	2.915	32	7.58	2313	27.6439	992.71	
8/26/2009	12:13:59	7680	73.56	29.334	2.889	32	7.57	2290	27.3801	992.94	
8/26/2009	12:14:59	7740	73.56	29.334	2.915	32	7.57	2283	27.2882	992.94	
8/26/2009	12:15:59	7800	73.56	29.333	2.915	32	7.57	2269	27.1293	992.94	
8/26/2009	12:16:59	7860	73.55	29.333	2.915	32	7.57	2259	27.005	992.94	
8/26/2009	12:17:59	7920	73.55	29.333	2.915	33	7.57	2248	26.8758	993.17	

McDowell Forest Preserve
Sediment Probe 1

8/26/2009	12:18:59	7980	73.56	29.336	2.915	33	7.57	2232	26.6751	993.17	
8/26/2009	12:19:59	8040	73.55	29.333	2.915	33	7.57	2226	26.6054	993.17	
8/26/2009	12:20:59	8100	73.56	29.334	2.863	33	7.57	2212	26.4356	993.4	
8/26/2009	12:21:59	8160	73.55	29.334	2.915	33	7.57	2199	26.2839	993.4	
8/26/2009	12:22:59	8220	73.55	29.336	2.915	33	7.57	2183	26.091	993.39	
8/26/2009	12:23:59	8280	73.55	29.334	2.915	33	7.57	2185	26.1136	993.4	
8/26/2009	12:24:59	8340	73.56	29.333	2.889	33	7.57	2168	25.9167	993.4	
8/26/2009	12:25:59	8400	73.56	29.334	2.889	34	7.56	2152	25.7243	993.4	
8/26/2009	12:26:59	8460	73.56	29.336	2.915	34	7.57	2140	25.5825	993.62	
8/26/2009	12:27:59	8520	73.56	29.334	2.837	34	7.56	2124	25.3944	993.62	
8/26/2009	12:28:59	8580	73.57	29.335	2.915	34	7.56	2112	25.2454	993.62	
8/26/2009	12:29:59	8640	73.57	29.334	2.915	34	7.56	2107	25.1966	993.4	
8/26/2009	12:30:59	8700	73.57	29.336	2.889	34	7.56	2104	25.154	993.4	
8/26/2009	12:31:59	8760	73.57	29.333	2.889	34	7.56	2085	24.926	993.62	
8/26/2009	12:32:59	8820	73.57	29.333	2.889	35	7.56	2079	24.8545	993.62	
8/26/2009	12:33:59	8880	73.57	29.333	2.837	35	7.56	2070	24.7457	993.62	
8/26/2009	12:34:59	8940	73.56	29.332	2.915	35	7.56	2053	24.5428	993.62	
8/26/2009	12:35:59	9000	73.57	29.332	2.915	35	7.56	2048	24.4849	993.62	
8/26/2009	12:36:59	9060	73.57	29.333	2.915	35	7.56	2036	24.3442	993.62	
8/26/2009	12:37:59	9120	73.57	29.333	2.915	35	7.56	2030	24.2743	993.62	
8/26/2009	12:38:59	9180	73.58	29.332	2.889	35	7.56	2015	24.0946	993.85	
8/26/2009	12:39:59	9240	73.58	29.332	2.889	35	7.55	2008	24.0063	993.85	

McDowell Forest Preserve
Sediment Probe 2

In-Situ Inc. Troll 9000 Pro XP

Report generated: 8/27/2009 13:57:43
Report from file: ...\SN48381 2009-08-26 100559 sod3-fp-sed1.bin
Win-Situ® Version 4.58.14.0

Serial number: 48381
Firmware Version 2.13
Unit name: MP Troll 9000

Test name: sod3-fp-sed1

Test defined on: 8/26/2009 10:05:42
Test started on: 8/26/2009 10:05:59
Test stopped on: 8/26/2009 12:40:54

Data gathered using Linear testing
Time between data points: 60.0 Seconds.
Number of data samples: 155

TOTAL DATA SAMPLES 155

Date	Time	ET (sec)	Chan[1] Temperature Fahrenheit	Chan[3] Barometric Inches Hg	Chan[5] Battery Volts	Chan[11] ORP millivolts	Chan[12] pH pH	Chan[37] Rugged DO micrograms/L	Chan[37] Rugged DO Sat %Saturation	Chan[45] Conductivity microSiemens/cm Actual Conductivity	Notes
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8/26/2009	10:05:59	0	71.42	29.276	2.915	142	7.55	8380	97.8258	1.32	Test Started
8/26/2009	10:06:59	60	71.6	29.394	2.915	143	7.54	8362	97.4072	1.32	
8/26/2009	10:07:59	120	71.77	29.401	2.941	144	7.52	8341	97.3068	1.32	
8/26/2009	10:08:59	180	71.9	29.408	2.915	145	7.52	8318	97.1496	1.32	
8/26/2009	10:09:59	240	72.03	29.412	2.941	144	7.53	8301	97.0703	1.32	
8/26/2009	10:10:59	300	72.17	29.419	2.941	144	7.53	8297	97.1436	1.32	
8/26/2009	10:11:59	360	72.29	29.426	2.915	144	7.53	8268	96.9126	1.32	
8/26/2009	10:12:59	420	72.42	29.432	2.915	144	7.53	8262	96.943	1.32	
8/26/2009	10:13:59	480	72.52	29.438	2.915	144	7.54	8244	96.8259	1.32	
8/26/2009	10:14:59	540	72.64	29.444	2.915	144	7.54	8247	96.9511	1.32	
8/26/2009	10:15:59	600	72.75	29.45	2.915	144	7.55	8231	96.8649	1.32	
8/26/2009	10:16:59	660	72.85	29.456	2.915	143	7.55	8242	97.0846	1.32	
8/26/2009	10:17:59	720	72.96	29.461	2.863	143	7.56	8216	96.8667	1.32	
8/26/2009	10:18:59	780	73.06	29.467	2.941	143	7.56	8210	96.8878	1.32	
8/26/2009	10:19:59	840	73.18	29.472	2.889	143	7.57	8198	96.8403	1.32	
8/26/2009	10:20:59	900	73.36	29.477	2.941	142	7.57	8185	96.8572	1.32	
8/26/2009	10:21:59	960	73.47	29.482	2.941	141	7.58	8163	96.684	1.32	
8/26/2009	10:22:59	1020	73.25	29.495	2.915	139	7.68	8065	95.2727	1.32	
8/26/2009	10:23:59	1080	72.9	29.51	2.837	140	7.75	8134	95.6812	1.32	
8/26/2009	10:24:59	1140	72.96	29.516	2.915	140	7.8	8150	95.906	1.32	
8/26/2009	10:25:59	1200	72.86	29.52	2.915	139	7.84	8158	95.8754	1.32	
8/26/2009	10:26:59	1260	72.58	29.522	2.915	145	7.81	8199	96.0726	1.32	
8/26/2009	10:27:59	1320	72.74	29.529	2.941	144	7.83	8235	96.6371	1.32	
8/26/2009	10:28:59	1380	72.14	29.539	2.915	149	7.77	8272	96.4168	1.32	
8/26/2009	10:29:59	1440	72.37	29.548	2.915	152	7.73	8233	96.1668	1.32	
8/26/2009	10:30:59	1500	72.42	29.552	2.889	152	7.72	8213	95.9707	1.32	
8/26/2009	10:31:59	1560	72.27	29.553	2.889	153	7.7	8209	95.7658	1.32	
8/26/2009	10:32:59	1620	71.85	29.554	2.915	152	7.7	8223	95.503	1.32	
8/26/2009	10:33:59	1680	72.14	29.554	2.941	152	7.71	8250	96.109	1.32	
8/26/2009	10:34:59	1740	72.23	29.555	2.941	152	7.72	8259	96.3067	1.32	
8/26/2009	10:35:59	1800	72.02	29.555	2.915	152	7.72	8283	96.3716	1.32	
8/26/2009	10:36:59	1860	70.52	29.546	2.889	155	7.73	8330	95.3946	2.71	
8/26/2009	10:37:59	1920	70.44	29.564	2.915	154	7.82	8378	95.8081	2.75	
8/26/2009	10:38:59	1980	73.06	29.568	2.889	142	7.96	6793	80.1177	983.02	Probe in Chamber
8/26/2009	10:39:59	2040	73.04	29.562	2.915	138	7.98	6353	74.9316	982.57	
8/26/2009	10:40:59	2100	73.14	29.414	2.889	138	7.96	6201	73.5933	983.46	
8/26/2009	10:41:59	2160	73.16	29.347	2.941	119	7.93	6070	72.2138	984.13	
8/26/2009	10:42:59	2220	73.18	29.341	2.863	98	7.94	5915	70.4069	984.35	
8/26/2009	10:43:59	2280	73.15	29.337	2.915	97	7.95	5851	69.6372	984.13	
8/26/2009	10:44:59	2340	73.17	29.335	2.915	98	7.93	5818	69.2539	984.13	
8/26/2009	10:45:59	2400	73.17	29.332	2.837	99	7.92	5822	69.3114	984.57	
8/26/2009	10:46:59	2460	73.18	29.33	2.915	99	7.92	5787	68.9051	984.57	
8/26/2009	10:47:59	2520	73.16	29.328	2.915	100	7.92	5732	68.2448	984.13	
8/26/2009	10:48:59	2580	73.17	29.327	2.941	100	7.92	5662	67.4191	984.13	
8/26/2009	10:49:59	2640	73.16	29.325	2.915	100	7.92	5604	66.7228	984.35	
8/26/2009	10:50:59	2700	73.16	29.325	2.941	101	7.92	5564	66.254	984.57	
8/26/2009	10:51:59	2760	73.15	29.323	2.889	101	7.92	5545	66.0243	984.57	
8/26/2009	10:52:59	2820	73.16	29.323	2.915	101	7.92	5546	66.0379	984.79	
8/26/2009	10:53:59	2880	73.16	29.321	2.941	101	7.92	5548	66.0661	984.57	

McDowell Forest Preserve
Sediment Probe 2

8/26/2009	10:54:59	2940	73.17	29.321	2.941	101	7.92	5529	65.8508	984.35	
8/26/2009	10:55:59	3000	73.16	29.326	2.915	-15	7.78	5088	60.5893	987.25	
8/26/2009	10:56:59	3060	73.19	29.325	2.889	-34	7.74	4660	55.5104	986.81	
8/26/2009	10:57:59	3120	73.18	29.33	2.915	-29	7.73	4430	52.7593	986.81	
8/26/2009	10:58:59	3180	73.19	29.333	2.941	-22	7.72	4304	51.2463	986.82	
8/26/2009	10:59:59	3240	73.19	29.336	2.915	-16	7.72	4189	49.8743	986.6	
8/26/2009	11:00:59	3300	73.19	29.335	2.941	-12	7.71	4112	48.965	986.83	
8/26/2009	11:01:59	3360	73.21	29.335	2.915	-9	7.7	4026	47.9478	987.5	
8/26/2009	11:02:59	3420	73.2	29.337	2.915	-8	7.69	3937	46.8806	987.51	
8/26/2009	11:03:59	3480	73.22	29.34	2.863	-6	7.68	3856	45.924	987.73	
8/26/2009	11:04:59	3540	73.22	29.343	2.915	-3	7.67	3773	44.9308	987.73	Data used for analysis
8/26/2009	11:05:59	3600	73.23	29.342	2.863	-1	7.67	3731	44.4385	987.96	
8/26/2009	11:06:59	3660	73.25	29.344	2.915	0	7.66	3649	43.4631	987.96	
8/26/2009	11:07:59	3720	73.25	29.344	2.915	2	7.66	3601	42.8931	988.19	
8/26/2009	11:08:59	3780	73.26	29.345	2.941	4	7.65	3545	42.2258	988.19	
8/26/2009	11:09:59	3840	73.29	29.347	2.915	5	7.65	3505	41.7553	988.64	
8/26/2009	11:10:59	3900	73.29	29.346	2.915	7	7.65	3460	41.2289	988.64	
8/26/2009	11:11:59	3960	73.29	29.346	2.941	8	7.65	3415	40.6902	988.87	
8/26/2009	11:12:59	4020	73.29	29.346	2.941	9	7.64	3375	40.2112	988.64	
8/26/2009	11:13:59	4080	73.31	29.344	2.941	10	7.64	3342	39.8292	988.64	
8/26/2009	11:14:59	4140	73.32	29.345	2.941	11	7.64	3307	39.4126	989.09	
8/26/2009	11:15:59	4200	73.32	29.345	2.941	12	7.64	3268	38.9514	989.32	
8/26/2009	11:16:59	4260	73.32	29.343	2.915	13	7.64	3242	38.6463	989.32	
8/26/2009	11:17:59	4320	73.34	29.345	2.941	14	7.63	3217	38.3499	989.54	
8/26/2009	11:18:59	4380	73.34	29.344	2.941	15	7.63	3183	37.9414	989.77	
8/26/2009	11:19:59	4440	73.34	29.345	2.915	15	7.63	3167	37.7516	989.77	
8/26/2009	11:20:59	4500	73.37	29.347	2.941	16	7.63	3149	37.5487	989.77	
8/26/2009	11:21:59	4560	73.36	29.345	2.941	17	7.63	3119	37.1886	989.77	
8/26/2009	11:22:59	4620	73.37	29.344	2.941	17	7.63	3094	36.9019	990	
8/26/2009	11:23:59	4680	73.37	29.346	2.915	18	7.62	3068	36.5905	990.22	
8/26/2009	11:24:59	4740	73.38	29.343	2.941	18	7.62	3061	36.5063	990.22	
8/26/2009	11:25:59	4800	73.38	29.345	2.915	19	7.62	3030	36.1356	990.45	
8/26/2009	11:26:59	4860	73.39	29.343	2.915	20	7.62	3010	35.9117	990.45	
8/26/2009	11:27:59	4920	73.38	29.344	2.915	20	7.62	2980	35.5473	990.68	
8/26/2009	11:28:59	4980	73.41	29.344	2.863	20	7.62	2966	35.3869	989.78	
8/26/2009	11:29:59	5040	73.42	29.345	2.941	21	7.62	2953	35.2283	990.68	
8/26/2009	11:30:59	5100	73.41	29.343	2.915	21	7.61	2929	34.947	990.9	
8/26/2009	11:31:59	5160	73.41	29.343	2.915	22	7.61	2913	34.759	990.9	
8/26/2009	11:32:59	5220	73.42	29.343	2.837	22	7.61	2896	34.5608	990.9	
8/26/2009	11:33:59	5280	73.44	29.343	2.837	23	7.61	2873	34.2858	991.13	
8/26/2009	11:34:59	5340	73.44	29.344	2.941	23	7.61	2854	34.0674	990.9	
8/26/2009	11:35:59	5400	73.45	29.342	2.915	23	7.61	2834	33.831	991.13	
8/26/2009	11:36:59	5460	73.45	29.342	2.915	24	7.61	2827	33.7407	991.36	
8/26/2009	11:37:59	5520	73.45	29.341	2.915	24	7.61	2802	33.443	991.13	
8/26/2009	11:38:59	5580	73.47	29.341	2.915	24	7.61	2790	33.3074	991.58	
8/26/2009	11:39:59	5640	73.45	29.341	2.915	25	7.6	2777	33.1524	991.58	
8/26/2009	11:40:59	5700	73.47	29.342	2.889	25	7.6	2765	33.0069	991.58	
8/26/2009	11:41:59	5760	73.47	29.341	2.915	25	7.6	2744	32.7576	991.58	
8/26/2009	11:42:59	5820	73.48	29.34	2.915	25	7.6	2727	32.5618	990.91	
8/26/2009	11:43:59	5880	73.49	29.341	2.915	26	7.6	2705	32.3022	991.58	
8/26/2009	11:44:59	5940	73.48	29.339	2.889	26	7.6	2689	32.1132	991.58	
8/26/2009	11:45:59	6000	73.5	29.339	2.915	26	7.6	2682	32.0298	991.81	
8/26/2009	11:46:59	6060	73.5	29.339	2.863	27	7.6	2666	31.8383	992.04	
8/26/2009	11:47:59	6120	73.51	29.341	2.915	27	7.6	2651	31.6683	992.26	
8/26/2009	11:48:59	6180	73.5	29.339	2.915	27	7.59	2637	31.4989	992.04	
8/26/2009	11:49:59	6240	73.51	29.339	2.915	27	7.59	2624	31.35	992.04	
8/26/2009	11:50:59	6300	73.51	29.339	2.915	28	7.59	2614	31.2215	992.26	
8/26/2009	11:51:59	6360	73.5	29.34	2.889	28	7.59	2592	30.9552	992.26	
8/26/2009	11:52:59	6420	73.52	29.338	2.837	28	7.59	2585	30.8849	992.49	
8/26/2009	11:53:59	6480	73.51	29.337	2.889	28	7.59	2572	30.73	992.26	
8/26/2009	11:54:59	6540	73.51	29.336	2.915	28	7.59	2546	30.4224	992.26	
8/26/2009	11:55:59	6600	73.53	29.338	2.837	28	7.59	2541	30.3646	992.49	
8/26/2009	11:56:59	6660	73.52	29.336	2.941	29	7.59	2518	30.0828	992.49	
8/26/2009	11:57:59	6720	73.53	29.336	2.863	29	7.59	2507	29.9571	992.04	
8/26/2009	11:58:59	6780	73.52	29.336	2.915	29	7.58	2488	29.7221	992.49	
8/26/2009	11:59:59	6840	73.51	29.335	2.863	29	7.58	2478	29.6011	992.71	
8/26/2009	12:00:59	6900	73.53	29.334	2.915	30	7.58	2468	29.4979	992.71	
8/26/2009	12:01:59	6960	73.52	29.335	2.889	30	7.58	2445	29.2122	992.71	
8/26/2009	12:02:59	7020	73.54	29.336	2.915	30	7.58	2440	29.1577	992.71	
8/26/2009	12:03:59	7080	73.54	29.335	2.915	30	7.58	2425	28.9781	992.94	
8/26/2009	12:04:59	7140	73.52	29.334	2.863	30	7.58	2403	28.7116	992.94	
8/26/2009	12:05:59	7200	73.54	29.335	2.837	31	7.58	2390	28.5679	992.94	
8/26/2009	12:06:59	7260	73.54	29.336	2.889	31	7.58	2388	28.534	992.71	
8/26/2009	12:07:59	7320	73.54	29.335	2.915	31	7.58	2377	28.4069	992.71	
8/26/2009	12:08:59	7380	73.54	29.335	2.915	31	7.58	2359	28.194	992.71	
8/26/2009	12:09:59	7440	73.54	29.337	2.915	31	7.58	2349	28.0745	992.71	
8/26/2009	12:10:59	7500	73.54	29.334	2.915	31	7.58	2337	27.926	992.71	
8/26/2009	12:11:59	7560	73.55	29.334	2.889	32	7.57	2324	27.7773	992.71	
8/26/2009	12:12:59	7620	73.54	29.334	2.915	32	7.58	2313	27.6439	992.71	
8/26/2009	12:13:59	7680	73.56	29.334	2.889	32	7.57	2290	27.3801	992.94	
8/26/2009	12:14:59	7740	73.56	29.334	2.915	32	7.57	2283	27.2882	992.94	
8/26/2009	12:15:59	7800	73.56	29.333	2.915	32	7.57	2269	27.1293	992.94	
8/26/2009	12:16:59	7860	73.55	29.333	2.915	32	7.57	2259	27.005	992.94	
8/26/2009	12:17:59	7920	73.55	29.333	2.915	33	7.57	2248	26.8758	993.17	

McDowell Forest Preserve
Sediment Probe 2

8/26/2009	12:18:59	7980	73.56	29.336	2.915	33	7.57	2232	26.6751	993.17	
8/26/2009	12:19:59	8040	73.55	29.333	2.915	33	7.57	2226	26.6054	993.17	
8/26/2009	12:20:59	8100	73.56	29.334	2.863	33	7.57	2212	26.4356	993.4	
8/26/2009	12:21:59	8160	73.55	29.334	2.915	33	7.57	2199	26.2839	993.4	
8/26/2009	12:22:59	8220	73.55	29.336	2.915	33	7.57	2183	26.091	993.39	
8/26/2009	12:23:59	8280	73.55	29.334	2.915	33	7.57	2185	26.1136	993.4	
8/26/2009	12:24:59	8340	73.56	29.333	2.889	33	7.57	2168	25.9167	993.4	
8/26/2009	12:25:59	8400	73.56	29.334	2.889	34	7.56	2152	25.7243	993.4	
8/26/2009	12:26:59	8460	73.56	29.336	2.915	34	7.57	2140	25.5825	993.62	
8/26/2009	12:27:59	8520	73.56	29.334	2.837	34	7.56	2124	25.3944	993.62	
8/26/2009	12:28:59	8580	73.57	29.335	2.915	34	7.56	2112	25.2454	993.62	
8/26/2009	12:29:59	8640	73.57	29.334	2.915	34	7.56	2107	25.1966	993.4	
8/26/2009	12:30:59	8700	73.57	29.336	2.889	34	7.56	2104	25.154	993.4	
8/26/2009	12:31:59	8760	73.57	29.333	2.889	34	7.56	2085	24.926	993.62	
8/26/2009	12:32:59	8820	73.57	29.333	2.889	35	7.56	2079	24.8545	993.62	
8/26/2009	12:33:59	8880	73.57	29.333	2.837	35	7.56	2070	24.7457	993.62	
8/26/2009	12:34:59	8940	73.56	29.332	2.915	35	7.56	2053	24.5428	993.62	
8/26/2009	12:35:59	9000	73.57	29.332	2.915	35	7.56	2048	24.4849	993.62	
8/26/2009	12:36:59	9060	73.57	29.333	2.915	35	7.56	2036	24.3442	993.62	
8/26/2009	12:37:59	9120	73.57	29.333	2.915	35	7.56	2030	24.2743	993.62	
8/26/2009	12:38:59	9180	73.58	29.332	2.889	35	7.56	2015	24.0946	993.85	
8/26/2009	12:39:59	9240	73.58	29.332	2.889	35	7.55	2008	24.0063	993.85	

McDowell Forest Preserve
Blank Chamber

In-Situ Inc. Troll 9000 Pro XP

Report generated: 8/27/2009 13:49:13
Report from file: ...\SN48396 2009-08-26 091109 sod3-fp-blnk.bin
Win-Situ® Version 4.58.14.0

Serial number: 48396
Firmware Version 2.13
Unit name: MP Troll 9000

Test name: sod3-fp-blnk

Test defined on: 8/26/2009 9:10:56
Test started on: 8/26/2009 9:11:09
Test stopped on: 8/26/2009 11:48:08

Data gathered using Linear testing
Time between data points: 60.0 Seconds.
Number of data samples: 157

TOTAL DATA SAMPLES 157

Date	Time	ET (sec)	Chan[1] Temperature Fahrenheit	Chan[3] Barometric Inches Hg	Chan[5] Battery Volts	Chan[11] ORP millivolts	Chan[12] pH pH	Chan[37] Rugged DO micrograms/L	Chan[37] Rugged DO Sat %Saturation	Chan[45] Conductivity microSiemens/cm Actual Conductivity	Notes
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8/26/2009	10:11:09	0	72.66	28.82	2.915	-131	7.85	8170	98.2121	1.25	Test Started
8/26/2009	10:12:09	60	72.77	28.948	2.837	-127	7.84	8215	98.423	1.25	
8/26/2009	10:13:09	120	72.9	28.959	2.915	-129	7.84	8179	98.0775	1.25	
8/26/2009	10:14:09	180	73.01	28.967	2.915	-129	7.84	8159	97.9416	1.25	
8/26/2009	10:15:09	240	73.11	28.975	2.863	-129	7.84	8153	97.9304	1.25	
8/26/2009	10:16:09	300	73.2	28.983	2.915	-129	7.84	8168	98.1796	1.25	
8/26/2009	10:17:09	360	73.29	28.99	2.915	-129	7.84	8167	98.2395	1.25	
8/26/2009	10:18:09	420	73.36	28.997	2.915	-130	7.84	8166	98.2808	1.25	
8/26/2009	10:19:09	480	73.47	29.004	2.915	-130	7.84	8166	98.3691	1.25	
8/26/2009	10:20:09	540	73.57	29.011	2.863	-130	7.84	8151	98.264	1.25	
8/26/2009	10:21:09	600	73.65	29.017	2.915	-130	7.84	8153	98.3581	1.25	
8/26/2009	10:22:09	660	73.75	29.024	2.915	-130	7.84	8135	98.2078	1.25	
8/26/2009	10:23:09	720	73.84	29.03	2.889	-131	7.84	8122	98.1205	1.25	
8/26/2009	10:24:09	780	74.23	29.038	2.863	-126	7.81	8175	99.1477	1.25	
8/26/2009	10:25:09	840	74.05	29.085	2.889	-109	7.83	8289	100.1753	1.25	
8/26/2009	10:26:09	900	73.29	29.113	2.889	-123	7.93	8253	98.8475	1.25	
8/26/2009	10:27:09	960	73.35	29.137	2.889	-122	7.96	8344	99.9075	1.25	
8/26/2009	10:28:09	1020	71.75	29.144	2.863	-114	7.91	8322	97.9422	1.25	
8/26/2009	10:29:09	1080	72.33	29.136	2.889	-114	7.93	8419	99.7369	1.25	
8/26/2009	10:30:09	1140	73.02	29.146	2.915	-120	7.95	8415	100.3784	1.25	
8/26/2009	10:31:09	1200	73.24	29.149	2.915	-123	7.97	8400	100.4277	1.25	
8/26/2009	10:32:09	1260	73.39	29.151	2.915	-125	7.98	8392	100.4764	1.25	
8/26/2009	10:33:09	1320	73.4	29.153	2.863	-125	7.99	8390	100.4587	1.25	
8/26/2009	10:34:09	1380	73.46	29.154	2.915	-127	7.99	8373	100.3251	1.25	
8/26/2009	10:35:09	1440	73.47	29.154	2.889	-128	8	8359	100.1652	1.25	
8/26/2009	10:36:09	1500	73.49	29.153	2.915	-128	8	8355	100.1305	1.25	
8/26/2009	10:37:09	1560	73.48	29.153	2.915	-129	8.01	8353	100.1054	1.25	
8/26/2009	10:38:09	1620	73.5	29.152	2.915	-129	8.01	8362	100.2351	1.25	
8/26/2009	10:39:09	1680	73.35	29.151	2.915	-127	8.01	8384	100.3444	1.25	
8/26/2009	10:40:09	1740	73.21	29.149	2.863	-126	8	8411	100.5203	1.25	
8/26/2009	10:41:09	1800	72.91	29.146	2.915	-124	8	8449	100.6597	1.25	
8/26/2009	10:42:09	1860	72.86	29.142	2.915	-125	7.99	8495	101.1711	1.25	
8/26/2009	10:43:09	1920	71.96	29.134	2.915	-126	7.98	8478	100.0406	1.25	
8/26/2009	10:44:09	1980	72.03	29.129	2.915	-127	7.98	8468	100.0169	1.25	
8/26/2009	10:45:09	2040	70.66	29.123	2.889	-128	7.98	8484	98.758	1.25	
8/26/2009	10:46:09	2100	71.29	29.117	2.915	-128	7.98	8493	99.5595	1.25	
8/26/2009	10:47:09	2160	71.03	29.111	2.863	-129	7.98	8527	99.6952	1.25	
8/26/2009	10:48:09	2220	71.1	29.103	2.863	-130	7.99	8534	99.8801	1.25	
8/26/2009	10:49:09	2280	71.02	29.099	2.915	-130	7.98	8526	99.7232	1.25	
8/26/2009	10:50:09	2340	70.75	29.093	2.915	-130	7.99	8531	99.5094	1.25	
8/26/2009	10:51:09	2400	70.89	29.086	2.915	-130	7.99	8544	99.8239	1.25	
8/26/2009	10:52:09	2460	69.58	29.095	2.915	-117	7.92	8628	99.3506	1.25	
8/26/2009	10:53:09	2520	72.93	29.092	2.863	-123	7.94	7046	84.391	990.24	Probe in Chamber
8/26/2009	10:54:09	2580	72.89	29.049	2.889	-129	7.94	6428	77.0637	989.29	
8/26/2009	10:55:09	2640	72.98	29.046	2.889	-128	7.93	6360	76.3303	990.94	
8/26/2009	10:56:09	2700	73.01	29.044	2.863	-127	7.92	6324	75.9279	991.18	
8/26/2009	10:57:09	2760	73.04	29.04	2.889	-126	7.92	6319	75.9026	991.42	
8/26/2009	10:58:09	2820	73.01	29.038	2.915	-126	7.92	6315	75.8373	991.42	
8/26/2009	10:59:09	2880	73.04	29.035	2.889	-126	7.92	6312	75.8378	991.42	

McDowell Forest Preserve
Blank Chamber

8/26/2009	11:00:09	2940	73.04	29.032	2.863	-125	7.92	6314	75.8624	991.42	
8/26/2009	11:01:09	3000	73.04	29.03	2.863	-125	7.92	6305	75.7717	991.65	
8/26/2009	11:02:09	3060	73.06	29.026	2.915	-125	7.92	6304	75.7723	991.89	
8/26/2009	11:03:09	3120	73.06	29.025	2.915	-125	7.92	6307	75.8184	991.89	
8/26/2009	11:04:09	3180	73.06	29.023	2.915	-125	7.92	6309	75.8418	991.89	Data used for analysis
8/26/2009	11:05:09	3240	73.08	29.021	2.863	-125	7.92	6302	75.781	992.13	
8/26/2009	11:06:09	3300	73.09	29.02	2.889	-125	7.92	6304	75.8207	992.13	
8/26/2009	11:07:09	3360	73.07	29.018	2.889	-125	7.92	6304	75.8074	992.13	
8/26/2009	11:08:09	3420	73.08	29.017	2.915	-125	7.92	6297	75.7351	992.13	
8/26/2009	11:09:09	3480	73.1	29.015	2.915	-124	7.92	6307	75.8753	992.37	
8/26/2009	11:10:09	3540	73.1	29.013	2.915	-125	7.92	6300	75.7996	992.37	
8/26/2009	11:11:09	3600	73.11	29.012	2.889	-124	7.92	6301	75.8226	992.37	
8/26/2009	11:12:09	3660	73.11	29.011	2.915	-125	7.92	6305	75.8643	992.6	
8/26/2009	11:13:09	3720	73.11	29.009	2.863	-124	7.92	6298	75.7917	992.37	
8/26/2009	11:14:09	3780	73.13	29.008	2.915	-124	7.92	6292	75.7354	992.84	
8/26/2009	11:15:09	3840	73.13	29.006	2.915	-124	7.92	6299	75.8236	992.84	
8/26/2009	11:16:09	3900	73.13	29.005	2.889	-124	7.92	6294	75.7642	992.84	
8/26/2009	11:17:09	3960	73.12	29.004	2.915	-124	7.92	6295	75.7846	993.08	
8/26/2009	11:18:09	4020	73.15	29.003	2.915	-124	7.92	6284	75.6779	993.08	
8/26/2009	11:19:09	4080	73.16	29.001	2.889	-123	7.92	6286	75.7093	993.08	
8/26/2009	11:20:09	4140	73.16	29	2.915	-123	7.92	6292	75.7837	993.08	
8/26/2009	11:21:09	4200	73.17	28.999	2.941	-123	7.92	6292	75.7929	993.32	
8/26/2009	11:22:09	4260	73.17	28.998	2.915	-123	7.92	6286	75.7296	993.32	
8/26/2009	11:23:09	4320	73.19	28.997	2.915	-123	7.92	6289	75.7745	993.32	
8/26/2009	11:24:09	4380	73.2	28.996	2.915	-123	7.92	6291	75.8205	993.32	
8/26/2009	11:25:09	4440	73.2	28.996	2.889	-123	7.92	6289	75.7986	993.55	
8/26/2009	11:26:09	4500	73.2	28.995	2.915	-123	7.92	6287	75.7723	993.55	
8/26/2009	11:27:09	4560	73.22	28.994	2.915	-124	7.92	6288	75.7997	993.55	
8/26/2009	11:28:09	4620	73.21	28.993	2.915	-124	7.92	6290	75.8254	993.55	
8/26/2009	11:29:09	4680	73.22	28.992	2.889	-124	7.92	6288	75.8025	993.79	
8/26/2009	11:30:09	4740	73.21	28.991	2.915	-124	7.92	6291	75.8417	993.55	
8/26/2009	11:31:09	4800	73.23	28.991	2.889	-124	7.92	6289	75.8335	993.55	
8/26/2009	11:32:09	4860	73.24	28.989	2.915	-124	7.92	6289	75.8423	993.79	
8/26/2009	11:33:09	4920	73.22	28.988	2.915	-124	7.92	6288	75.8156	993.79	
8/26/2009	11:34:09	4980	73.25	28.988	2.915	-123	7.92	6282	75.7671	994.03	
8/26/2009	11:35:09	5040	73.24	29	2.915	-124	7.92	6284	75.7604	994.03	
8/26/2009	11:36:09	5100	73.23	29.128	2.889	-124	7.92	6279	75.3479	994.27	
8/26/2009	11:37:09	5160	73.26	29.203	2.915	-124	7.92	6279	75.1599	994.03	
8/26/2009	11:38:09	5220	73.23	29.255	2.915	-123	7.92	6281	75.0349	994.27	
8/26/2009	11:39:09	5280	73.27	29.285	2.915	-124	7.92	6282	74.991	994.27	
8/26/2009	11:40:09	5340	73.25	29.303	2.889	-124	7.92	6285	74.9744	994.27	
8/26/2009	11:41:09	5400	73.25	29.313	2.863	-123	7.92	6273	74.7964	994.27	
8/26/2009	11:42:09	5460	73.26	29.317	2.863	-123	7.92	6282	74.9003	994.51	
8/26/2009	11:43:09	5520	73.26	29.319	2.915	-123	7.92	6274	74.8048	994.27	
8/26/2009	11:44:09	5580	73.26	29.322	2.915	-123	7.92	6278	74.8432	994.27	
8/26/2009	11:45:09	5640	73.29	29.322	2.915	-123	7.92	6269	74.7603	994.27	
8/26/2009	11:46:09	5700	73.28	29.323	2.915	-123	7.92	6282	74.8989	994.27	
8/26/2009	11:47:09	5760	73.26	29.324	2.915	-123	7.92	6277	74.8278	994.51	
8/26/2009	11:48:09	5820	73.27	29.324	2.915	-124	7.92	6278	74.8387	994.27	
8/26/2009	11:49:09	5880	73.28	29.325	2.889	-123	7.92	6281	74.8867	994.5	
8/26/2009	11:50:09	5940	73.27	29.324	2.915	-123	7.92	6270	74.7485	994.27	
8/26/2009	11:51:09	6000	73.28	29.326	2.915	-123	7.92	6273	74.7817	994.5	
8/26/2009	11:52:09	6060	73.3	29.326	2.915	-123	7.92	6279	74.8672	994.5	
8/26/2009	11:53:09	6120	73.29	29.327	2.915	-123	7.92	6274	74.8067	994.74	
8/26/2009	11:54:09	6180	73.27	29.327	2.889	-123	7.92	6272	74.7661	994.5	
8/26/2009	11:55:09	6240	73.3	29.328	2.915	-123	7.92	6274	74.812	994.5	
8/26/2009	11:56:09	6300	73.28	29.329	2.915	-123	7.92	6274	74.7976	994.5	
8/26/2009	11:57:09	6360	73.28	29.329	2.863	-122	7.92	6266	74.6922	994.74	
8/26/2009	11:58:09	6420	73.29	29.33	2.915	-123	7.92	6268	74.7349	994.5	
8/26/2009	11:59:09	6480	73.3	29.331	2.889	-123	7.92	6254	74.5709	994.98	
8/26/2009	12:00:09	6540	73.3	29.332	2.915	-123	7.92	6257	74.5982	994.74	
8/26/2009	12:01:09	6600	73.29	29.332	2.915	-123	7.92	6268	74.7158	994.74	
8/26/2009	12:02:09	6660	73.3	29.332	2.915	-123	7.92	6270	74.7531	994.74	
8/26/2009	12:03:09	6720	73.3	29.331	2.915	-123	7.92	6265	74.6982	994.74	
8/26/2009	12:04:09	6780	73.3	29.331	2.915	-122	7.92	6258	74.6044	994.98	
8/26/2009	12:05:09	6840	73.31	29.331	2.915	-122	7.92	6268	74.7415	994.74	
8/26/2009	12:06:09	6900	73.3	29.332	2.863	-122	7.92	6270	74.7577	994.98	
8/26/2009	12:07:09	6960	73.31	29.332	2.915	-122	7.92	6263	74.6807	994.74	
8/26/2009	12:08:09	7020	73.31	29.332	2.915	-122	7.92	6262	74.663	994.74	
8/26/2009	12:09:09	7080	73.31	29.333	2.915	-122	7.92	6262	74.6635	994.98	
8/26/2009	12:10:09	7140	73.31	29.332	2.915	-122	7.92	6255	74.5847	994.98	
8/26/2009	12:11:09	7200	73.31	29.332	2.889	-122	7.92	6258	74.6258	995.22	
8/26/2009	12:12:09	7260	73.33	29.332	2.863	-122	7.92	6257	74.6169	994.98	
8/26/2009	12:13:09	7320	73.32	29.331	2.915	-122	7.92	6249	74.522	994.98	
8/26/2009	12:14:09	7380	73.33	29.33	2.915	-122	7.92	6252	74.5664	994.98	
8/26/2009	12:15:09	7440	73.33	29.33	2.915	-122	7.92	6264	74.7125	995.22	
8/26/2009	12:16:09	7500	73.33	29.329	2.889	-122	7.92	6266	74.734	995.22	
8/26/2009	12:17:09	7560	73.33	29.329	2.915	-122	7.92	6259	74.6574	994.98	
8/26/2009	12:18:09	7620	73.33	29.33	2.863	-122	7.92	6264	74.7145	994.98	
8/26/2009	12:19:09	7680	73.33	29.33	2.863	-122	7.92	6265	74.726	994.98	
8/26/2009	12:20:09	7740	73.34	29.329	2.915	-123	7.92	6255	74.6141	995.22	
8/26/2009	12:21:09	7800	73.35	29.33	2.915	-123	7.92	6249	74.5486	995.22	
8/26/2009	12:22:09	7860	73.34	29.329	2.889	-123	7.92	6242	74.4636	995.22	
8/26/2009	12:23:09	7920	73.34	29.329	2.915	-122	7.92	6251	74.5635	995.22	

8/26/2009	12:24:09	7980	73.36	29.329	2.915	-122	7.92	6231	74.3405	995.22	
8/26/2009	12:25:09	8040	73.35	29.328	2.889	-122	7.92	6247	74.5359	995.22	
8/26/2009	12:26:09	8100	73.35	29.329	2.915	-122	7.92	6247	74.5331	995.46	
8/26/2009	12:27:09	8160	73.36	29.329	2.915	-122	7.92	6240	74.4523	995.46	
8/26/2009	12:28:09	8220	73.35	29.329	2.889	-122	7.92	6258	74.6517	995.46	
8/26/2009	12:29:09	8280	73.35	29.329	2.889	-122	7.92	6251	74.5738	995.46	
8/26/2009	12:30:09	8340	73.35	29.329	2.889	-123	7.92	6252	74.5893	995.46	
8/26/2009	12:31:09	8400	73.37	29.329	2.915	-123	7.92	6252	74.6075	995.7	
8/26/2009	12:32:09	8460	73.37	29.33	2.889	-123	7.92	6261	74.7079	995.46	
8/26/2009	12:33:09	8520	73.37	29.329	2.915	-123	7.92	6252	74.6028	995.46	
8/26/2009	12:34:09	8580	73.36	29.329	2.863	-123	7.92	6253	74.6076	995.22	
8/26/2009	12:35:09	8640	73.37	29.33	2.915	-123	7.92	6242	74.4815	995.46	
8/26/2009	12:36:09	8700	73.38	29.33	2.889	-123	7.92	6252	74.6086	995.46	
8/26/2009	12:37:09	8760	73.37	29.331	2.915	-123	7.92	6262	74.7118	995.7	
8/26/2009	12:38:09	8820	73.36	29.331	2.889	-123	7.92	6253	74.6055	995.46	
8/26/2009	12:39:09	8880	73.37	29.332	2.889	-123	7.92	6252	74.599	995.46	
8/26/2009	12:40:09	8940	73.38	29.331	2.915	-123	7.92	6254	74.6291	995.46	
8/26/2009	12:41:09	9000	73.38	29.332	2.915	-123	7.92	6246	74.5304	995.94	
8/26/2009	12:42:09	9060	73.38	29.331	2.915	-123	7.92	6252	74.6131	995.7	
8/26/2009	12:43:09	9120	73.37	29.33	2.915	-123	7.91	6250	74.575	995.7	
8/26/2009	12:44:09	9180	73.38	29.33	2.915	-123	7.92	6257	74.6628	995.7	
8/26/2009	12:45:09	9240	73.39	29.343	2.889	-123	7.92	6246	74.5053	996.18	
8/26/2009	12:46:09	9300	73.38	29.338	2.915	-124	7.92	6248	74.5378	996.18	
8/26/2009	12:47:09	9360	73.38	29.331	2.915	-126	7.92	6244	74.5075	995.94	

Knock Knolls
Sediment Probe 1

In-Situ Inc. Troll 9000 Pro XP

Report generated: 8/27/2009 13:58:31
Report from file: ...\SN48381 2009-08-26 141802 sod4-knoch-sed1.bin
Win-Situ® Version 4.58.14.0

Serial number: 48381
Firmware Version 2.13
Unit name: MP Troll 9000

Test name: sod4-knoch-sed1

Test defined on: 8/26/2009 14:17:55
Test started on: 8/26/2009 14:18:02
Test stopped on: 8/26/2009 17:10:51

Data gathered using Linear testing
Time between data points: 60.0 Seconds.
Number of data samples: 173

TOTAL DATA SAMPLES 173

Date	Time	ET (sec)	Chan[1] Temperature Fahrenheit	Chan[3] Barometric Inches Hg	Chan[5] Battery Volts	Chan[11] ORP millivolts	Chan[12] pH pH	Chan[37] Rugged DO micrograms/L	Chan[37] Rugged DO Sat %Saturation	Chan[45] Conductivity microSiemens/cm Actual Conductivity	Notes
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8/26/2009	14:18:02	0	72.9	29.364	2.889	95	8.22	8604	101.7168	1.32	Test Started
8/26/2009	14:19:02	60	73.08	29.441	2.915	95	8.22	8492	100.3137	1.32	
8/26/2009	14:20:02	120	73.27	29.448	2.889	94	8.22	8459	100.1045	1.32	
8/26/2009	14:21:02	180	73.44	29.454	2.915	94	8.21	8446	100.1151	1.32	
8/26/2009	14:22:02	240	73.57	29.459	2.915	94	8.21	8456	100.3447	1.32	
8/26/2009	14:23:02	300	73.72	29.464	2.889	94	8.21	8437	100.2625	1.32	
8/26/2009	14:24:02	360	73.84	29.468	2.915	94	8.2	8398	99.9147	1.32	
8/26/2009	14:25:02	420	73.94	29.472	2.837	94	8.2	8385	99.8522	1.32	
8/26/2009	14:26:02	480	74.03	29.477	2.889	95	8.19	8377	99.8297	1.32	
8/26/2009	14:27:02	540	74.14	29.47	2.915	95	8.19	8574	102.3214	1.32	
8/26/2009	14:28:02	600	71.86	29.481	2.837	101	8.23	8309	96.7586	1.32	
8/26/2009	14:29:02	660	72.55	29.488	2.915	102	8.23	8380	98.2784	1.32	
8/26/2009	14:30:02	720	72.04	29.496	2.889	107	8.21	8475	98.825	1.32	
8/26/2009	14:31:02	780	72.06	29.493	2.889	107	8.24	8466	98.7557	1.32	
8/26/2009	14:32:02	840	72.04	29.495	2.915	106	8.26	8463	98.6928	1.32	
8/26/2009	14:33:02	900	72.04	29.496	2.915	105	8.27	8439	98.3993	1.32	
8/26/2009	14:34:02	960	72.11	29.497	2.889	104	8.28	8456	98.6756	1.32	
8/26/2009	14:35:02	1020	72.12	29.499	2.889	103	8.3	8451	98.6199	1.32	
8/26/2009	14:36:02	1080	72.16	29.5	2.889	102	8.3	8455	98.7024	1.32	
8/26/2009	14:37:02	1140	72.2	29.501	2.915	101	8.31	8445	98.6272	1.32	
8/26/2009	14:38:02	1200	72.25	29.502	2.915	101	8.32	8438	98.5982	1.32	
8/26/2009	14:39:02	1260	72.27	29.503	2.915	100	8.33	8440	98.6329	1.32	
8/26/2009	14:40:02	1320	72.31	29.505	2.889	100	8.33	8435	98.6056	1.32	
8/26/2009	14:41:02	1380	72.32	29.506	2.915	99	8.34	8446	98.7465	1.32	
8/26/2009	14:42:02	1440	72.32	29.508	2.889	99	8.34	8447	98.7506	1.32	
8/26/2009	14:43:02	1500	72.34	29.509	2.889	99	8.35	8450	98.8081	1.32	
8/26/2009	14:44:02	1560	72.36	29.512	2.889	98	8.35	8456	98.8793	1.32	
8/26/2009	14:45:02	1620	72.37	29.513	2.915	98	8.35	8451	98.8409	1.32	
8/26/2009	14:46:02	1680	72.37	29.513	2.915	98	8.36	8440	98.7076	1.32	
8/26/2009	14:47:02	1740	72.37	29.515	2.889	97	8.36	8452	98.8419	1.32	
8/26/2009	14:48:02	1800	72.37	29.516	2.837	97	8.36	8450	98.8129	1.32	
8/26/2009	14:49:02	1860	72.43	29.52	2.915	97	8.37	8466	99.048	1.32	
8/26/2009	14:50:02	1920	72.01	29.505	2.889	101	8.34	8498	99.0354	1.32	
8/26/2009	14:51:02	1980	71.56	29.504	2.915	103	8.31	8520	98.8108	1.32	
8/26/2009	14:52:02	2040	71.66	29.507	2.889	103	8.31	8488	98.5423	1.32	
8/26/2009	14:53:02	2100	71.37	29.512	2.889	105	8.31	8472	98.0344	1.32	
8/26/2009	14:54:02	2160	71.46	29.508	2.915	106	8.26	8493	98.3806	1.32	
8/26/2009	14:55:02	2220	71.17	29.508	2.889	107	8.23	8554	98.7825	1.32	
8/26/2009	14:56:02	2280	71.22	29.508	2.915	107	8.26	8537	98.6315	1.32	
8/26/2009	14:57:02	2340	70.84	29.503	2.915	107	8.28	8522	98.08	1.32	
8/26/2009	14:58:02	2400	70.83	29.497	2.889	109	8.29	8555	98.4749	1.32	
8/26/2009	14:59:02	2460	70.89	29.491	2.915	111	8.29	8606	99.1371	1.32	
8/26/2009	15:00:02	2520	71.06	29.486	2.837	110	8.3	8577	99.0065	1.32	
8/26/2009	15:01:02	2580	71.07	29.486	2.915	110	8.31	8584	99.095	1.32	
8/26/2009	15:02:02	2640	70.85	29.482	2.889	112	8.31	8582	98.8525	1.32	
8/26/2009	15:03:02	2700	70.59	29.479	2.889	114	8.31	8615	98.9606	1.32	
8/26/2009	15:04:02	2760	70.45	29.469	2.915	116	8.32	8626	98.9744	1.32	
8/26/2009	15:05:02	2820	69.99	29.467	2.915	92	8.33	8705	99.3873	1.32	
8/26/2009	15:06:02	2880	69.67	29.463	2.889	76	7.99	6849	77.9417	1.32	
8/26/2009	15:07:02	2940	69.73	29.455	2.889	66	7.99	6700	76.3102	1.32	
8/26/2009	15:08:02	3000	69.84	29.447	2.889	65	8	6764	77.1556	1.32	
8/26/2009	15:09:02	3060	69.96	29.438	2.915	66	8.01	6780	77.4635	1.32	

8/26/2009	15:10:02	3120	69.85	29.429	2.889	67	8.01	6853	78.232	1.32	
8/26/2009	15:11:02	3180	69.84	29.421	2.889	68	8.01	6879	78.5501	1.32	
8/26/2009	15:12:02	3240	69.65	29.413	2.915	68	8.02	6919	78.855	1.32	
8/26/2009	15:13:02	3300	69.29	29.404	2.915	69	8.01	6955	78.9835	1.32	
8/26/2009	15:14:02	3360	69.2	29.395	2.837	70	8.01	6954	78.9217	1.32	
8/26/2009	15:15:02	3420	68.87	29.386	2.889	70	8.01	7042	79.6568	1.32	
8/26/2009	15:16:02	3480	68.57	29.376	2.889	70	8.02	7066	79.6868	1.32	
8/26/2009	15:17:02	3540	68.22	29.367	2.863	71	8.02	7092	79.6929	1.32	
8/26/2009	15:18:02	3600	68.4	29.357	2.915	72	8.01	7025	79.1343	1.32	
8/26/2009	15:19:02	3660	68.17	29.349	2.889	72	8.01	7037	79.0923	1.32	
8/26/2009	15:20:02	3720	68.24	29.34	2.915	72	8.02	7013	78.8993	1.32	
8/26/2009	15:21:02	3780	68.89	29.334	2.837	79	7.88	8454	95.8114	1.32	
8/26/2009	15:22:02	3840	68.49	29.349	2.915	81	7.88	8499	95.8629	1.32	
8/26/2009	15:23:02	3900	68.67	29.355	2.915	84	7.9	8638	97.6028	1.32	
8/26/2009	15:24:02	3960	68.2	29.365	2.915	85	7.92	8607	96.7124	1.32	
8/26/2009	15:25:02	4020	71.64	29.377	2.889	67	7.92	7187	83.9714	660.77	Probe in Chamber
8/26/2009	15:26:02	4080	71.75	29.391	2.889	-49	7.68	5135	60.0296	666.35	
8/26/2009	15:27:02	4140	71.75	29.398	2.915	-54	7.64	4463	52.1691	665.95	
8/26/2009	15:28:02	4200	71.75	29.403	2.837	-50	7.62	4253	49.7089	665.85	
8/26/2009	15:29:02	4260	71.76	29.403	2.889	-46	7.6	4112	48.0556	665.65	
8/26/2009	15:30:02	4320	71.77	29.402	2.863	-42	7.59	4011	46.8844	665.65	
8/26/2009	15:31:02	4380	71.77	29.401	2.889	-38	7.59	3927	45.9067	665.76	
8/26/2009	15:32:02	4440	71.77	29.4	2.863	-34	7.58	3867	45.2004	665.76	
8/26/2009	15:33:02	4500	71.79	29.399	2.863	-31	7.58	3815	44.6128	665.77	
8/26/2009	15:34:02	4560	71.78	29.398	2.889	-27	7.57	3756	43.914	665.87	
8/26/2009	15:35:02	4620	71.81	29.396	2.915	-24	7.57	3710	43.3979	665.97	
8/26/2009	15:36:02	4680	71.81	29.397	2.889	-21	7.56	3673	42.9655	665.98	
8/26/2009	15:37:02	4740	71.83	29.399	2.915	-19	7.56	3610	42.2262	666.09	
8/26/2009	15:38:02	4800	71.84	29.402	2.889	-17	7.56	3572	41.7853	666.19	
8/26/2009	15:39:02	4860	71.84	29.406	2.915	-15	7.55	3537	41.3673	666.2	
8/26/2009	15:40:02	4920	71.85	29.406	2.915	-13	7.55	3494	40.8722	666.2	
8/26/2009	15:41:02	4980	71.85	29.406	2.889	-12	7.55	3468	40.5678	666.41	
8/26/2009	15:42:02	5040	71.87	29.408	2.915	-10	7.55	3431	40.1385	666.51	
8/26/2009	15:43:02	5100	71.87	29.406	2.889	-9	7.54	3398	39.7607	666.61	
8/26/2009	15:44:02	5160	71.87	29.405	2.889	-8	7.54	3360	39.3107	666.72	
8/26/2009	15:45:02	5220	71.87	29.406	2.915	-6	7.54	3330	38.9628	666.72	
8/26/2009	15:46:02	5280	71.88	29.403	2.915	-5	7.54	3294	38.552	666.82	
8/26/2009	15:47:02	5340	71.89	29.401	2.889	-4	7.53	3271	38.2909	666.93	
8/26/2009	15:48:02	5400	71.9	29.402	2.889	-3	7.53	3244	37.9692	666.93	
8/26/2009	15:49:02	5460	71.91	29.399	2.837	-2	7.53	3214	37.6254	667.03	
8/26/2009	15:50:02	5520	71.91	29.398	2.837	-2	7.53	3190	37.3501	666.93	
8/26/2009	15:51:02	5580	71.92	29.399	2.863	-1	7.53	3166	37.0678	667.14	
8/26/2009	15:52:02	5640	71.93	29.397	2.889	0	7.53	3131	36.6614	667.14	
8/26/2009	15:53:02	5700	71.92	29.396	2.889	1	7.53	3110	36.414	667.24	Data used for analysis
8/26/2009	15:54:02	5760	71.92	29.397	2.915	2	7.52	3092	36.2084	667.34	
8/26/2009	15:55:02	5820	71.94	29.395	2.915	3	7.52	3066	35.9132	667.45	
8/26/2009	15:56:02	5880	71.95	29.394	2.889	3	7.52	3042	35.6314	667.55	
8/26/2009	15:57:02	5940	71.95	29.394	2.889	4	7.52	3018	35.3566	667.65	
8/26/2009	15:58:02	6000	71.96	29.391	2.889	5	7.51	3000	35.1569	667.65	
8/26/2009	15:59:02	6060	71.96	29.391	2.915	5	7.51	2989	35.0189	667.65	
8/26/2009	16:00:02	6120	71.98	29.392	2.889	6	7.51	2957	34.6513	667.86	
8/26/2009	16:01:02	6180	71.98	29.39	2.889	6	7.51	2934	34.3889	667.76	
8/26/2009	16:02:02	6240	71.98	29.391	2.889	7	7.51	2922	34.2527	667.96	
8/26/2009	16:03:02	6300	71.99	29.389	2.915	7	7.51	2902	34.0217	668.07	
8/26/2009	16:04:02	6360	72	29.389	2.889	8	7.51	2875	33.6987	668.17	
8/26/2009	16:05:02	6420	71.99	29.39	2.915	8	7.51	2859	33.5175	667.96	
8/26/2009	16:06:02	6480	72	29.388	2.837	9	7.5	2847	33.377	668.27	
8/26/2009	16:07:02	6540	72	29.387	2.837	9	7.5	2826	33.1321	668.38	
8/26/2009	16:08:02	6600	72.01	29.39	2.837	9	7.5	2807	32.9041	668.38	
8/26/2009	16:09:02	6660	72	29.387	2.863	10	7.5	2785	32.6493	668.48	
8/26/2009	16:10:02	6720	72.02	29.386	2.889	10	7.5	2770	32.4809	668.58	
8/26/2009	16:11:02	6780	72.03	29.388	2.915	11	7.5	2755	32.3145	668.58	
8/26/2009	16:12:02	6840	72.04	29.387	2.889	11	7.49	2735	32.0818	668.79	
8/26/2009	16:13:02	6900	72.03	29.386	2.889	11	7.49	2718	31.8832	668.79	
8/26/2009	16:14:02	6960	72.04	29.387	2.915	12	7.49	2702	31.6879	668.79	
8/26/2009	16:15:02	7020	72.04	29.385	2.889	12	7.49	2689	31.5438	668.89	
8/26/2009	16:16:02	7080	72.04	29.384	2.889	12	7.49	2663	31.2399	668.99	
8/26/2009	16:17:02	7140	72.04	29.384	2.889	13	7.49	2637	30.934	668.99	
8/26/2009	16:18:02	7200	72.04	29.384	2.915	13	7.49	2626	30.8073	669.1	
8/26/2009	16:19:02	7260	72.06	29.382	2.889	13	7.49	2611	30.6374	669.2	
8/26/2009	16:20:02	7320	72.05	29.382	2.889	14	7.48	2589	30.3791	669.1	
8/26/2009	16:21:02	7380	72.06	29.383	2.811	14	7.48	2578	30.2517	669.3	
8/26/2009	16:22:02	7440	72.06	29.381	2.889	14	7.48	2567	30.1175	669.3	
8/26/2009	16:23:02	7500	72.06	29.38	2.889	14	7.48	2538	29.7811	669.41	
8/26/2009	16:24:02	7560	72.08	29.382	2.889	15	7.48	2532	29.7174	669.41	
8/26/2009	16:25:02	7620	72.07	29.381	2.811	15	7.48	2521	29.5876	669.41	
8/26/2009	16:26:02	7680	72.08	29.381	2.863	15	7.48	2501	29.3534	669.41	
8/26/2009	16:27:02	7740	72.07	29.383	2.889	16	7.47	2483	29.1424	669.61	
8/26/2009	16:28:02	7800	72.08	29.382	2.889	16	7.48	2475	29.05	669.61	
8/26/2009	16:29:02	7860	72.06	29.38	2.811	16	7.48	2452	28.7795	669.61	
8/26/2009	16:30:02	7920	72.08	29.382	2.889	16	7.47	2435	28.5752	669.72	
8/26/2009	16:31:02	7980	72.07	29.381	2.889	17	7.47	2419	28.3863	669.82	
8/26/2009	16:32:02	8040	72.09	29.381	2.863	17	7.47	2405	28.2362	669.92	
8/26/2009	16:33:02	8100	72.09	29.381	2.889	17	7.47	2395	28.1172	669.82	
8/26/2009	16:34:02	8160	72.09	29.379	2.863	17	7.47	2379	27.9316	670.03	
8/26/2009	16:35:02	8220	72.1	29.379	2.889	17	7.47	2365	27.7667	670.13	
8/26/2009	16:36:02	8280	72.1	29.381	2.889	18	7.47	2355	27.6462	670.03	

Knock Knolls
Sediment Probe 1

8/26/2009	16:37:02	8340	72.09	29.379	2.889	18	7.47	2334	27.3994	670.03	
8/26/2009	16:38:02	8400	72.09	29.379	2.811	18	7.47	2314	27.1648	670.13	
8/26/2009	16:39:02	8460	72.1	29.378	2.889	18	7.47	2306	27.0791	670.23	
8/26/2009	16:40:02	8520	72.1	29.377	2.811	19	7.47	2294	26.9318	670.23	
8/26/2009	16:41:02	8580	72.11	29.377	2.889	19	7.46	2279	26.7564	670.34	
8/26/2009	16:42:02	8640	72.11	29.378	2.889	19	7.47	2270	26.6569	670.34	
8/26/2009	16:43:02	8700	72.1	29.376	2.889	19	7.47	2238	26.2834	670.23	
8/26/2009	16:44:02	8760	72.11	29.376	2.863	19	7.47	2216	26.0176	670.34	
8/26/2009	16:45:02	8820	72.1	29.375	2.889	20	7.47	2189	25.7023	670.34	
8/26/2009	16:46:02	8880	72.11	29.375	2.889	20	7.46	2172	25.5069	670.34	
8/26/2009	16:47:02	8940	72.08	29.376	2.889	20	7.46	2189	25.6948	670.34	
8/26/2009	16:48:02	9000	72.09	29.374	2.889	21	7.46	2187	25.6791	670.23	
8/26/2009	16:49:02	9060	72.08	29.376	2.889	21	7.45	2175	25.5363	670.34	
8/26/2009	16:50:02	9120	72.09	29.374	2.889	21	7.46	2175	25.533	670.44	
8/26/2009	16:51:02	9180	72.08	29.374	2.863	21	7.46	2166	25.4319	670.44	
8/26/2009	16:52:02	9240	72.07	29.376	2.889	21	7.45	2151	25.2487	670.54	
8/26/2009	16:53:02	9300	72.09	29.374	2.863	21	7.45	2132	25.0293	670.34	
8/26/2009	16:54:02	9360	72.1	29.374	2.811	22	7.45	2122	24.9132	670.44	
8/26/2009	16:55:02	9420	72.08	29.375	2.889	22	7.45	2112	24.7904	670.54	
8/26/2009	16:56:02	9480	72.1	29.373	2.863	22	7.45	2096	24.6089	670.65	
8/26/2009	16:57:02	9540	72.07	29.373	2.889	22	7.45	2091	24.5427	670.65	
8/26/2009	16:58:02	9600	72.09	29.375	2.889	22	7.45	2075	24.3594	670.85	
8/26/2009	16:59:02	9660	72.08	29.373	2.863	22	7.45	2065	24.249	670.65	
8/26/2009	17:00:02	9720	72.09	29.373	2.837	23	7.45	2060	24.1821	670.75	
8/26/2009	17:01:02	9780	72.09	29.375	2.889	23	7.45	2043	23.9829	670.85	
8/26/2009	17:02:02	9840	72.08	29.373	2.811	23	7.45	2032	23.8545	670.85	
8/26/2009	17:03:02	9900	72.08	29.373	2.863	23	7.44	2027	23.7973	670.96	
8/26/2009	17:04:02	9960	72.1	29.375	2.889	23	7.45	2009	23.5912	670.96	
8/26/2009	17:05:02	10020	72.09	29.374	2.889	24	7.45	2002	23.5023	671.06	
8/26/2009	17:06:02	10080	72.09	29.374	2.889	24	7.45	1990	23.3656	670.96	
8/26/2009	17:07:02	10140	72.09	29.376	2.889	24	7.44	1983	23.2847	671.06	
8/26/2009	17:08:02	10200	72.08	29.375	2.889	24	7.44	1973	23.1641	671.06	
8/26/2009	17:09:02	10260	72.08	29.374	2.863	24	7.44	1963	23.0468	671.06	
8/26/2009	17:10:02	10320	72.08	29.376	2.889	25	7.44	1950	22.8871	671.16	

Knock Knolls
Sediment Probe 2

In-Situ Inc. Troll 9000 Pro XP

Report generated: 8/27/2009 13:50:31
Report from file: ...\SN48396 2009-08-26 132057 sod4-knoch-blank.bin
Win-Situ® Version 4.58.14.0

Serial number: 48396
Firmware Version 2.13
Unit name: MP Troll 9000

Test name: sod4-knoch-blank

Test defined on: 8/26/2009 13:20:46
Test started on: 8/26/2009 13:20:57
Test stopped on: 8/26/2009 16:19:03

Data gathered using Linear testing
Time between data points: 60.0 Seconds.
Number of data samples: 179

TOTAL DATA SAMPLES 179

Date	Time	ET (sec)	Chan[1] Temperature Fahrenheit	Chan[3] Barometric Inches Hg	Chan[5] Battery Volts	Chan[11] ORP millivolts	Chan[12] pH pH	Chan[37] Rugged DO micrograms/L	Chan[37] Rugged DO Sat %Saturation	Chan[45] Conductivity microSiemens /cm Actual Conductivity	Notes
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8/26/2009	14:20:57	0	73.34	29.426	2.915	-121	7.74	8577	101.6539	1.25	Test Started
8/26/2009	14:21:57	60	73.52	29.397	2.889	-122	7.75	8609	102.3315	1.25	
8/26/2009	14:22:57	120	73.75	29.375	2.915	-122	7.75	8544	101.8847	1.25	
8/26/2009	14:23:57	180	73.92	29.374	2.889	-123	7.75	8507	101.6237	1.25	
8/26/2009	14:24:57	240	74.06	29.374	2.863	-123	7.75	8485	101.5096	1.25	
8/26/2009	14:25:57	300	74.18	29.374	2.915	-123	7.75	8462	101.3626	1.25	
8/26/2009	14:26:57	360	71.66	29.364	2.837	-105	7.74	8372	97.6741	1.25	
8/26/2009	14:27:57	420	71.43	29.381	2.837	-108	7.77	8442	98.1977	1.25	
8/26/2009	14:28:57	480	71.94	29.378	2.837	-111	7.77	8465	99.0074	1.25	
8/26/2009	14:29:57	540	71.7	29.381	2.889	-111	7.75	8516	99.3454	1.25	
8/26/2009	14:30:57	600	72.12	29.383	2.889	-113	7.75	8513	99.741	1.25	
8/26/2009	14:31:57	660	72.22	29.381	2.889	-115	7.76	8494	99.6381	1.25	
8/26/2009	14:32:57	720	72.29	29.38	2.889	-116	7.76	8491	99.6784	1.25	
8/26/2009	14:33:57	780	72.39	29.379	2.837	-118	7.77	8483	99.695	1.25	
8/26/2009	14:34:57	840	72.46	29.377	2.837	-119	7.77	8479	99.7305	1.25	
8/26/2009	14:35:57	900	72.52	29.376	2.889	-120	7.77	8472	99.7154	1.25	
8/26/2009	14:36:57	960	72.58	29.374	2.889	-120	7.77	8474	99.8053	1.25	
8/26/2009	14:37:57	1020	72.65	29.374	2.889	-121	7.77	8465	99.7771	1.25	
8/26/2009	14:38:57	1080	72.69	29.372	2.837	-122	7.77	8470	99.8802	1.25	
8/26/2009	14:39:57	1140	72.74	29.371	2.889	-122	7.77	8459	99.8073	1.25	
8/26/2009	14:40:57	1200	72.78	29.37	2.889	-123	7.77	8464	99.9148	1.25	
8/26/2009	14:41:57	1260	72.84	29.369	2.889	-124	7.77	8464	99.9881	1.25	
8/26/2009	14:42:57	1320	72.86	29.368	2.889	-124	7.77	8453	99.8781	1.25	
8/26/2009	14:43:57	1380	72.88	29.368	2.863	-125	7.76	8452	99.8941	1.25	
8/26/2009	14:44:57	1440	72.9	29.367	2.889	-125	7.76	8452	99.9123	1.25	
8/26/2009	14:45:57	1500	72.92	29.367	2.863	-125	7.76	8448	99.8846	1.25	
8/26/2009	14:46:57	1560	72.93	29.366	2.889	-125	7.76	8455	99.9817	1.25	
8/26/2009	14:47:57	1620	72.93	29.366	2.889	-126	7.76	8444	99.8563	1.25	
8/26/2009	14:48:57	1680	72.92	29.362	2.863	-126	7.76	8450	99.936	1.25	
8/26/2009	14:49:57	1740	72.48	29.353	2.863	-124	7.75	8478	99.8282	1.25	
8/26/2009	14:50:57	1800	72.34	29.35	2.889	-120	7.75	8503	99.9838	1.25	
8/26/2009	14:51:57	1860	72.34	29.363	2.915	-121	7.74	8520	100.1357	1.25	
8/26/2009	14:52:57	1920	72.13	29.349	2.915	-120	7.73	8526	100.0301	1.25	
8/26/2009	14:53:57	1980	71.75	29.347	2.863	-117	7.7	8510	99.4502	1.25	
8/26/2009	14:54:57	2040	71.53	29.346	2.915	-117	7.69	8599	100.2512	1.25	
8/26/2009	14:55:57	2100	71.47	29.337	2.915	-113	7.69	8595	100.1683	1.25	
8/26/2009	14:56:57	2160	71.41	29.344	2.915	-113	7.71	8651	100.7379	1.25	
8/26/2009	14:57:57	2220	70.4	29.342	2.889	-105	7.7	8717	100.4049	1.25	
8/26/2009	14:58:57	2280	70.73	29.324	2.915	-104	7.72	8750	101.2171	1.25	
8/26/2009	14:59:57	2340	70.97	29.321	2.915	-103	7.73	8718	101.1204	1.25	
8/26/2009	15:00:57	2400	71.01	29.315	2.915	-102	7.73	8696	100.9333	1.25	
8/26/2009	15:01:57	2460	70.78	29.31	2.863	-97	7.73	8717	100.932	1.25	
8/26/2009	15:02:57	2520	70.6	29.305	2.915	-94	7.73	8740	101.0292	1.25	
8/26/2009	15:03:57	2580	70.48	29.319	2.889	-92	7.73	8739	100.8346	1.25	
8/26/2009	15:04:57	2640	70.25	29.312	2.889	-89	7.73	8748	100.7157	1.25	
8/26/2009	15:05:57	2700	70.16	29.288	2.889	-89	7.74	6709	77.2249	1.25	
8/26/2009	15:06:57	2760	70.29	29.371	2.915	-90	7.72	6848	78.702	1.25	
8/26/2009	15:07:57	2820	70.25	29.363	2.915	-90	7.7	7036	80.8491	1.25	
8/26/2009	15:08:57	2880	70.05	29.357	2.863	-90	7.69	7037	80.7115	1.25	

Knock Knolls
Sediment Probe 2

8/26/2009	15:09:57	2940	69.87	29.349	2.915	-89	7.68	7041	80.6136	1.25	
8/26/2009	15:10:57	3000	69.87	29.342	2.863	-90	7.67	7055	80.7988	1.25	
8/26/2009	15:11:57	3060	69.85	29.336	2.889	-89	7.67	7038	80.6036	1.25	
8/26/2009	15:12:57	3120	69.49	29.329	2.915	-87	7.67	7078	80.7678	1.25	
8/26/2009	15:13:57	3180	69.38	29.321	2.889	-87	7.67	7130	81.2746	1.25	
8/26/2009	15:14:57	3240	69.13	29.313	2.863	-85	7.67	7202	81.9014	1.25	
8/26/2009	15:15:57	3300	68.91	29.304	2.915	-85	7.66	7211	81.8332	1.25	
8/26/2009	15:16:57	3360	68.76	29.296	2.863	-85	7.66	7212	81.7326	1.25	
8/26/2009	15:17:57	3420	68.77	29.287	2.915	-84	7.66	7207	81.7058	1.25	
8/26/2009	15:18:57	3480	68.64	29.363	2.915	-82	7.65	7245	81.8076	1.25	
8/26/2009	15:19:57	3540	68.67	29.354	2.915	-83	7.65	7244	81.857	1.25	
8/26/2009	15:20:57	3600	68.38	29.353	2.915	-75	7.6	8294	93.4159	1.25	
8/26/2009	15:21:57	3660	68.46	29.356	2.915	-75	7.59	8816	99.3778	1.25	
8/26/2009	15:22:57	3720	68.61	29.367	2.915	-74	7.57	8895	100.3938	1.25	
8/26/2009	15:23:57	3780	71.62	29.379	2.863	-108	7.84	7584	88.5855	670.34	Probe in chamber
8/26/2009	15:24:57	3840	71.76	29.383	2.915	-110	7.87	7423	86.8206	671.75	
8/26/2009	15:25:57	3900	71.79	29.382	2.915	-110	7.9	7350	86.0036	671.97	
8/26/2009	15:26:57	3960	71.79	29.378	2.863	-110	7.91	7350	86.0103	671.97	
8/26/2009	15:27:57	4020	71.79	29.373	2.915	-111	7.92	7344	85.949	671.97	
8/26/2009	15:28:57	4080	71.82	29.369	2.915	-111	7.92	7340	85.9497	672.08	
8/26/2009	15:29:57	4140	71.79	29.364	2.915	-111	7.92	7338	85.9125	672.08	
8/26/2009	15:30:57	4200	71.82	29.36	2.915	-111	7.92	7341	85.9858	672.3	
8/26/2009	15:31:57	4260	71.84	29.353	2.863	-112	7.92	7342	86.0302	672.19	
8/26/2009	15:32:57	4320	71.82	29.345	2.915	-112	7.92	7339	86.0136	672.3	
8/26/2009	15:33:57	4380	71.83	29.336	2.889	-112	7.92	7338	86.0305	672.19	
8/26/2009	15:34:57	4440	71.83	29.325	2.889	-112	7.92	7343	86.116	672.3	
8/26/2009	15:35:57	4500	71.83	29.318	2.863	-112	7.92	7337	86.0742	672.41	
8/26/2009	15:36:57	4560	71.83	29.311	2.863	-112	7.92	7338	86.1163	672.41	
8/26/2009	15:37:57	4620	71.84	29.303	2.915	-112	7.93	7342	86.1898	672.52	
8/26/2009	15:38:57	4680	71.86	29.296	2.863	-112	7.93	7341	86.2122	672.41	
8/26/2009	15:39:57	4740	71.85	29.29	2.889	-112	7.93	7340	86.2187	672.52	
8/26/2009	15:40:57	4800	71.86	29.283	2.915	-112	7.93	7340	86.2411	672.52	
8/26/2009	15:41:57	4860	71.87	29.277	2.837	-112	7.93	7344	86.3183	672.62	
8/26/2009	15:42:57	4920	71.86	29.273	2.915	-112	7.93	7331	86.1654	672.73	
8/26/2009	15:43:57	4980	71.88	29.27	2.915	-112	7.92	7340	86.3018	672.62	
8/26/2009	15:44:57	5040	71.88	29.267	2.915	-112	7.93	7344	86.3636	672.62	
8/26/2009	15:45:57	5100	71.89	29.262	2.889	-112	7.92	7338	86.3032	672.73	
8/26/2009	15:46:57	5160	71.89	29.26	2.915	-112	7.93	7341	86.3479	672.73	
8/26/2009	15:47:57	5220	71.89	29.257	2.889	-112	7.93	7332	86.2534	672.73	
8/26/2009	15:48:57	5280	71.88	29.255	2.889	-112	7.93	7340	86.3534	672.73	
8/26/2009	15:49:57	5340	71.9	29.253	2.915	-112	7.92	7344	86.4228	672.95	
8/26/2009	15:50:57	5400	71.9	29.251	2.915	-112	7.93	7343	86.4077	672.95	
8/26/2009	15:51:57	5460	71.91	29.248	2.915	-112	7.93	7330	86.2788	672.95	
8/26/2009	15:52:57	5520	71.91	29.246	2.915	-113	7.93	7342	86.4269	672.95	
8/26/2009	15:53:57	5580	71.91	29.245	2.889	-113	7.93	7334	86.3418	672.95	
8/26/2009	15:54:57	5640	71.9	29.245	2.915	-113	7.93	7337	86.3593	673.06	
8/26/2009	15:55:57	5700	71.93	29.243	2.889	-113	7.92	7335	86.3676	673.17	
8/26/2009	15:56:57	5760	71.93	29.24	2.915	-113	7.93	7344	86.4859	673.06	
8/26/2009	15:57:57	5820	71.93	29.238	2.915	-113	7.93	7335	86.3903	673.17	
8/26/2009	15:58:57	5880	71.92	29.237	2.889	-113	7.93	7337	86.4007	673.17	
8/26/2009	15:59:57	5940	71.91	29.236	2.915	-112	7.92	7342	86.4521	673.27	
8/26/2009	16:00:57	6000	71.92	29.235	2.863	-112	7.92	7348	86.537	673.27	
8/26/2009	16:01:57	6060	71.92	29.234	2.915	-112	7.93	7337	86.4092	673.16	
8/26/2009	16:02:57	6120	71.93	29.235	2.863	-112	7.92	7338	86.4387	673.27	
8/26/2009	16:03:57	6180	71.94	29.233	2.889	-112	7.93	7338	86.4519	673.16	
8/26/2009	16:04:57	6240	71.94	29.233	2.837	-112	7.92	7346	86.5434	673.16	
8/26/2009	16:05:57	6300	71.94	29.231	2.863	-112	7.92	7345	86.5327	673.27	
8/26/2009	16:06:57	6360	71.94	29.23	2.863	-112	7.93	7330	86.3602	673.38	
8/26/2009	16:07:57	6420	71.94	29.229	2.915	-112	7.93	7349	86.587	673.38	
8/26/2009	16:08:57	6480	71.96	29.229	2.863	-112	7.92	7338	86.4725	673.38	
8/26/2009	16:09:57	6540	71.95	29.228	2.889	-112	7.93	7333	86.4118	673.38	
8/26/2009	16:10:57	6600	71.97	29.227	2.915	-112	7.92	7351	86.649	673.38	
8/26/2009	16:11:57	6660	71.96	29.227	2.915	-112	7.93	7334	86.4341	673.49	
8/26/2009	16:12:57	6720	71.97	29.225	2.863	-112	7.93	7338	86.4929	673.38	
8/26/2009	16:13:57	6780	71.96	29.225	2.863	-112	7.93	7346	86.5874	673.49	
8/26/2009	16:14:57	6840	71.96	29.223	2.863	-112	7.92	7335	86.4584	673.49	
8/26/2009	16:15:57	6900	71.96	29.222	2.915	-113	7.93	7347	86.6028	673.49	
8/26/2009	16:16:57	6960	71.98	29.222	2.889	-113	7.92	7333	86.4641	673.6	
8/26/2009	16:17:57	7020	71.97	29.22	2.915	-113	7.93	7334	86.4732	673.6	
8/26/2009	16:18:57	7080	71.97	29.218	2.889	-112	7.93	7344	86.5852	673.6	
8/26/2009	16:19:57	7140	71.98	29.216	2.915	-112	7.92	7338	86.5332	673.6	
8/26/2009	16:20:57	7200	71.99	29.214	2.863	-112	7.92	7337	86.5334	673.6	
8/26/2009	16:21:57	7260	71.99	29.214	2.915	-112	7.92	7338	86.5446	673.71	
8/26/2009	16:22:57	7320	71.98	29.213	2.863	-112	7.93	7334	86.4974	673.71	
8/26/2009	16:23:57	7380	71.98	29.212	2.889	-112	7.92	7338	86.5491	673.71	
8/26/2009	16:24:57	7440	71.98	29.212	2.915	-112	7.93	7334	86.5044	673.82	
8/26/2009	16:25:57	7500	71.98	29.21	2.915	-112	7.93	7335	86.5127	673.82	
8/26/2009	16:26:57	7560	71.98	29.21	2.915	-112	7.93	7333	86.4904	673.93	
8/26/2009	16:27:57	7620	72	29.206	2.889	-112	7.92	7332	86.5118	673.82	
8/26/2009	16:28:57	7680	71.99	29.205	2.863	-112	7.92	7329	86.4749	673.71	
8/26/2009	16:29:57	7740	71.98	29.202	2.889	-112	7.92	7338	86.5865	673.93	
8/26/2009	16:30:57	7800	71.99	29.201	2.889	-112	7.93	7329	86.486	674.04	
8/26/2009	16:31:57	7860	72.01	29.202	2.889	-112	7.92	7337	86.587	673.93	
8/26/2009	16:32:57	7920	71.99	29.2	2.837	-112	7.93	7341	86.6303	673.93	

Knock Knolls

Sediment Probe 2

8/26/2009	16:33:57	7980	72.01	29.199	2.889	-112	7.92	7337	86.5996	674.04	
8/26/2009	16:34:57	8040	71.99	29.197	2.889	-112	7.92	7331	86.5148	674.04	
8/26/2009	16:35:57	8100	71.99	29.197	2.889	-112	7.92	7338	86.6032	674.15	
8/26/2009	16:36:57	8160	71.99	29.195	2.863	-112	7.92	7334	86.5612	674.04	
8/26/2009	16:37:57	8220	71.99	29.195	2.889	-112	7.92	7330	86.5099	674.15	
8/26/2009	16:38:57	8280	72	29.195	2.863	-112	7.92	7337	86.5999	674.15	
8/26/2009	16:39:57	8340	72	29.196	2.889	-112	7.92	7333	86.5465	674.15	
8/26/2009	16:40:57	8400	71.99	29.2	2.889	-112	7.93	7343	86.6498	674.26	
8/26/2009	16:41:57	8460	71.99	29.203	2.863	-112	7.92	7334	86.5397	674.26	
8/26/2009	16:42:57	8520	72	29.205	2.889	-112	7.93	7319	86.3684	674.26	
8/26/2009	16:43:57	8580	72	29.206	2.863	-112	7.92	7333	86.5218	674.26	
8/26/2009	16:44:57	8640	71.99	29.208	2.889	-112	7.92	7328	86.4549	674.37	
8/26/2009	16:45:57	8700	72	29.209	2.863	-112	7.92	7329	86.4713	674.37	
8/26/2009	16:46:57	8760	72	29.21	2.889	-112	7.92	7334	86.5212	674.58	
8/26/2009	16:47:57	8820	72.01	29.212	2.889	-112	7.92	7337	86.5615	674.47	
8/26/2009	16:48:57	8880	72	29.212	2.889	-112	7.92	7325	86.4079	674.47	
8/26/2009	16:49:57	8940	72	29.214	2.889	-112	7.92	7335	86.5267	674.47	
8/26/2009	16:50:57	9000	72	29.214	2.889	-112	7.92	7330	86.4696	674.69	
8/26/2009	16:51:57	9060	72.01	29.214	2.889	-112	7.93	7333	86.5142	674.69	
8/26/2009	16:52:57	9120	72.01	29.215	2.889	-112	7.92	7333	86.5096	674.69	
8/26/2009	16:53:57	9180	72	29.216	2.837	-112	7.92	7333	86.4885	674.69	
8/26/2009	16:54:57	9240	72.01	29.218	2.889	-112	7.93	7333	86.4989	674.69	
8/26/2009	16:55:57	9300	72.02	29.218	2.889	-112	7.92	7334	86.521	674.91	
8/26/2009	16:56:57	9360	72.01	29.217	2.889	-112	7.92	7337	86.5476	674.8	
8/26/2009	16:57:57	9420	72.02	29.219	2.889	-112	7.92	7326	86.4206	674.91	
8/26/2009	16:58:57	9480	72.02	29.221	2.863	-112	7.92	7338	86.549	675.02	
8/26/2009	16:59:57	9540	72.01	29.221	2.889	-112	7.92	7338	86.5559	675.02	
8/26/2009	17:00:57	9600	72.03	29.224	2.889	-112	7.92	7330	86.4637	675.13	
8/26/2009	17:01:57	9660	72.02	29.227	2.889	-112	7.92	7332	86.4667	675.13	
8/26/2009	17:02:57	9720	72.03	29.229	2.863	-112	7.92	7342	86.5825	675.13	
8/26/2009	17:03:57	9780	72.01	29.234	2.889	-112	7.92	7324	86.3451	675.25	
8/26/2009	17:04:57	9840	72.02	29.242	2.889	-113	7.92	7336	86.4646	675.14	
8/26/2009	17:05:57	9900	72.02	29.245	2.889	-113	7.92	7331	86.3954	675.25	
8/26/2009	17:06:57	9960	72.03	29.248	2.837	-113	7.92	7324	86.3199	675.25	
8/26/2009	17:07:57	10020	72.01	29.25	2.889	-112	7.92	7337	86.4443	675.36	
8/26/2009	17:08:57	10080	72.02	29.252	2.889	-113	7.92	7338	86.4545	675.36	
8/26/2009	17:09:57	10140	72.01	29.255	2.889	-113	7.92	7331	86.357	675.25	
8/26/2009	17:10:57	10200	72.01	29.258	2.889	-113	7.92	7346	86.5309	675.47	
8/26/2009	17:11:57	10260	72.01	29.264	2.889	-112	7.92	7333	86.3617	675.47	
8/26/2009	17:12:57	10320	72.01	29.269	2.863	-112	7.92	7333	86.3382	675.47	
8/26/2009	17:13:57	10380	72.01	29.288	2.837	-114	7.93	7326	86.206	675.91	
8/26/2009	17:14:57	10440	72.03	29.31	2.863	-114	7.93	7318	86.0648	676.13	
8/26/2009	17:15:57	10500	72.02	29.327	2.863	-114	7.93	7317	85.9858	676.24	
8/26/2009	17:16:57	10560	72.01	29.34	2.811	-114	7.93	7329	86.0871	676.46	
8/26/2009	17:17:57	10620	72.02	29.354	2.863	-115	7.93	7323	85.9719	676.58	
8/26/2009	17:18:57	10680	72.02	29.367	2.837	-114	7.92	7315	85.8404	676.69	Test Failed
											Data not used

Knock Knolls
Blank Chamber

In-Situ Inc. Troll 9000 Pro XP

Report generated: 8/27/2009 13:50:31
Report from file: ...\SN48396 2009-08-26 132057 sod4-knoch-blank.bin
Win-Situ® Version 4.58.14.0

Serial number: 48396
Firmware Version 2.13
Unit name: MP Troll 9000

Test name: sod4-knoch-blank

Test defined on: 8/26/2009 13:20:46
Test started on: 8/26/2009 13:20:57
Test stopped on: 8/26/2009 16:19:03

Data gathered using Linear testing
Time between data points: 60.0 Seconds.
Number of data samples: 179

TOTAL DATA SAMPLES 179

Date	Time	ET (sec)	Chan[1] Temperature Fahrenheit	Chan[3] Barometric Inches Hg	Chan[5] Battery Volts	Chan[11] ORP millivolts	Chan[12] pH pH	Chan[37] Rugged DO micrograms/L	Chan[37] Rugged DO Sat %Saturation	Chan[45] Conductivity microSiemens/cm Actual Conductivity	Notes
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8/26/2009	14:20:57	0	73.34	29.426	2.915	-121	7.74	8577	101.6539	1.25	Test Started
8/26/2009	14:21:57	60	73.52	29.397	2.889	-122	7.75	8609	102.3315	1.25	
8/26/2009	14:22:57	120	73.75	29.375	2.915	-122	7.75	8544	101.8847	1.25	
8/26/2009	14:23:57	180	73.92	29.374	2.889	-123	7.75	8507	101.6237	1.25	
8/26/2009	14:24:57	240	74.06	29.374	2.863	-123	7.75	8485	101.5096	1.25	
8/26/2009	14:25:57	300	74.18	29.374	2.915	-123	7.75	8462	101.3626	1.25	
8/26/2009	14:26:57	360	71.66	29.364	2.837	-105	7.74	8372	97.6741	1.25	
8/26/2009	14:27:57	420	71.43	29.381	2.837	-108	7.77	8442	98.1977	1.25	
8/26/2009	14:28:57	480	71.94	29.378	2.837	-111	7.77	8465	99.0074	1.25	
8/26/2009	14:29:57	540	71.7	29.381	2.889	-111	7.75	8516	99.3454	1.25	
8/26/2009	14:30:57	600	72.12	29.383	2.889	-113	7.75	8513	99.741	1.25	
8/26/2009	14:31:57	660	72.22	29.381	2.889	-115	7.76	8494	99.6381	1.25	
8/26/2009	14:32:57	720	72.29	29.38	2.889	-116	7.76	8491	99.6784	1.25	
8/26/2009	14:33:57	780	72.39	29.379	2.837	-118	7.77	8483	99.695	1.25	
8/26/2009	14:34:57	840	72.46	29.377	2.837	-119	7.77	8479	99.7305	1.25	
8/26/2009	14:35:57	900	72.52	29.376	2.889	-120	7.77	8472	99.7154	1.25	
8/26/2009	14:36:57	960	72.58	29.374	2.889	-120	7.77	8474	99.8053	1.25	
8/26/2009	14:37:57	1020	72.65	29.374	2.889	-121	7.77	8465	99.7771	1.25	
8/26/2009	14:38:57	1080	72.69	29.372	2.837	-122	7.77	8470	99.8802	1.25	
8/26/2009	14:39:57	1140	72.74	29.371	2.889	-122	7.77	8459	99.8073	1.25	
8/26/2009	14:40:57	1200	72.78	29.37	2.889	-123	7.77	8464	99.9148	1.25	
8/26/2009	14:41:57	1260	72.84	29.369	2.889	-124	7.77	8464	99.9881	1.25	
8/26/2009	14:42:57	1320	72.86	29.368	2.889	-124	7.77	8453	99.8781	1.25	
8/26/2009	14:43:57	1380	72.88	29.368	2.863	-125	7.76	8452	99.8941	1.25	
8/26/2009	14:44:57	1440	72.9	29.367	2.889	-125	7.76	8452	99.9123	1.25	
8/26/2009	14:45:57	1500	72.92	29.367	2.863	-125	7.76	8448	99.8846	1.25	
8/26/2009	14:46:57	1560	72.93	29.366	2.889	-125	7.76	8455	99.9817	1.25	
8/26/2009	14:47:57	1620	72.93	29.366	2.889	-126	7.76	8444	99.8563	1.25	
8/26/2009	14:48:57	1680	72.92	29.362	2.863	-126	7.76	8450	99.936	1.25	
8/26/2009	14:49:57	1740	72.48	29.353	2.863	-124	7.75	8478	99.8282	1.25	
8/26/2009	14:50:57	1800	72.34	29.35	2.889	-120	7.75	8503	99.9838	1.25	
8/26/2009	14:51:57	1860	72.34	29.363	2.915	-121	7.74	8520	100.1357	1.25	
8/26/2009	14:52:57	1920	72.13	29.349	2.915	-120	7.73	8526	100.0301	1.25	
8/26/2009	14:53:57	1980	71.75	29.347	2.863	-117	7.7	8510	99.4502	1.25	
8/26/2009	14:54:57	2040	71.53	29.346	2.915	-117	7.69	8599	100.2512	1.25	
8/26/2009	14:55:57	2100	71.47	29.337	2.915	-113	7.69	8595	100.1683	1.25	
8/26/2009	14:56:57	2160	71.41	29.344	2.915	-113	7.71	8651	100.7379	1.25	
8/26/2009	14:57:57	2220	70.4	29.342	2.889	-105	7.7	8717	100.4049	1.25	
8/26/2009	14:58:57	2280	70.73	29.324	2.915	-104	7.72	8750	101.2171	1.25	
8/26/2009	14:59:57	2340	70.97	29.321	2.915	-103	7.73	8718	101.1204	1.25	
8/26/2009	15:00:57	2400	71.01	29.315	2.915	-102	7.73	8696	100.9333	1.25	
8/26/2009	15:01:57	2460	70.78	29.31	2.863	-97	7.73	8717	100.932	1.25	
8/26/2009	15:02:57	2520	70.6	29.305	2.915	-94	7.73	8740	101.0292	1.25	
8/26/2009	15:03:57	2580	70.48	29.319	2.889	-92	7.73	8739	100.8346	1.25	
8/26/2009	15:04:57	2640	70.25	29.312	2.889	-89	7.73	8748	100.7157	1.25	
8/26/2009	15:05:57	2700	70.16	29.288	2.889	-89	7.74	6709	77.2249	1.25	
8/26/2009	15:06:57	2760	70.29	29.371	2.915	-90	7.72	6848	78.702	1.25	
8/26/2009	15:07:57	2820	70.25	29.363	2.915	-90	7.7	7036	80.8491	1.25	
8/26/2009	15:08:57	2880	70.05	29.357	2.863	-90	7.69	7037	80.7115	1.25	
8/26/2009	15:09:57	2940	69.87	29.349	2.915	-89	7.68	7041	80.6136	1.25	
8/26/2009	15:10:57	3000	69.87	29.342	2.863	-90	7.67	7055	80.7988	1.25	
8/26/2009	15:11:57	3060	69.85	29.336	2.889	-89	7.67	7038	80.6036	1.25	

Knock Knolls
Blank Chamber

8/26/2009	15:12:57	3120	69.49	29.329	2.915	-87	7.67	7078	80.7678	1.25	
8/26/2009	15:13:57	3180	69.38	29.321	2.889	-87	7.67	7130	81.2746	1.25	
8/26/2009	15:14:57	3240	69.13	29.313	2.863	-85	7.67	7202	81.9014	1.25	
8/26/2009	15:15:57	3300	68.91	29.304	2.915	-85	7.66	7211	81.8332	1.25	
8/26/2009	15:16:57	3360	68.76	29.296	2.863	-85	7.66	7212	81.7326	1.25	
8/26/2009	15:17:57	3420	68.77	29.287	2.915	-84	7.66	7207	81.7058	1.25	
8/26/2009	15:18:57	3480	68.64	29.363	2.915	-82	7.65	7245	81.8076	1.25	
8/26/2009	15:19:57	3540	68.67	29.354	2.915	-83	7.65	7244	81.857	1.25	
8/26/2009	15:20:57	3600	68.38	29.353	2.915	-75	7.6	8294	93.4159	1.25	
8/26/2009	15:21:57	3660	68.46	29.356	2.915	-75	7.59	8816	99.3778	1.25	
8/26/2009	15:22:57	3720	68.61	29.367	2.915	-74	7.57	8895	100.3938	1.25	
8/26/2009	15:23:57	3780	71.62	29.379	2.863	-108	7.84	7584	88.5855	670.34	Probe in Chamber
8/26/2009	15:24:57	3840	71.76	29.383	2.915	-110	7.87	7423	86.8206	671.75	
8/26/2009	15:25:57	3900	71.79	29.382	2.915	-110	7.9	7350	86.0036	671.97	
8/26/2009	15:26:57	3960	71.79	29.378	2.863	-110	7.91	7350	86.0103	671.97	
8/26/2009	15:27:57	4020	71.79	29.373	2.915	-111	7.92	7344	85.949	671.97	
8/26/2009	15:28:57	4080	71.82	29.369	2.915	-111	7.92	7340	85.9497	672.08	
8/26/2009	15:29:57	4140	71.79	29.364	2.915	-111	7.92	7338	85.9125	672.08	
8/26/2009	15:30:57	4200	71.82	29.36	2.915	-111	7.92	7341	85.9858	672.3	
8/26/2009	15:31:57	4260	71.84	29.353	2.863	-112	7.92	7342	86.0302	672.19	
8/26/2009	15:32:57	4320	71.82	29.345	2.915	-112	7.92	7339	86.0136	672.3	
8/26/2009	15:33:57	4380	71.83	29.336	2.889	-112	7.92	7338	86.0305	672.19	
8/26/2009	15:34:57	4440	71.83	29.325	2.889	-112	7.92	7343	86.116	672.3	
8/26/2009	15:35:57	4500	71.83	29.318	2.863	-112	7.92	7337	86.0742	672.41	
8/26/2009	15:36:57	4560	71.83	29.311	2.863	-112	7.92	7338	86.1163	672.41	
8/26/2009	15:37:57	4620	71.84	29.303	2.915	-112	7.93	7342	86.1898	672.52	
8/26/2009	15:38:57	4680	71.86	29.296	2.863	-112	7.93	7341	86.2122	672.41	
8/26/2009	15:39:57	4740	71.85	29.29	2.889	-112	7.93	7340	86.2187	672.52	
8/26/2009	15:40:57	4800	71.86	29.283	2.915	-112	7.93	7340	86.2411	672.52	
8/26/2009	15:41:57	4860	71.87	29.277	2.837	-112	7.93	7344	86.3183	672.62	
8/26/2009	15:42:57	4920	71.86	29.273	2.915	-112	7.93	7331	86.1654	672.73	
8/26/2009	15:43:57	4980	71.88	29.27	2.915	-112	7.92	7340	86.3018	672.62	
8/26/2009	15:44:57	5040	71.88	29.267	2.915	-112	7.93	7344	86.3636	672.62	
8/26/2009	15:45:57	5100	71.89	29.262	2.889	-112	7.92	7338	86.3032	672.73	
8/26/2009	15:46:57	5160	71.89	29.26	2.915	-112	7.93	7341	86.3479	672.73	
8/26/2009	15:47:57	5220	71.89	29.257	2.889	-112	7.93	7332	86.2534	672.73	
8/26/2009	15:48:57	5280	71.88	29.255	2.889	-112	7.93	7340	86.3534	672.73	
8/26/2009	15:49:57	5340	71.9	29.253	2.915	-112	7.92	7344	86.4228	672.95	
8/26/2009	15:50:57	5400	71.9	29.251	2.915	-112	7.93	7343	86.4077	672.95	
8/26/2009	15:51:57	5460	71.91	29.248	2.915	-112	7.93	7330	86.2788	672.95	
8/26/2009	15:52:57	5520	71.91	29.246	2.915	-113	7.93	7342	86.4269	672.95	
8/26/2009	15:53:57	5580	71.91	29.245	2.889	-113	7.93	7334	86.3418	672.95	Data used for analysis
8/26/2009	15:54:57	5640	71.9	29.245	2.915	-113	7.93	7337	86.3593	673.06	
8/26/2009	15:55:57	5700	71.93	29.243	2.889	-113	7.92	7335	86.3676	673.17	
8/26/2009	15:56:57	5760	71.93	29.24	2.915	-113	7.93	7344	86.4859	673.06	
8/26/2009	15:57:57	5820	71.93	29.238	2.915	-113	7.93	7335	86.3903	673.17	
8/26/2009	15:58:57	5880	71.92	29.237	2.889	-113	7.93	7337	86.4007	673.17	
8/26/2009	15:59:57	5940	71.91	29.236	2.915	-112	7.92	7342	86.4521	673.27	
8/26/2009	16:00:57	6000	71.92	29.235	2.863	-112	7.92	7348	86.537	673.27	
8/26/2009	16:01:57	6060	71.92	29.234	2.915	-112	7.93	7337	86.4092	673.16	
8/26/2009	16:02:57	6120	71.93	29.235	2.863	-112	7.92	7338	86.4387	673.27	
8/26/2009	16:03:57	6180	71.94	29.233	2.889	-112	7.93	7338	86.4519	673.16	
8/26/2009	16:04:57	6240	71.94	29.233	2.837	-112	7.92	7346	86.5434	673.16	
8/26/2009	16:05:57	6300	71.94	29.231	2.863	-112	7.92	7345	86.5327	673.27	
8/26/2009	16:06:57	6360	71.94	29.23	2.863	-112	7.93	7330	86.3602	673.38	
8/26/2009	16:07:57	6420	71.94	29.229	2.915	-112	7.93	7349	86.587	673.38	
8/26/2009	16:08:57	6480	71.96	29.229	2.863	-112	7.92	7338	86.4725	673.38	
8/26/2009	16:09:57	6540	71.95	29.228	2.889	-112	7.93	7333	86.4118	673.38	
8/26/2009	16:10:57	6600	71.97	29.227	2.915	-112	7.92	7351	86.649	673.38	
8/26/2009	16:11:57	6660	71.96	29.227	2.915	-112	7.93	7334	86.4341	673.49	
8/26/2009	16:12:57	6720	71.97	29.225	2.863	-112	7.93	7338	86.4929	673.38	
8/26/2009	16:13:57	6780	71.96	29.225	2.863	-112	7.93	7346	86.5874	673.49	
8/26/2009	16:14:57	6840	71.96	29.223	2.863	-112	7.92	7335	86.4584	673.49	
8/26/2009	16:15:57	6900	71.96	29.222	2.915	-113	7.93	7347	86.6028	673.49	
8/26/2009	16:16:57	6960	71.98	29.222	2.889	-113	7.92	7333	86.4641	673.6	
8/26/2009	16:17:57	7020	71.97	29.22	2.915	-113	7.93	7334	86.4732	673.6	
8/26/2009	16:18:57	7080	71.97	29.218	2.889	-112	7.93	7344	86.5852	673.6	
8/26/2009	16:19:57	7140	71.98	29.216	2.915	-112	7.92	7338	86.5332	673.6	
8/26/2009	16:20:57	7200	71.99	29.214	2.863	-112	7.92	7337	86.5334	673.6	
8/26/2009	16:21:57	7260	71.99	29.214	2.915	-112	7.92	7338	86.5446	673.71	
8/26/2009	16:22:57	7320	71.98	29.213	2.863	-112	7.93	7334	86.4974	673.71	
8/26/2009	16:23:57	7380	71.98	29.212	2.889	-112	7.92	7338	86.5491	673.71	
8/26/2009	16:24:57	7440	71.98	29.212	2.915	-112	7.93	7334	86.5044	673.82	
8/26/2009	16:25:57	7500	71.98	29.21	2.915	-112	7.93	7335	86.5127	673.82	
8/26/2009	16:26:57	7560	71.98	29.21	2.915	-112	7.93	7333	86.4904	673.93	
8/26/2009	16:27:57	7620	72	29.206	2.889	-112	7.92	7332	86.5118	673.82	
8/26/2009	16:28:57	7680	71.99	29.205	2.863	-112	7.92	7329	86.4749	673.71	
8/26/2009	16:29:57	7740	71.98	29.202	2.889	-112	7.92	7338	86.5865	673.93	
8/26/2009	16:30:57	7800	71.99	29.201	2.889	-112	7.93	7329	86.486	674.04	
8/26/2009	16:31:57	7860	72.01	29.202	2.889	-112	7.92	7337	86.587	673.93	
8/26/2009	16:32:57	7920	71.99	29.2	2.837	-112	7.93	7341	86.6303	673.93	
8/26/2009	16:33:57	7980	72.01	29.199	2.889	-112	7.92	7337	86.5996	674.04	
8/26/2009	16:34:57	8040	71.99	29.197	2.889	-112	7.92	7331	86.5148	674.04	
8/26/2009	16:35:57	8100	71.99	29.197	2.889	-112	7.92	7338	86.6032	674.15	
8/26/2009	16:36:57	8160	71.99	29.195	2.863	-112	7.92	7334	86.5612	674.04	
8/26/2009	16:37:57	8220	71.99	29.195	2.889	-112	7.92	7330	86.5099	674.15	
8/26/2009	16:38:57	8280	72	29.195	2.863	-112	7.92	7337	86.5999	674.15	

Knock Knolls
Blank Chamber

8/26/2009	16:39:57	8340	72	29.196	2.889	-112	7.92	7333	86.5465	674.15	
8/26/2009	16:40:57	8400	71.99	29.2	2.889	-112	7.93	7343	86.6498	674.26	
8/26/2009	16:41:57	8460	71.99	29.203	2.863	-112	7.92	7334	86.5397	674.26	
8/26/2009	16:42:57	8520	72	29.205	2.889	-112	7.93	7319	86.3684	674.26	
8/26/2009	16:43:57	8580	72	29.206	2.863	-112	7.92	7333	86.5218	674.26	
8/26/2009	16:44:57	8640	71.99	29.208	2.889	-112	7.92	7328	86.4549	674.37	
8/26/2009	16:45:57	8700	72	29.209	2.863	-112	7.92	7329	86.4713	674.37	
8/26/2009	16:46:57	8760	72	29.21	2.889	-112	7.92	7334	86.5212	674.58	
8/26/2009	16:47:57	8820	72.01	29.212	2.889	-112	7.92	7337	86.5615	674.47	
8/26/2009	16:48:57	8880	72	29.212	2.889	-112	7.92	7325	86.4079	674.47	
8/26/2009	16:49:57	8940	72	29.214	2.889	-112	7.92	7335	86.5267	674.47	
8/26/2009	16:50:57	9000	72	29.214	2.889	-112	7.92	7330	86.4696	674.69	
8/26/2009	16:51:57	9060	72.01	29.214	2.889	-112	7.93	7333	86.5142	674.69	
8/26/2009	16:52:57	9120	72.01	29.215	2.889	-112	7.92	7333	86.5096	674.69	
8/26/2009	16:53:57	9180	72	29.216	2.837	-112	7.92	7333	86.4885	674.69	
8/26/2009	16:54:57	9240	72.01	29.218	2.889	-112	7.93	7333	86.4989	674.69	
8/26/2009	16:55:57	9300	72.02	29.218	2.889	-112	7.92	7334	86.521	674.91	
8/26/2009	16:56:57	9360	72.01	29.217	2.889	-112	7.92	7337	86.5476	674.8	
8/26/2009	16:57:57	9420	72.02	29.219	2.889	-112	7.92	7326	86.4206	674.91	
8/26/2009	16:58:57	9480	72.02	29.221	2.863	-112	7.92	7338	86.549	675.02	
8/26/2009	16:59:57	9540	72.01	29.221	2.889	-112	7.92	7338	86.5559	675.02	
8/26/2009	17:00:57	9600	72.03	29.224	2.889	-112	7.92	7330	86.4637	675.13	
8/26/2009	17:01:57	9660	72.02	29.227	2.889	-112	7.92	7332	86.4667	675.13	
8/26/2009	17:02:57	9720	72.03	29.229	2.863	-112	7.92	7342	86.5825	675.13	
8/26/2009	17:03:57	9780	72.01	29.234	2.889	-112	7.92	7324	86.3451	675.25	
8/26/2009	17:04:57	9840	72.02	29.242	2.889	-113	7.92	7336	86.4646	675.14	
8/26/2009	17:05:57	9900	72.02	29.245	2.889	-113	7.92	7331	86.3954	675.25	
8/26/2009	17:06:57	9960	72.03	29.248	2.837	-113	7.92	7324	86.3199	675.25	
8/26/2009	17:07:57	10020	72.01	29.25	2.889	-112	7.92	7337	86.4443	675.36	
8/26/2009	17:08:57	10080	72.02	29.252	2.889	-113	7.92	7338	86.4545	675.36	
8/26/2009	17:09:57	10140	72.01	29.255	2.889	-113	7.92	7331	86.357	675.25	
8/26/2009	17:10:57	10200	72.01	29.258	2.889	-113	7.92	7346	86.5309	675.47	
8/26/2009	17:11:57	10260	72.01	29.264	2.889	-112	7.92	7333	86.3617	675.47	
8/26/2009	17:12:57	10320	72.01	29.269	2.863	-112	7.92	7333	86.3382	675.47	
8/26/2009	17:13:57	10380	72.01	29.288	2.837	-114	7.93	7326	86.206	675.91	
8/26/2009	17:14:57	10440	72.03	29.31	2.863	-114	7.93	7318	86.0648	676.13	
8/26/2009	17:15:57	10500	72.02	29.327	2.863	-114	7.93	7317	85.9858	676.24	
8/26/2009	17:16:57	10560	72.01	29.34	2.811	-114	7.93	7329	86.0871	676.46	
8/26/2009	17:17:57	10620	72.02	29.354	2.863	-115	7.93	7323	85.9719	676.58	
8/26/2009	17:18:57	10680	72.02	29.367	2.837	-114	7.92	7315	85.8404	676.69	

Naperville
Sediment Probe 1

In-Situ Inc. Troll 9000 Pro XP

Report generated: 9/30/2009 13:37:12
Report from file: ...\SN48193 2009-09-29 103934 sed-01.bin
Win-Situ® Version 4.58.14.0

Serial number: 48193
Firmware Version 2.13
Unit name: MP Troll 9000

Test name: sed-01

Test defined on: 9/29/2009 10:39:19
Test started on: 9/29/2009 10:39:34
Test stopped on: 9/29/2009 13:50:26

Data gathered using Linear testing
Time between data points: 60.0 Seconds.
Number of data samples: 191

TOTAL DATA SAMPLES 191

Date	Time	ET (sec)	Chan[1] Temperature Fahrenheit	Chan[3] Barometric Inches Hg	Chan[5] Battery Volts	Chan[11] ORP millivolts	Chan[12] pH pH	Chan[37] Rugged DO micrograms/L	Chan[37] Rugged DO Sat %Saturation	Chan[45] Conductivity microSiemens/cm Actual Conductivity	Notes
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9/29/2009	10:39:34	0	54.23	29.333	3.411	199	6.74	7872	75.1163	1.38	Test Started
9/29/2009	10:40:34	60	54.27	29.437	3.382	241	6.6	7827	74.4603	1.38	
9/29/2009	10:41:34	120	54.45	29.432	3.411	245	5.92	7890	75.239	1.38	
9/29/2009	10:42:34	180	54.6	29.426	3.411	245	5.91	7902	75.5167	1.38	
9/29/2009	10:43:34	240	54.73	29.42	3.382	244	5.9	7907	75.6947	1.38	
9/29/2009	10:44:34	300	54.84	29.416	3.382	244	5.89	7904	75.7892	1.38	
9/29/2009	10:45:34	360	54.97	29.411	3.411	243	5.89	7907	75.957	1.38	
9/29/2009	10:46:34	420	55.11	29.407	3.382	243	5.88	7896	75.9825	1.38	
9/29/2009	10:47:34	480	55.22	29.405	3.352	242	5.88	7889	76.0269	1.38	
9/29/2009	10:48:34	540	55.24	29.404	3.382	242	5.88	7881	75.9806	1.38	
9/29/2009	10:49:34	600	55.29	29.403	3.382	241	5.88	7877	75.9906	1.38	
9/29/2009	10:50:34	660	55.35	29.401	3.382	241	5.89	7866	75.9334	1.38	
9/29/2009	10:51:34	720	55.4	29.399	3.382	241	5.89	7854	75.8785	1.38	
9/29/2009	10:52:34	780	55.44	29.398	3.411	241	5.89	7855	75.9287	1.38	
9/29/2009	10:53:34	840	55.49	29.396	3.382	241	5.89	7845	75.8841	1.38	
9/29/2009	10:54:34	900	55.54	29.394	3.352	241	5.89	7840	75.895	1.38	
9/29/2009	10:55:34	960	55.59	29.392	3.352	240	5.89	7840	75.946	1.38	
9/29/2009	10:56:34	1020	55.64	29.39	3.382	240	5.89	7829	75.8799	1.38	
9/29/2009	10:57:34	1080	55.69	29.389	3.382	240	5.89	7827	75.917	1.38	
9/29/2009	10:58:34	1140	55.75	29.388	3.382	240	5.89	7829	75.9955	1.38	
9/29/2009	10:59:34	1200	55.8	29.387	3.382	240	5.89	7824	76.0046	1.38	
9/29/2009	11:00:34	1260	55.87	29.385	3.352	240	5.89	7819	76.0161	1.38	
9/29/2009	11:01:34	1320	55.91	29.384	3.382	240	5.9	7815	76.0175	1.38	
9/29/2009	11:02:34	1380	55.93	29.383	3.352	240	5.9	7812	76.0077	1.38	
9/29/2009	11:03:34	1440	55.95	29.381	3.352	240	5.9	7808	76.0008	1.38	
9/29/2009	11:04:34	1500	56	29.381	3.382	240	5.9	7808	76.0447	1.38	
9/29/2009	11:05:34	1560	56.02	29.376	3.352	235	5.87	7808	76.0735	1.38	
9/29/2009	11:06:34	1620	55.91	29.389	3.352	236	5.86	7794	75.8022	1.38	
9/29/2009	11:07:34	1680	55.65	29.383	3.352	237	5.85	7778	75.4246	1.38	
9/29/2009	11:08:34	1740	54.67	29.351	3.382	232	5.97	7806	74.8511	1.38	
9/29/2009	11:09:34	1800	54.71	29.338	3.382	230	6.05	7775	74.6241	1.38	
9/29/2009	11:10:34	1860	54.52	29.43	3.382	237	5.88	7819	74.6377	1.38	
9/29/2009	11:11:34	1920	54.8	29.428	3.382	237	5.88	7842	75.1205	1.38	
9/29/2009	11:12:34	1980	54.97	29.428	3.352	237	5.88	7862	75.4748	1.38	
9/29/2009	11:13:34	2040	55.12	29.428	3.382	236	5.89	7873	75.7234	1.38	
9/29/2009	11:14:34	2100	55.23	29.428	3.382	237	5.89	7872	75.8198	1.38	
9/29/2009	11:15:34	2160	55.33	29.428	3.382	236	5.89	7876	75.9442	1.38	
9/29/2009	11:16:34	2220	55.46	29.412	3.352	236	5.89	7874	76.0903	1.38	
9/29/2009	11:17:34	2280	48.87	29.448	3.382	242	5.83	9832	87.1991	1.38	
9/29/2009	11:18:34	2340	48.27	29.465	3.382	252	5.66	10495	92.2883	1.38	
9/29/2009	11:19:34	2400	48.86	29.476	3.382	270	5.46	10673	94.5605	1.38	

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9/29/2009	11:20:34	2460	49.09	29.504	3.382	278	5.31	10692	94.9239	1.38	
9/29/2009	11:21:34	2520	48.95	29.492	3.382	284	5.23	10839	96.0915	1.38	
9/29/2009	11:22:34	2580	49.03	29.49	3.352	276	5.58	10767	95.5584	1.38	
9/29/2009	11:23:34	2640	48.68	29.484	3.352	270	5.57	10669	94.265	1.38	
9/29/2009	11:24:34	2700	49.04	29.473	3.382	283	5.49	10726	95.2636	1.38	
9/29/2009	11:25:34	2760	49.23	29.465	3.352	284	5.74	10674	95.0751	1.38	
9/29/2009	11:26:34	2820	49.38	29.445	3.352	284	5.72	10617	94.8143	1.38	
9/29/2009	11:27:34	2880	49.62	29.428	3.352	283	5.72	10679	95.7176	1.38	
9/29/2009	11:28:34	2940	49.93	29.421	3.382	286	5.66	10612	95.534	1.38	
9/29/2009	11:29:34	3000	50.12	29.412	3.352	303	5.65	10701	96.6065	1.38	
9/29/2009	11:30:34	3060	50.04	29.403	3.382	303	5.67	10663	96.1925	1.38	
9/29/2009	11:31:34	3120	50.34	29.395	3.352	305	5.64	10696	96.8993	1.38	
9/29/2009	11:32:34	3180	50.34	29.387	3.382	303	5.65	10696	96.9239	1.38	
9/29/2009	11:33:34	3240	50.23	29.381	3.382	310	5.6	10661	96.4875	1.38	
9/29/2009	11:34:34	3300	50.19	29.374	3.352	307	5.61	10685	96.6787	1.38	
9/29/2009	11:35:34	3360	50.34	29.396	3.382	317	5.7	10639	96.379	1.38	
9/29/2009	11:36:34	3420	50.63	29.392	3.382	316	5.78	10620	96.5786	1.38	
9/29/2009	11:37:34	3480	50.41	29.381	3.352	314	5.88	10572	95.9032	1.38	
9/29/2009	11:38:34	3540	50.4	29.377	3.352	313	5.85	10542	95.6387	1.38	
9/29/2009	11:39:34	3600	50.46	29.373	3.352	314	5.84	10523	95.5493	1.38	
9/29/2009	11:40:34	3660	50.38	29.369	3.382	314	5.83	10502	95.2726	1.38	
9/29/2009	11:41:34	3720	50.33	29.363	3.382	314	5.87	10513	95.3335	1.38	
9/29/2009	11:42:34	3780	50.34	29.359	3.352	314	5.86	10474	95.0015	1.38	
9/29/2009	11:43:34	3840	50.32	29.354	3.382	313	5.88	10456	94.8377	1.38	
9/29/2009	11:44:34	3900	50.27	29.359	3.382	318	5.93	10513	95.274	1.38	
9/29/2009	11:45:34	3960	56.48	29.374	3.382	251	7.02	9279	91.1745	695.01	Probe in Chamber
9/29/2009	11:46:34	4020	56.56	29.402	3.382	247	7.09	9030	88.7198	693.78	
9/29/2009	11:47:34	4080	56.63	29.426	3.382	243	7.14	8968	88.1274	689.28	
9/29/2009	11:48:34	4140	56.7	29.445	3.382	240	7.18	8931	87.7665	687.52	Data Used for Analysis
9/29/2009	11:49:34	4200	56.71	29.461	3.382	236	7.22	8895	87.3844	688.71	
9/29/2009	11:50:34	4260	56.78	29.476	3.352	233	7.26	8875	87.2157	690.17	
9/29/2009	11:51:34	4320	56.79	29.489	3.352	230	7.29	8850	86.9471	691.64	
9/29/2009	11:52:34	4380	56.8	29.499	3.352	227	7.32	8832	86.7516	691.9	
9/29/2009	11:53:34	4440	56.8	29.509	3.382	224	7.35	8829	86.6841	692.56	
9/29/2009	11:54:34	4500	56.8	29.518	3.382	222	7.37	8817	86.5504	693.5	
9/29/2009	11:55:34	4560	56.88	29.525	3.382	219	7.4	8790	86.3444	697.46	
9/29/2009	11:56:34	4620	57.02	29.533	3.382	207	7.44	8756	86.1369	696.76	
9/29/2009	11:57:34	4680	57.03	29.539	3.352	200	7.47	8717	85.7384	696.75	
9/29/2009	11:58:34	4740	57.06	29.543	3.382	194	7.5	8675	85.3427	696.74	
9/29/2009	11:59:34	4800	57.07	29.548	3.352	190	7.53	8651	85.1054	696.74	
9/29/2009	12:00:34	4860	57.08	29.552	3.382	187	7.55	8622	84.8219	697	
9/29/2009	12:01:34	4920	57.11	29.556	3.352	184	7.57	8594	84.5612	697	
9/29/2009	12:02:34	4980	57.11	29.558	3.382	182	7.59	8568	84.2984	697.13	
9/29/2009	12:03:34	5040	57.12	29.561	3.352	180	7.61	8546	84.0933	697.26	
9/29/2009	12:04:34	5100	57.13	29.564	3.382	179	7.62	8529	83.9304	697.39	
9/29/2009	12:05:34	5160	57.15	29.567	3.382	178	7.64	8508	83.729	697.39	
9/29/2009	12:06:34	5220	57.16	29.57	3.382	177	7.65	8489	83.5462	697.66	
9/29/2009	12:07:34	5280	57.18	29.572	3.382	176	7.66	8475	83.4205	697.66	
9/29/2009	12:08:34	5340	57.2	29.574	3.352	176	7.67	8461	83.3013	697.66	
9/29/2009	12:09:34	5400	57.21	29.577	3.352	175	7.68	8451	83.1999	697.79	
9/29/2009	12:10:34	5460	57.22	29.579	3.352	175	7.69	8432	83.0219	697.93	
9/29/2009	12:11:34	5520	57.24	29.581	3.382	174	7.7	8424	82.944	697.92	
9/29/2009	12:12:34	5580	57.24	29.583	3.352	174	7.71	8409	82.7988	698.06	
9/29/2009	12:13:34	5640	57.27	29.396	3.382	174	7.7	8398	83.2501	699.17	
9/29/2009	12:14:34	5700	57.27	29.371	3.382	174	7.71	8389	83.2415	699.3	
9/29/2009	12:15:34	5760	57.28	29.37	3.382	173	7.73	8345	82.8081	699.29	
9/29/2009	12:16:34	5820	57.28	29.37	3.352	172	7.73	8330	82.6734	699.43	
9/29/2009	12:17:34	5880	57.31	29.37	3.352	172	7.74	8327	82.6669	699.56	
9/29/2009	12:18:34	5940	57.31	29.37	3.382	172	7.74	8307	82.4725	699.7	
9/29/2009	12:19:34	6000	57.33	29.37	3.352	171	7.75	8297	82.3848	699.83	
9/29/2009	12:20:34	6060	57.35	29.369	3.382	171	7.76	8302	82.4587	699.97	
9/29/2009	12:21:34	6120	57.35	29.37	3.352	171	7.76	8276	82.1971	700.1	
9/29/2009	12:22:34	6180	57.36	29.369	3.382	171	7.77	8291	82.3645	700.24	
9/29/2009	12:23:34	6240	57.37	29.369	3.382	170	7.77	8257	82.0373	700.37	
9/29/2009	12:24:34	6300	57.39	29.369	3.382	170	7.78	8242	81.9024	700.65	
9/29/2009	12:25:34	6360	57.4	29.37	3.352	170	7.78	8247	81.9633	700.79	
9/29/2009	12:26:34	6420	57.4	29.369	3.352	170	7.78	8220	81.6988	700.78	
9/29/2009	12:27:34	6480	57.42	29.369	3.382	170	7.79	8205	81.5693	700.92	
9/29/2009	12:28:34	6540	57.43	29.368	3.382	170	7.79	8199	81.5196	701.06	
9/29/2009	12:29:34	6600	57.43	29.369	3.352	169	7.79	8194	81.4662	701.2	
9/29/2009	12:30:34	6660	57.44	29.367	3.352	170	7.8	8170	81.2501	701.34	
9/29/2009	12:31:34	6720	57.47	29.369	3.382	169	7.8	8168	81.2415	701.48	
9/29/2009	12:32:34	6780	57.47	29.368	3.352	169	7.8	8158	81.1597	701.61	
9/29/2009	12:33:34	6840	57.48	29.368	3.352	169	7.81	8142	81.0003	701.75	
9/29/2009	12:34:34	6900	57.5	29.369	3.382	169	7.81	8131	80.9073	701.89	
9/29/2009	12:35:34	6960	57.51	29.369	3.382	168	7.81	8132	80.922	702.03	
9/29/2009	12:36:34	7020	57.52	29.369	3.352	169	7.82	8116	80.7841	702.03	
9/29/2009	12:37:34	7080	57.54	29.369	3.382	169	7.82	8131	80.9459	702.31	
9/29/2009	12:38:34	7140	57.56	29.372	3.352	169	7.82	8117	80.8273	701.61	

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Sediment Probe 1

9/29/2009	12:39:34	7200	57.57	29.374	3.352	169	7.82	8108	80.7336	701.62	
9/29/2009	12:40:34	7260	57.58	29.373	3.382	169	7.82	8107	80.7419	701.9	
9/29/2009	12:41:34	7320	57.59	29.374	3.352	169	7.82	8091	80.5931	701.9	
9/29/2009	12:42:34	7380	57.59	29.374	3.382	169	7.82	8080	80.4864	702.04	
9/29/2009	12:43:34	7440	57.61	29.374	3.382	169	7.82	8073	80.4273	702.19	
9/29/2009	12:44:34	7500	57.62	29.375	3.382	169	7.82	8065	80.3561	702.33	
9/29/2009	12:45:34	7560	57.62	29.375	3.382	169	7.83	8058	80.2822	702.33	
9/29/2009	12:46:34	7620	57.65	29.4	3.382	169	7.83	8043	80.0953	702.47	
9/29/2009	12:47:34	7680	57.65	29.399	3.382	169	7.83	8036	80.027	702.61	
9/29/2009	12:48:34	7740	57.67	29.399	3.352	168	7.83	8033	80.0223	702.75	
9/29/2009	12:49:34	7800	57.67	29.399	3.382	168	7.83	8015	79.8425	702.89	
9/29/2009	12:50:34	7860	57.68	29.398	3.352	168	7.83	8011	79.8122	702.89	
9/29/2009	12:51:34	7920	57.69	29.398	3.352	168	7.83	7999	79.7021	703.03	
9/29/2009	12:52:34	7980	57.7	29.419	3.382	169	7.82	7986	79.5252	703.87	
9/29/2009	12:53:34	8040	57.71	29.378	3.352	168	7.83	7997	79.7651	704.16	
9/29/2009	12:54:34	8100	57.72	29.376	3.352	167	7.82	7960	79.4035	704.15	
9/29/2009	12:55:34	8160	57.73	29.375	3.382	167	7.82	7929	79.1128	704.15	
9/29/2009	12:56:34	8220	57.75	29.376	3.382	167	7.82	7932	79.1515	704.28	
9/29/2009	12:57:34	8280	57.75	29.374	3.352	167	7.82	7904	78.8799	704.42	
9/29/2009	12:58:34	8340	57.77	29.375	3.352	167	7.82	7894	78.7923	704.56	
9/29/2009	12:59:34	8400	57.78	29.375	3.352	167	7.83	7884	78.703	704.7	
9/29/2009	13:00:34	8460	57.79	29.374	3.382	166	7.83	7893	78.805	704.83	
9/29/2009	13:01:34	8520	57.79	29.375	3.352	166	7.83	7862	78.4985	704.83	
9/29/2009	13:02:34	8580	57.82	29.376	3.382	166	7.83	7860	78.5076	705.11	
9/29/2009	13:03:34	8640	57.81	29.376	3.382	166	7.83	7846	78.3557	705.11	
9/29/2009	13:04:34	8700	57.83	29.376	3.382	166	7.83	7837	78.2821	705.25	
9/29/2009	13:05:34	8760	57.84	29.376	3.382	166	7.83	7849	78.4034	705.39	
9/29/2009	13:06:34	8820	57.84	29.375	3.382	166	7.83	7814	78.0662	705.53	
9/29/2009	13:07:34	8880	57.86	29.374	3.352	166	7.83	7817	78.1073	705.67	
9/29/2009	13:08:34	8940	57.86	29.374	3.382	166	7.83	7825	78.1961	705.81	
9/29/2009	13:09:34	9000	57.87	29.373	3.382	165	7.83	7812	78.0747	705.95	
9/29/2009	13:10:34	9060	57.88	29.373	3.382	165	7.83	7801	77.9734	706.09	
9/29/2009	13:11:34	9120	57.9	29.373	3.352	165	7.83	7791	77.8931	706.23	
9/29/2009	13:12:34	9180	57.9	29.373	3.352	165	7.83	7767	77.6579	706.22	
9/29/2009	13:13:34	9240	57.91	29.372	3.352	165	7.83	7776	77.7545	706.36	
9/29/2009	13:14:34	9300	57.91	29.371	3.382	165	7.83	7753	77.5344	706.51	
9/29/2009	13:15:34	9360	57.94	29.371	3.382	165	7.83	7746	77.4861	706.65	
9/29/2009	13:16:34	9420	57.93	29.37	3.352	165	7.83	7726	77.2877	706.93	
9/29/2009	13:17:34	9480	57.96	29.369	3.382	165	7.83	7721	77.2582	706.93	
9/29/2009	13:18:34	9540	57.96	29.368	3.352	165	7.83	7720	77.2506	707.07	
9/29/2009	13:19:34	9600	57.97	29.369	3.382	165	7.83	7709	77.1563	707.21	
9/29/2009	13:20:34	9660	57.97	29.368	3.382	165	7.83	7688	76.9393	707.35	
9/29/2009	13:21:34	9720	57.99	29.369	3.352	165	7.83	7700	77.0832	707.49	
9/29/2009	13:22:34	9780	58.01	29.369	3.352	165	7.83	7698	77.0772	707.49	
9/29/2009	13:23:34	9840	58.02	29.369	3.352	164	7.83	7672	76.8221	707.63	
9/29/2009	13:24:34	9900	58.01	29.37	3.352	164	7.83	7665	76.7498	707.91	
9/29/2009	13:25:34	9960	58.04	29.369	3.352	164	7.83	7662	76.7496	708.06	
9/29/2009	13:26:34	10020	58.05	29.37	3.382	164	7.83	7651	76.6359	708.2	
9/29/2009	13:27:34	10080	58.06	29.37	3.382	164	7.83	7644	76.5785	708.2	
9/29/2009	13:28:34	10140	58.06	29.37	3.352	164	7.83	7638	76.5221	708.48	
9/29/2009	13:29:34	10200	58.07	29.369	3.352	164	7.83	7626	76.4201	708.62	
9/29/2009	13:30:34	10260	58.1	29.371	3.323	164	7.83	7633	76.5104	708.62	
9/29/2009	13:31:34	10320	58.11	29.37	3.382	164	7.83	7625	76.4346	708.76	
9/29/2009	13:32:34	10380	58.11	29.37	3.352	164	7.83	7612	76.3061	708.76	
9/29/2009	13:33:34	10440	58.13	29.369	3.382	164	7.83	7587	76.0778	709.05	
9/29/2009	13:34:34	10500	58.14	29.369	3.352	164	7.83	7580	76.0208	709.19	
9/29/2009	13:35:34	10560	58.13	29.368	3.382	164	7.83	7574	75.9534	709.19	
9/29/2009	13:36:34	10620	58.16	29.368	3.352	164	7.83	7581	76.0463	709.47	
9/29/2009	13:37:34	10680	58.17	29.367	3.323	164	7.83	7568	75.926	709.47	
9/29/2009	13:38:34	10740	58.17	29.367	3.382	164	7.83	7546	75.7097	709.61	
9/29/2009	13:39:34	10800	58.18	29.366	3.352	164	7.83	7540	75.6596	709.75	
9/29/2009	13:40:34	10860	58.18	29.366	3.352	165	7.83	7531	75.5629	709.04	
9/29/2009	13:41:34	10920	58.18	29.368	3.352	165	7.83	7548	75.7415	709.05	
9/29/2009	13:42:34	10980	58.18	29.369	3.382	165	7.82	7555	75.8061	709.05	
9/29/2009	13:43:34	11040	58.18	29.369	3.382	165	7.82	7536	75.6136	709.05	
9/29/2009	13:44:34	11100	58.2	29.368	3.352	165	7.82	7528	75.5521	709.2	
9/29/2009	13:45:34	11160	58.2	29.367	3.352	165	7.82	7534	75.6118	709.2	
9/29/2009	13:46:34	11220	58.2	29.367	3.352	165	7.82	7531	75.5861	709.2	
9/29/2009	13:47:34	11280	58.2	29.367	3.382	165	7.82	7530	75.57	709.35	
9/29/2009	13:48:34	11340	58.2	29.368	3.382	165	7.82	7526	75.5313	709.35	
9/29/2009	13:49:34	11400	58.19	29.37	3.382	165	7.82	7532	75.5795	710.06	

Naperville
Sediment Probe 2

In-Situ Inc. Troll 9000 Pro XP

Report generated: 9/30/2009 13:46:20
Report from file: ...\SN48194 2009-09-29 104415 sed-2.bin
Win-Situ® Version 4.58.14.0

Serial number: 48194
Firmware Version 2.13
Unit name: MP Troll 9000

Test name: sed-2

Test defined on: 9/29/2009 10:43:33
Test started on: 9/29/2009 10:44:15
Test stopped on: 9/29/2009 13:51:32

Data gathered using Linear testing
Time between data points: 60.0 Seconds.
Number of data samples: 188

TOTAL DATA SAMPLES 188

Date	Time	ET (sec)	Chan[1] Temperature Fahrenheit	Chan[3] Barometric Inches Hg	Chan[5] Battery Volts	Chan[11] ORP millivolts	Chan[12] pH pH	Chan[37] Rugged DO micrograms/L	Chan[37] Rugged DO Sat %Saturation	Chan[45] Conductivity microSiemens/cm Actual Conductivity	Notes
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9/29/2009	10:44:15	0	53.16	29.362	3.029	228	6.81	7755	72.9307	1.32	Test Started
9/29/2009	10:45:15	60	52.99	29.366	3	221	6.92	7786	73.1758	402.56	
9/29/2009	10:46:15	120	53.09	29.47	3.029	214	6.93	7882	73.7895	1.32	
9/29/2009	10:47:15	180	53.1	29.474	3.029	212	6.94	7894	73.9017	1.32	
9/29/2009	10:48:15	240	53.15	29.473	3.029	212	6.94	7900	74.0109	1.32	
9/29/2009	10:49:15	300	53.22	29.472	3.029	211	6.95	7901	74.084	1.32	
9/29/2009	10:50:15	360	53.29	29.471	3.029	211	6.95	7898	74.131	1.32	
9/29/2009	10:51:15	420	53.35	29.469	3.029	210	6.95	7892	74.1307	1.32	
9/29/2009	10:52:15	480	53.42	29.469	3.058	209	6.95	7881	74.0944	1.32	
9/29/2009	10:53:15	540	53.47	29.468	3.029	209	6.95	7872	74.0628	1.32	
9/29/2009	10:54:15	600	53.54	29.467	3.058	209	6.95	7859	73.9977	1.32	
9/29/2009	10:55:15	660	53.6	29.467	3.029	209	6.95	7855	74.0167	1.32	
9/29/2009	10:56:15	720	53.66	29.466	3.029	209	6.95	7844	73.9727	1.32	
9/29/2009	10:57:15	780	53.72	29.466	3.029	208	6.95	7829	73.8814	1.32	
9/29/2009	10:58:15	840	53.79	29.466	3.029	207	6.95	7820	73.8727	1.32	
9/29/2009	10:59:15	900	53.86	29.465	3	207	6.95	7798	73.7301	1.32	
9/29/2009	11:00:15	960	53.9	29.464	3.058	206	6.95	7794	73.7353	1.32	
9/29/2009	11:01:15	1020	53.95	29.463	3.029	204	6.95	7764	73.4994	1.32	
9/29/2009	11:02:15	1080	54.01	29.462	3.029	204	6.95	7769	73.6012	1.32	
9/29/2009	11:03:15	1140	54.07	29.466	3.029	203	6.95	7761	73.5677	1.32	
9/29/2009	11:04:15	1200	54.14	29.461	3.029	203	6.95	7740	73.4498	1.32	
9/29/2009	11:05:15	1260	54.17	29.459	3.029	203	6.95	7738	73.4645	1.32	
9/29/2009	11:06:15	1320	54.21	29.457	3.029	204	6.95	7724	73.376	1.32	
9/29/2009	11:07:15	1380	54.25	29.453	3.029	204	6.95	7706	73.2465	1.32	
9/29/2009	11:08:15	1440	54.26	29.451	3.029	203	6.95	7699	73.2015	1.32	
9/29/2009	11:09:15	1500	54.28	29.448	3.029	202	6.95	7693	73.1678	1.32	
9/29/2009	11:10:15	1560	54.32	29.447	3	202	6.95	7693	73.1994	1.32	
9/29/2009	11:11:15	1620	54.35	29.447	3	202	6.95	7682	73.1258	1.32	
9/29/2009	11:12:15	1680	54.38	29.446	3.029	201	6.95	7682	73.1568	1.32	
9/29/2009	11:13:15	1740	54.43	29.444	3.029	201	6.95	7676	73.1516	1.32	
9/29/2009	11:14:15	1800	49.73	29.47	3.029	245	6.28	9319	83.5357	1.32	
9/29/2009	11:15:15	1860	47.1	29.478	3.029	268	5.58	11130	96.3051	1.32	
9/29/2009	11:16:15	1920	47.38	29.471	3.029	276	5.6	11267	97.8802	1.32	
9/29/2009	11:17:15	1980	47.63	29.465	3.029	286	5.56	11325	98.7666	50.27	
9/29/2009	11:18:15	2040	47.96	29.457	3.029	297	5.44	11272	98.7654	50.17	
9/29/2009	11:19:15	2100	48.29	29.455	3.029	298	6.1	11173	98.311	1.32	
9/29/2009	11:20:15	2160	47.99	29.464	3.029	292	5.97	11031	96.6467	1.32	
9/29/2009	11:21:15	2220	47.98	29.524	3.029	314	5.76	11071	96.7819	1.32	
9/29/2009	11:22:15	2280	47.94	29.504	3.029	307	5.89	11108	97.1372	50.91	

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9/29/2009	11:23:15	2340	48.49	29.505	3	274	6.83	10978	96.6974	1.32	
9/29/2009	11:24:15	2400	49.39	29.495	3.058	272	6.61	10896	97.1496	1.32	
9/29/2009	11:25:15	2460	48.43	29.482	3.029	308	5.73	11151	98.228	50.56	
9/29/2009	11:26:15	2520	48.18	29.471	3.029	308	5.72	11241	98.727	50.49	
9/29/2009	11:27:15	2580	48.54	29.46	3.029	293	6.04	11284	99.6046	1.32	
9/29/2009	11:28:15	2640	48.7	29.448	3	289	6.3	11300	100.0014	1.32	
9/29/2009	11:29:15	2700	48.72	29.436	3	284	6.3	11360	100.5981	1.32	
9/29/2009	11:30:15	2760	48.69	29.426	3.029	289	6.36	11354	100.5416	1.32	
9/29/2009	11:31:15	2820	48.73	29.417	3	282	6.34	11333	100.4384	1.32	
9/29/2009	11:32:15	2880	48.67	29.408	3.029	280	6.35	11327	100.3337	1.32	
9/29/2009	11:33:15	2940	48.84	29.404	3.029	254	6.13	11271	100.0847	1.32	
9/29/2009	11:34:15	3000	49.46	29.407	3.029	258	6.01	11134	99.661	1.32	
9/29/2009	11:35:15	3060	49.68	29.398	3.029	258	6.57	11025	99.0162	1.32	
9/29/2009	11:36:15	3120	49.94	29.404	3.029	261	6.58	11002	99.1219	1.32	
9/29/2009	11:37:15	3180	50.19	29.398	3.029	260	6.63	10967	99.1432	1.32	
9/29/2009	11:38:15	3240	50.18	29.394	3.029	263	6.65	10984	99.3061	1.32	
9/29/2009	11:39:15	3300	50.16	29.388	3.029	266	6.66	10977	99.2324	1.32	
9/29/2009	11:40:15	3360	50.25	29.383	3.029	267	6.69	10947	99.1013	1.32	
9/29/2009	11:41:15	3420	50.26	29.378	3.029	269	6.68	10956	99.2161	1.32	
9/29/2009	11:42:15	3480	49.93	29.365	3.029	277	6.79	11020	99.4044	1.32	
9/29/2009	11:43:15	3540	56.82	29.371	3.029	217	7.78	9980	98.5007	734	
9/29/2009	11:44:15	3600	56.8	29.405	3	204	7.9	9414	92.7745	731.13	Probe in Chamb
9/29/2009	11:45:15	3660	56.9	29.431	3	204	7.93	9354	92.2063	731.63	
9/29/2009	11:46:15	3720	56.88	29.455	3	205	7.95	9262	91.2172	733.41	
9/29/2009	11:47:15	3780	56.91	29.474	3.029	206	7.96	9202	90.591	734.73	
9/29/2009	11:48:15	3840	56.92	29.49	3	207	7.97	9153	90.0734	736.04	
9/29/2009	11:49:15	3900	56.91	29.505	3.029	208	7.98	9123	89.72	736.88	
9/29/2009	11:50:15	3960	56.94	29.517	3.058	209	7.98	9100	89.4901	736.91	
9/29/2009	11:51:15	4020	56.98	29.421	3.029	201	7.99	9051	89.3516	735.32	
9/29/2009	11:52:15	4080	57.02	29.403	3	178	7.98	2706	26.7426	738.25	
9/29/2009	11:53:15	4140	57	29.402	3	183	7.98	2083	20.5823	737.78	
9/29/2009	11:54:15	4200	57.09	29.415	3.058	172	7.97	1883	18.6131	740.4	
9/29/2009	11:55:15	4260	57.12	29.398	3.029	121	7.95	1827	18.0819	740.91	
9/29/2009	11:56:15	4320	57.14	29.398	3	101	7.95	1840	18.2118	740.93	
9/29/2009	11:57:15	4380	57.15	29.399	3	100	7.95	1888	18.6861	741.27	
9/29/2009	11:58:15	4440	57.16	29.399	3.029	102	7.95	1953	19.3371	741.45	
9/29/2009	11:59:15	4500	57.18	29.4	3	103	7.94	2032	20.1215	741.47	
9/29/2009	12:00:15	4560	57.18	29.4	3.029	106	7.94	2109	20.8882	741.81	
9/29/2009	12:01:15	4620	57.19	29.399	3	109	7.94	2190	21.6877	741.83	
9/29/2009	12:02:15	4680	57.21	29.398	3	112	7.94	2272	22.5091	742	
9/29/2009	12:03:15	4740	57.22	29.399	3.029	116	7.94	2358	23.3683	742.18	
9/29/2009	12:04:15	4800	57.23	29.399	3	119	7.94	2430	24.078	742.18	
9/29/2009	12:05:15	4860	57.24	29.398	3.029	122	7.93	2503	24.8058	742.52	
9/29/2009	12:06:15	4920	57.26	29.397	3	125	7.93	2583	25.6099	742.86	
9/29/2009	12:07:15	4980	57.26	29.397	3.029	128	7.93	2662	26.3918	742.86	
9/29/2009	12:08:15	5040	57.28	29.397	3	130	7.93	2724	27.0156	742.87	
9/29/2009	12:09:15	5100	57.29	29.396	3.029	133	7.93	2800	27.7674	743.04	
9/29/2009	12:10:15	5160	57.31	29.396	3.029	135	7.93	2876	28.5325	743.04	
9/29/2009	12:11:15	5220	57.33	29.497	3.029	136	7.93	3052	30.1742	743.03	
9/29/2009	12:12:15	5280	57.34	29.492	3.058	138	7.93	3172	31.3803	743.19	
9/29/2009	12:13:15	5340	57.35	29.487	3.029	141	7.92	3195	31.6146	743.35	
9/29/2009	12:14:15	5400	57.36	29.483	3.029	142	7.92	3233	31.9945	743.52	
9/29/2009	12:15:15	5460	57.38	29.474	3.029	144	7.92	3371	33.3759	743.68	
9/29/2009	12:16:15	5520	57.38	29.476	3.058	137	7.91	3814	37.7599	744.01	
9/29/2009	12:17:15	5580	57.41	29.473	3.029	133	7.91	3827	37.9134	744.17	
9/29/2009	12:18:15	5640	57.43	29.471	3.058	133	7.91	3858	38.2302	744.17	
9/29/2009	12:19:15	5700	57.43	29.469	3.029	133	7.91	3875	38.4005	744.5	
9/29/2009	12:20:15	5760	57.44	29.468	3.058	133	7.91	3929	38.9387	744.5	
9/29/2009	12:21:15	5820	57.45	29.468	3.058	133	7.91	3998	39.6317	744.66	
9/29/2009	12:22:15	5880	57.47	29.468	3.029	133	7.91	4099	40.6404	744.66	
9/29/2009	12:23:15	5940	57.48	29.469	3.058	134	7.9	4234	41.985	744.99	
9/29/2009	12:24:15	6000	57.49	29.468	3.058	135	7.9	4276	42.4057	744.99	
9/29/2009	12:25:15	6060	57.5	29.469	3.029	136	7.9	4381	43.451	745.16	
9/29/2009	12:26:15	6120	57.52	29.469	3.029	137	7.9	4463	44.2793	745.16	
9/29/2009	12:27:15	6180	57.52	29.47	3.058	138	7.9	4472	44.3588	745.49	
9/29/2009	12:28:15	6240	57.53	29.471	3.029	138	7.9	4516	44.807	745.49	
9/29/2009	12:29:15	6300	57.54	29.471	3.029	139	7.9	4601	45.6493	745.65	
9/29/2009	12:30:15	6360	57.57	29.473	3.058	139	7.9	4660	46.2554	745.82	
9/29/2009	12:31:15	6420	57.56	29.474	3.029	139	7.9	4791	47.5424	745.98	
9/29/2009	12:32:15	6480	57.58	29.475	3.029	140	7.9	4833	47.9735	745.99	
9/29/2009	12:33:15	6540	57.59	29.476	3.058	140	7.89	4869	48.3351	746.15	
9/29/2009	12:34:15	6600	57.61	29.477	3.058	141	7.89	4937	49.0167	746.32	
9/29/2009	12:35:15	6660	57.62	29.478	3.058	141	7.89	5007	49.7175	746.48	
9/29/2009	12:36:15	6720	57.63	29.402	3.029	141	7.89	5102	50.8017	746.48	
9/29/2009	12:37:15	6780	57.64	29.411	3.058	139	7.9	5156	51.3348	747.32	
9/29/2009	12:38:15	6840	57.64	29.402	3.029	138	7.9	5163	51.4142	747.49	
9/29/2009	12:39:15	6900	57.65	29.402	3.058	138	7.9	5178	51.5719	747.5	

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9/29/2009	12:40:15	6960	57.66	29.401	3.029	139	7.9	5279	52.5815	747.84	
9/29/2009	12:41:15	7020	57.67	29.401	3	140	7.89	5323	53.0368	747.84	
9/29/2009	12:42:15	7080	57.68	29.4	3.029	140	7.89	5382	53.6259	748.02	
9/29/2009	12:43:15	7140	57.69	29.4	3.029	140	7.89	5443	54.2451	748.02	
9/29/2009	12:44:15	7200	57.71	29.401	3	140	7.89	5503	54.8532	748.19	
9/29/2009	12:45:15	7260	57.72	29.401	3.029	141	7.89	5558	55.4097	748.36	
9/29/2009	12:46:15	7320	57.72	29.401	3	141	7.89	5590	55.7265	748.37	
9/29/2009	12:47:15	7380	57.73	29.401	3	141	7.89	5641	56.2322	748.54	
9/29/2009	12:48:15	7440	57.74	29.401	3.029	141	7.89	5711	56.9469	748.71	
9/29/2009	12:49:15	7500	57.75	29.399	3	142	7.89	5751	57.3569	748.88	
9/29/2009	12:50:15	7560	57.76	29.401	3	143	7.88	5779	57.6367	748.37	
9/29/2009	12:51:15	7620	57.78	29.401	3.029	144	7.88	5811	57.9691	748.37	
9/29/2009	12:52:15	7680	57.8	29.401	3.029	144	7.88	5849	58.3573	748.53	
9/29/2009	12:53:15	7740	57.79	29.402	3.029	144	7.88	5903	58.884	748.69	
9/29/2009	12:54:15	7800	57.81	29.403	3.029	144	7.88	5945	59.3262	748.85	
9/29/2009	12:55:15	7860	57.82	29.403	3.029	145	7.88	5965	59.5252	749.02	
9/29/2009	12:56:15	7920	57.83	29.404	3.029	145	7.88	6000	59.8815	749.02	
9/29/2009	12:57:15	7980	57.84	29.404	3.029	145	7.88	6045	60.3426	749.18	
9/29/2009	12:58:15	8040	57.85	29.404	3.058	145	7.87	6095	60.843	749.35	
9/29/2009	12:59:15	8100	57.86	29.405	3.029	146	7.87	6150	61.3998	749.34	
9/29/2009	13:00:15	8160	57.86	29.406	3.029	146	7.87	6178	61.6761	749.51	
9/29/2009	13:01:15	8220	57.88	29.406	3.058	146	7.87	6200	61.9056	749.51	
9/29/2009	13:02:15	8280	57.89	29.406	3.029	146	7.87	6222	62.1445	749.68	
9/29/2009	13:03:15	8340	57.91	29.406	3.029	146	7.87	6271	62.6401	749.84	
9/29/2009	13:04:15	8400	57.91	29.406	3.029	147	7.87	6315	63.081	750.01	
9/29/2009	13:05:15	8460	57.93	29.406	3.029	147	7.87	6348	63.4304	750.01	
9/29/2009	13:06:15	8520	57.93	29.405	3.029	147	7.87	6374	63.69	750.18	
9/29/2009	13:07:15	8580	57.94	29.405	3.029	148	7.87	6393	63.8811	750.34	
9/29/2009	13:08:15	8640	57.94	29.404	3.029	148	7.87	6405	64.015	750.34	
9/29/2009	13:09:15	8700	57.95	29.404	3.029	148	7.87	6420	64.165	750.51	
9/29/2009	13:10:15	8760	57.96	29.404	3.029	149	7.86	6453	64.5031	750.68	
9/29/2009	13:11:15	8820	57.97	29.403	3.029	149	7.86	6472	64.7142	750.85	
9/29/2009	13:12:15	8880	57.99	29.403	3.029	149	7.86	6507	65.0669	750.85	
9/29/2009	13:13:15	8940	58	29.402	3.029	149	7.86	6552	65.5302	751.02	
9/29/2009	13:14:15	9000	57.99	29.401	3.029	150	7.86	6597	65.9833	751.18	
9/29/2009	13:15:15	9060	58.01	29.4	3.029	150	7.86	6616	66.187	751.18	
9/29/2009	13:16:15	9120	58.02	29.4	3.029	150	7.86	6643	66.4622	751.35	
9/29/2009	13:17:15	9180	58.03	29.399	3.029	150	7.86	6655	66.5997	751.52	
9/29/2009	13:18:15	9240	58.04	29.4	3.029	151	7.86	6675	66.8009	751.69	
9/29/2009	13:19:15	9300	58.06	29.401	3.029	151	7.86	6686	66.9207	751.86	
9/29/2009	13:20:15	9360	58.06	29.4	3.029	151	7.86	6724	67.308	751.86	
9/29/2009	13:21:15	9420	58.07	29.401	3.029	151	7.85	6733	67.3979	752.03	
9/29/2009	13:22:15	9480	58.09	29.401	3.029	151	7.86	6736	67.4459	752.03	
9/29/2009	13:23:15	9540	58.1	29.4	3.058	151	7.86	6750	67.5974	752.2	
9/29/2009	13:24:15	9600	58.1	29.4	3.029	151	7.85	6775	67.8563	752.37	
9/29/2009	13:25:15	9660	58.11	29.401	3.029	151	7.85	6784	67.9433	752.54	
9/29/2009	13:26:15	9720	58.12	29.401	3.029	151	7.85	6795	68.0706	752.71	
9/29/2009	13:27:15	9780	58.15	29.401	3.029	151	7.85	6836	68.495	752.71	
9/29/2009	13:28:15	9840	58.15	29.401	3.029	151	7.85	6858	68.7175	752.88	
9/29/2009	13:29:15	9900	58.15	29.401	3.029	152	7.85	6866	68.7981	753.05	
9/29/2009	13:30:15	9960	58.17	29.402	3.058	152	7.85	6879	68.9373	753.05	
9/29/2009	13:31:15	10020	58.2	29.401	3.029	152	7.85	6879	68.9733	753.22	
9/29/2009	13:32:15	10080	58.2	29.401	3.029	152	7.85	6913	69.3094	753.22	
9/29/2009	13:33:15	10140	58.2	29.401	3.029	152	7.85	6927	69.4522	753.39	
9/29/2009	13:34:15	10200	58.2	29.4	3.029	153	7.85	6951	69.6981	753.56	
9/29/2009	13:35:15	10260	58.23	29.398	3.058	153	7.85	6952	69.7413	753.73	
9/29/2009	13:36:15	10320	58.24	29.399	3.029	153	7.84	6982	70.0422	753.73	
9/29/2009	13:37:15	10380	58.24	29.398	3.029	153	7.85	6999	70.213	753.9	
9/29/2009	13:38:15	10440	58.25	29.399	3.058	154	7.85	6952	69.7489	753.9	
9/29/2009	13:39:15	10500	58.24	29.398	3.029	155	7.85	6947	69.6934	753.9	
9/29/2009	13:40:15	10560	58.25	29.398	3.029	156	7.85	6936	69.587	753.9	
9/29/2009	13:41:15	10620	58.25	29.398	3.029	157	7.84	6926	69.4925	754.07	
9/29/2009	13:42:15	10680	58.26	29.397	3.029	157	7.84	6925	69.4869	753.91	
9/29/2009	13:43:15	10740	58.24	29.397	3.029	158	7.83	6932	69.5528	754.08	
9/29/2009	13:44:15	10800	58.26	29.398	3.058	158	7.83	6941	69.6449	753.91	
9/29/2009	13:45:15	10860	58.27	29.397	3.029	159	7.83	6952	69.7692	753.91	
9/29/2009	13:46:15	10920	58.25	29.397	3.058	159	7.84	6963	69.8659	754.08	
9/29/2009	13:47:15	10980	58.25	29.397	3.029	160	7.84	6967	69.9	754.08	
9/29/2009	13:48:15	11040	58.26	29.397	3.029	160	7.84	6973	69.9722	753.91	
9/29/2009	13:49:15	11100	58.25	29.407	3.029	161	7.84	6961	69.8213	754.08	
9/29/2009	13:50:15	11160	58.26	29.459	3.029	161	7.85	7469	74.7865	754.93	
9/29/2009	13:51:15	11220	58.26	29.4	3.029	163	7.86	7575	76.0079	754.76	Test Failed
											Data not used

Naperville
Blank Chamber

In-Situ Inc. Troll 9000 Pro XP

Report generated: 9/30/2009 13:42:57
Report from file: ...\SN48057 2009-09-29 085511 blank1.bin
Win-Situ® Version 4.58.14.0

Serial number: 48057
Firmware Version 2.13
Unit name: MP Troll 9000

Test name: blank1

Test defined on: 9/29/2009 8:54:06
Test started on: 9/29/2009 8:55:11
Test stopped on: 9/29/2009 11:47:43

Data gathered using Linear testing
Time between data points: 60.0 Seconds.
Number of data samples: 173

TOTAL DATA SAMPLES 173

Date	Time	ET (sec)	Chan[1] Temperature Fahrenheit	Chan[3] Barometric Inches Hg	Chan[5] Battery Volts	Chan[11] ORP millivolts	Chan[12] pH pH	Chan[37] Rugged DO micrograms/L	Chan[37] Rugged DO Sat %Saturation	Chan[45] Conductivity microSiemens/cm Actual Conductivity	Notes
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9/29/2009	9:55:11	0	53.78	28.504	2.911	197	6.66	8019	78.354	55.12	Test Started
9/29/2009	9:56:11	60	53.45	28.504	2.882	197	6.52	8002	77.9246	272.54	
9/29/2009	9:57:11	120	53.68	28.504	2.911	197	6.52	7923	77.3809	273.88	
9/29/2009	9:58:11	180	53.66	28.504	2.882	196	6.51	7863	76.7757	273.75	
9/29/2009	9:59:11	240	53.65	28.504	2.911	196	6.5	7808	76.2365	273.1	
9/29/2009	10:00:11	300	53.66	28.504	2.911	196	6.5	7759	75.7561	271.19	
9/29/2009	10:01:11	360	53.7	28.504	2.882	196	6.49	7723	75.4493	271.92	
9/29/2009	10:02:11	420	53.72	28.504	2.911	196	6.49	7689	75.1353	272.89	
9/29/2009	10:03:11	480	53.75	28.504	2.911	196	6.48	7673	75.0035	258.16	
9/29/2009	10:04:11	540	53.73	28.504	2.882	196	6.47	7689	75.1481	268.57	
9/29/2009	10:05:11	600	53.72	28.504	2.882	197	6.47	7693	75.1725	255.31	
9/29/2009	10:06:11	660	53.75	28.504	2.882	197	6.47	7680	75.0761	270.11	
9/29/2009	10:07:11	720	53.73	28.504	2.852	197	6.47	7646	74.7234	273.86	
9/29/2009	10:08:11	780	53.77	28.504	2.882	197	6.47	7623	74.5319	273.27	
9/29/2009	10:09:11	840	53.78	28.504	2.911	197	6.47	7594	74.2579	266.21	
9/29/2009	10:10:11	900	53.81	28.504	2.882	197	6.47	7583	74.1831	272.95	
9/29/2009	10:11:11	960	53.85	28.504	2.882	197	6.48	7551	73.9039	272.86	
9/29/2009	10:12:11	1020	53.85	28.504	2.852	198	6.48	7543	73.8342	275.1	
9/29/2009	10:13:11	1080	53.87	28.504	2.882	198	6.49	7543	73.8456	274.23	
9/29/2009	10:14:11	1140	53.87	28.504	2.852	198	6.5	7533	73.6705	1.35	
9/29/2009	10:15:11	1200	54.33	28.504	2.882	199	6.47	7759	76.3408	56.16	
9/29/2009	10:16:11	1260	54.66	28.504	2.882	200	6.47	7784	76.9042	55.98	
9/29/2009	10:17:11	1320	54.89	28.504	2.882	201	6.47	7817	77.447	55.99	
9/29/2009	10:18:11	1380	47.95	28.504	2.911	164	7.06	9758	88.3833	60.89	
9/29/2009	10:19:11	1440	46.83	28.504	2.882	200	6.36	10570	94.3098	60.61	
9/29/2009	10:20:11	1500	47.79	28.504	2.882	205	6.5	10748	97.1279	59.63	
9/29/2009	10:21:11	1560	48.29	28.504	2.882	222	6.43	10930	99.4388	60.16	
9/29/2009	10:22:11	1620	48.08	28.504	2.911	231	6.41	11108	100.7818	60.98	
9/29/2009	10:23:11	1680	48.76	28.504	2.882	237	6.39	11196	102.501	63.02	
9/29/2009	10:24:11	1740	49.01	28.504	2.882	244	6.43	11122	102.1654	63.38	
9/29/2009	10:25:11	1800	49.13	28.504	2.911	254	6.44	11192	102.9738	63.13	
9/29/2009	10:26:11	1860	49.26	28.504	2.882	290	6.44	11175	102.994	62.69	
9/29/2009	10:27:11	1920	49.15	28.504	2.911	295	6.43	11185	102.9332	62.7	
9/29/2009	10:28:11	1980	49.28	28.504	2.911	288	6.45	11144	102.7455	62.74	
9/29/2009	10:29:11	2040	49.41	28.504	2.911	277	6.47	11087	102.3925	62.82	
9/29/2009	10:30:11	2100	49.35	28.504	2.911	278	6.47	11155	102.9341	62.8	
9/29/2009	10:31:11	2160	49.34	28.504	2.882	276	6.48	11193	103.2697	62.59	
9/29/2009	10:32:11	2220	49.42	28.504	2.911	275	6.51	11206	103.4945	62.55	
9/29/2009	10:33:11	2280	49.56	28.504	2.911	272	6.51	11184	103.4799	62.63	
9/29/2009	10:34:11	2340	49.71	28.504	2.882	271	6.53	11176	103.6228	62.63	
9/29/2009	10:35:11	2400	49.8	28.504	2.882	269	6.53	11217	104.1194	62.64	
9/29/2009	10:36:11	2460	50.08	28.504	2.911	270	6.56	11163	103.9925	62.68	

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9/29/2009	10:37:11	2520	50.61	28.504	2.911	268	6.56	11150	104.6076	62.63	
9/29/2009	10:38:11	2580	50.77	28.504	2.911	273	6.54	11159	104.8991	62.63	
9/29/2009	10:39:11	2640	50.93	28.504	2.911	270	6.6	11113	104.6863	62.67	
9/29/2009	10:40:11	2700	51.21	28.504	2.911	268	6.6	11022	104.2023	62.66	
9/29/2009	10:41:11	2760	50.95	28.504	2.882	271	6.54	11195	105.4857	62.49	
9/29/2009	10:42:11	2820	50.71	28.504	2.911	269	6.51	11254	105.7105	62.54	
9/29/2009	10:43:11	2880	50.84	28.504	2.911	264	6.54	11198	105.3622	62.51	
9/29/2009	10:44:11	2940	50.85	28.504	2.911	264	6.56	11194	105.3445	62.55	
9/29/2009	10:45:11	3000	50.85	28.504	2.882	263	6.54	11184	105.2525	62.49	
9/29/2009	10:46:11	3060	50.73	28.504	2.911	264	6.57	11216	105.3761	62.54	
9/29/2009	10:47:11	3120	50.83	28.504	2.911	261	6.57	11196	105.3432	62.53	
9/29/2009	10:48:11	3180	50.95	28.504	2.911	264	6.62	11113	104.7104	62.4	
9/29/2009	10:49:11	3240	50.98	28.504	2.911	263	6.62	11035	104.0153	62.46	
9/29/2009	10:50:11	3300	51.15	28.504	2.911	260	6.69	10785	101.8962	62.56	
9/29/2009	10:51:11	3360	51.27	28.504	2.911	257	6.72	10831	102.4836	62.37	
9/29/2009	10:52:11	3420	51.86	28.504	2.882	255	6.7	10807	103.0431	62.19	
9/29/2009	10:53:11	3480	52.11	28.504	2.882	250	6.4	10753	102.8629	62.23	
9/29/2009	10:54:11	3540	56.75	28.504	2.911	181	7.44	9689	98.4923	709.65	Probe in Chamber
9/29/2009	10:55:11	3600	56.54	28.504	2.882	174	7.48	9498	96.3012	710.66	
9/29/2009	10:56:11	3660	56.61	28.504	2.911	170	7.52	9424	95.6268	714.33	
9/29/2009	10:57:11	3720	56.98	28.504	2.911	163	7.64	9278	94.5751	714.76	
9/29/2009	10:58:11	3780	56.98	28.504	2.911	158	7.71	9246	94.2533	714.89	
9/29/2009	10:59:11	3840	57	28.504	2.911	156	7.76	9250	94.3177	714.88	
9/29/2009	11:00:11	3900	57.02	28.504	2.911	153	7.79	9248	94.312	715.02	
9/29/2009	11:01:11	3960	57.03	28.504	2.911	152	7.82	9244	94.2901	715.16	
9/29/2009	11:02:11	4020	57.04	28.504	2.911	150	7.84	9236	94.2153	715.3	
9/29/2009	11:03:11	4080	57.05	28.504	2.911	149	7.85	9238	94.2457	715.44	Data used for analysis
9/29/2009	11:04:11	4140	57.06	28.504	2.911	148	7.87	9232	94.1993	715.58	(not all plotted)
9/29/2009	11:05:11	4200	57.07	28.504	2.882	147	7.88	9235	94.2413	715.57	
9/29/2009	11:06:11	4260	57.08	28.504	2.882	147	7.89	9225	94.1546	715.71	
9/29/2009	11:07:11	4320	57.11	28.504	2.882	146	7.89	9232	94.2555	715.86	
9/29/2009	11:08:11	4380	57.11	28.504	2.911	145	7.9	9232	94.256	715.85	
9/29/2009	11:09:11	4440	57.1	28.504	2.911	145	7.91	9232	94.2466	715.85	
9/29/2009	11:10:11	4500	57.12	28.504	2.882	144	7.91	9232	94.2676	716.14	
9/29/2009	11:11:11	4560	57.13	28.504	2.882	144	7.92	9229	94.2488	716.14	
9/29/2009	11:12:11	4620	57.15	28.504	2.911	144	7.92	9227	94.2483	716.29	
9/29/2009	11:13:11	4680	57.15	28.504	2.911	143	7.93	9229	94.2792	716.29	
9/29/2009	11:14:11	4740	57.16	28.504	2.911	143	7.93	9234	94.3273	716.43	
9/29/2009	11:15:11	4800	57.17	28.504	2.911	143	7.93	9235	94.3539	716.58	
9/29/2009	11:16:11	4860	57.18	28.504	2.911	142	7.94	9225	94.2664	716.58	
9/29/2009	11:17:11	4920	57.19	28.504	2.882	142	7.94	9232	94.3506	716.72	
9/29/2009	11:18:11	4980	57.21	28.504	2.882	142	7.94	9226	94.3142	716.72	
9/29/2009	11:19:11	5040	57.22	28.504	2.882	142	7.94	9220	94.2657	716.87	
9/29/2009	11:20:11	5100	57.22	28.504	2.882	141	7.95	9221	94.27	717.02	
9/29/2009	11:21:11	5160	57.23	28.504	2.911	141	7.95	9231	94.3845	717.02	
9/29/2009	11:22:11	5220	57.25	28.504	2.882	141	7.95	9231	94.4083	717.17	
9/29/2009	11:23:11	5280	57.27	28.504	2.882	141	7.95	9225	94.366	717.16	
9/29/2009	11:24:11	5340	57.26	28.504	2.882	141	7.95	9223	94.3319	717.16	
9/29/2009	11:25:11	5400	57.28	28.504	2.911	141	7.95	9226	94.3942	717.46	
9/29/2009	11:26:11	5460	57.29	28.504	2.911	140	7.95	9227	94.4065	717.46	
9/29/2009	11:27:11	5520	57.29	28.504	2.882	140	7.96	9233	94.4745	717.46	
9/29/2009	11:28:11	5580	57.3	28.504	2.911	140	7.96	9225	94.403	717.61	
9/29/2009	11:29:11	5640	57.32	28.504	2.882	140	7.96	9223	94.3971	717.76	
9/29/2009	11:30:11	5700	57.33	28.504	2.911	140	7.96	9226	94.4493	717.76	
9/29/2009	11:31:11	5760	57.33	28.504	2.911	140	7.96	9234	94.5311	717.9	
9/29/2009	11:32:11	5820	57.36	28.504	2.911	140	7.96	9232	94.5393	718.05	
9/29/2009	11:33:11	5880	57.36	28.504	2.911	139	7.96	9231	94.5326	718.2	
9/29/2009	11:34:11	5940	57.37	28.504	2.882	139	7.96	9240	94.637	718.2	
9/29/2009	11:35:11	6000	57.38	28.504	2.882	139	7.96	9225	94.4942	718.35	
9/29/2009	11:36:11	6060	57.39	28.504	2.882	139	7.96	9222	94.4797	718.35	
9/29/2009	11:37:11	6120	57.39	28.504	2.911	139	7.96	9227	94.5211	718.5	
9/29/2009	11:38:11	6180	57.42	28.504	2.911	139	7.97	9228	94.5657	718.65	
9/29/2009	11:39:11	6240	57.43	28.504	2.911	139	7.97	9236	94.6656	718.65	
9/29/2009	11:40:11	6300	57.43	28.504	2.882	139	7.97	9230	94.6093	718.8	
9/29/2009	11:41:11	6360	57.44	28.504	2.882	139	7.97	9228	94.596	718.8	
9/29/2009	11:42:11	6420	57.45	28.504	2.911	139	7.97	9228	94.6013	718.95	
9/29/2009	11:43:11	6480	57.46	28.504	2.911	138	7.97	9232	94.6643	718.95	
9/29/2009	11:44:11	6540	57.46	28.504	2.882	138	7.97	9232	94.6602	719.09	
9/29/2009	11:45:11	6600	57.49	28.504	2.911	138	7.97	9224	94.6167	719.24	
9/29/2009	11:46:11	6660	57.49	28.504	2.882	138	7.97	9226	94.6278	719.24	
9/29/2009	11:47:11	6720	57.52	28.504	2.882	138	7.97	9226	94.6638	719.39	
9/29/2009	11:48:11	6780	57.51	28.504	2.911	138	7.97	9222	94.6087	719.39	
9/29/2009	11:49:11	6840	57.51	28.504	2.911	138	7.97	9224	94.6344	719.69	
9/29/2009	11:50:11	6900	57.54	28.504	2.882	138	7.97	9231	94.7373	719.69	
9/29/2009	11:51:11	6960	57.55	28.504	2.911	138	7.97	9222	94.6545	719.84	
9/29/2009	11:52:11	7020	57.54	28.504	2.911	138	7.97	9229	94.7279	719.84	
9/29/2009	11:53:11	7080	57.57	28.504	2.911	138	7.97	9227	94.7301	719.99	
9/29/2009	11:54:11	7140	57.56	28.504	2.911	138	7.97	9231	94.7631	720.14	
9/29/2009	11:55:11	7200	57.57	28.504	2.882	138	7.97	9227	94.736	720.29	

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9/29/2009	11:56:11	7260	57.58	28.504	2.911	137	7.97	9222	94.6983	720.29	
9/29/2009	11:57:11	7320	57.6	28.504	2.911	137	7.97	9229	94.7917	720.44	
9/29/2009	11:58:11	7380	57.6	28.504	2.882	137	7.97	9223	94.7288	720.59	
9/29/2009	11:59:11	7440	57.62	28.504	2.911	137	7.98	9225	94.7726	720.59	
9/29/2009	12:00:11	7500	57.64	28.504	2.882	137	7.98	9224	94.7839	720.59	
9/29/2009	12:01:11	7560	57.65	28.504	2.882	137	7.98	9220	94.7527	720.74	
9/29/2009	12:02:11	7620	57.66	28.504	2.882	137	7.98	9222	94.7819	720.89	
9/29/2009	12:03:11	7680	57.66	28.504	2.911	137	7.98	9232	94.8853	720.89	
9/29/2009	12:04:11	7740	57.66	28.504	2.911	137	7.98	9234	94.9045	721.19	
9/29/2009	12:05:11	7800	57.67	28.504	2.911	137	7.98	9221	94.7931	721.34	
9/29/2009	12:06:11	7860	57.67	28.504	2.882	137	7.98	9235	94.9377	721.34	
9/29/2009	12:07:11	7920	57.69	28.504	2.882	137	7.98	9223	94.8388	721.49	
9/29/2009	12:08:11	7980	57.71	28.504	2.882	137	7.98	9231	94.9405	721.49	
9/29/2009	12:09:11	8040	57.72	28.504	2.882	137	7.98	9223	94.8727	721.64	
9/29/2009	12:10:11	8100	57.73	28.504	2.911	137	7.98	9230	94.9477	721.79	
9/29/2009	12:11:11	8160	57.73	28.504	2.911	137	7.98	9231	94.9663	721.79	
9/29/2009	12:12:11	8220	57.76	28.504	2.911	137	7.98	9226	94.9405	721.94	
9/29/2009	12:13:11	8280	57.76	28.504	2.882	137	7.98	9228	94.9597	722.09	
9/29/2009	12:14:11	8340	57.76	28.504	2.882	137	7.98	9225	94.9416	722.09	
9/29/2009	12:15:11	8400	57.78	28.504	2.911	136	7.98	9228	94.9901	722.24	
9/29/2009	12:16:11	8460	57.79	28.504	2.911	136	7.98	9223	94.9502	722.39	
9/29/2009	12:17:11	8520	57.8	28.504	2.911	136	7.98	9231	95.04	722.54	
9/29/2009	12:18:11	8580	57.8	28.504	2.911	136	7.98	9227	94.9966	722.69	
9/29/2009	12:19:11	8640	57.82	28.504	2.911	136	7.98	9225	95.0053	722.69	
9/29/2009	12:20:11	8700	57.84	28.504	2.882	136	7.98	9223	95.008	722.84	
9/29/2009	12:21:11	8760	57.84	28.504	2.911	136	7.98	9220	94.9773	723.15	
9/29/2009	12:22:11	8820	57.85	28.504	2.882	136	7.98	9225	95.0431	723.15	
9/29/2009	12:23:11	8880	57.86	28.504	2.911	136	7.98	9223	95.0357	723.3	
9/29/2009	12:24:11	8940	57.87	28.504	2.882	136	7.98	9227	95.0862	723.45	
9/29/2009	12:25:11	9000	57.88	28.504	2.911	136	7.98	9221	95.0335	723.45	
9/29/2009	12:26:11	9060	57.9	28.504	2.882	136	7.98	9229	95.1439	723.6	
9/29/2009	12:27:11	9120	57.91	28.504	2.911	136	7.98	9230	95.1566	723.75	
9/29/2009	12:28:11	9180	57.92	28.504	2.882	136	7.98	9231	95.1791	723.75	
9/29/2009	12:29:11	9240	57.94	28.504	2.911	136	7.98	9221	95.0971	723.9	
9/29/2009	12:30:11	9300	57.95	28.504	2.882	136	7.98	9225	95.1563	724.05	
9/29/2009	12:31:11	9360	57.96	28.504	2.882	136	7.98	9235	95.2681	724.2	
9/29/2009	12:32:11	9420	57.97	28.504	2.911	136	7.98	9226	95.1848	724.2	
9/29/2009	12:33:11	9480	57.98	28.504	2.911	136	7.98	9226	95.1946	724.35	
9/29/2009	12:34:11	9540	57.99	28.504	2.911	136	7.98	9219	95.1433	724.5	
9/29/2009	12:35:11	9600	58.01	28.504	2.911	136	7.98	9228	95.2458	724.5	
9/29/2009	12:36:11	9660	58.02	28.504	2.911	136	7.98	9223	95.2164	724.66	
9/29/2009	12:37:11	9720	58.03	28.504	2.911	136	7.98	9223	95.2237	724.81	
9/29/2009	12:38:11	9780	58.04	28.504	2.882	136	7.98	9225	95.2556	724.96	
9/29/2009	12:39:11	9840	58.04	28.504	2.911	136	7.98	9221	95.2202	725.11	
9/29/2009	12:40:11	9900	58.05	28.504	2.911	135	7.98	9221	95.224	725.11	
9/29/2009	12:41:11	9960	58.07	28.504	2.911	135	7.98	9216	95.1959	725.11	
9/29/2009	12:42:11	10020	58.06	28.504	2.911	135	7.98	9213	95.1571	725.11	
9/29/2009	12:43:11	10080	58.07	28.504	2.911	135	7.98	9220	95.2389	725.11	
9/29/2009	12:44:11	10140	58.07	28.504	2.911	135	7.98	9211	95.1494	725.26	
9/29/2009	12:45:11	10200	58.08	28.504	2.911	135	7.98	9203	95.0752	725.26	
9/29/2009	12:46:11	10260	58.07	28.504	2.911	135	7.98	9184	94.8695	725.56	
9/29/2009	12:47:11	10320	58.07	28.504	2.911	135	7.98	9168	94.7098	725.71	

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Appendix B
Field Log Sheets

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Location DuPage River Date ~~7~~-16-09

Project / Client SOD Sampling - Site visit

1400 - On site SOD-5 Hanover Park
on W. DuPage river
Site accessed from WWTP or Arlington Rd.
- Easier access from WWTP - Ask permission
but can be reached through riparian buffer
from Arlington road
- Stream shallow - 2 ft max, appears to
be soft sediment with some debris
· decent flow, steep banks, turbid.
2 Photos - from E bank near
Arlington Road, - Upstream, substrate.
· Approx 75 yrds up from WWTP fence
Note - boat not likely to be needed or
usable at this site
- Additional access upstream at Arlington Rd
bridge -
2 Photos from bridge - downstream, substrate
1420 - Attempting to access SOD-4 - Bartlett
No access except through WWTP, observed stream
from upstream approx ½ mile. Flows through
large grassland/pasture. Decent flow, soft sediments -
banks less steep than SOD5.
1 photo of WWTP access.
Boat questionable for this location

Location W DuPage River Date 7-16-09

Project / Client SOD Sampling - Site Visits

1445 - On site SOD-3 - West Chicago.
Easiest access from WWTP. can be reached
from bridge downstream at Roosevelt Rd
and possibly from park off Rt 59.
- Stream considerably wider - 50ft estimate,
2-3 ft deep, mixed fine sediment and
debris, rock. Sediment layer appears to be
mostly shallow, minimal in-stream structure,
- Access from Roosevelt includes difficult banks
and parking. Banks steep and heavily vegetated
3 photos - Upstream, discharge, substrate.
- Note: Discharge appears to be from
Pipe near Roosevelt Bridge.

1500 - Access point to SOD-3 from forest Preserve
parking area approx. 0.2 miles upstream.
Would require 0.1 mile walk.
- Boat could be used, but not necessary at location

1520 - On site SOD-2 - McDowell Forest Preserve.
Site easily accessible - Park Area. Area upstream
of bridge backed up, wide, some macrophytes.
Small dam overflow below bridge. Boat could
be used and may be helpful at this site.
Photos: 4 - Down, Up, Sub, Upstream
Site very turbid, hard to gauge depth visually

Location W. DuPage River Date 7-16-09

Project / Client SOD Sampling - Site Visit.

1530 - SOD-2 site will most likely have mix
of substrate with fines in deeper part of
pool - depth may be an issue here,
Recommend upstream of bridge due to small
drop off below and re-aeration possible,

1600 - On site SOD-1 - Naperville - Knoch Knolls
Park - Point appears to be completely
inaccessible. Park access approx 0.5 miles
upstream. Possible to float down to site or
may be private property access.
Visited site from upstream park
3 photos - down, sub, upstream
- Stream wide - 50-75', shallow 1-2 ft.
More natural banks, probably more gravel and
cobble substrate - may be reason for down
stream - also this is still the W. Branch.
Boat possible if shallow draft.

1620 - Offsite SOD-1

Br
Br 7-16-09

Location W. DuPage River Date 8/25/09

Project / Client SOD Sampling

0815 - On site Forest Preserve Grounds and Resources office to meet with Steve McKracken of the resource group.
Crew: B. Bennett (author), D. Jordan, B. Dunavant
Weather: Sunny 88°F high forecast
Tasks for the day: Discuss locations + access with S. McKracken, begin sampling at upstream-most site (SOD-5).
0835 - S. McKracken arrives - begin discussing site locations. Talks with Jenny Clark about replacing Bartlett location with one on Mainstem DuPage. J. Clark confirmed that original list may be altered.
0940 in route to Hanover Park site
1000 - On site Hanover Park WRP. Met with Larry Stahl - plant supervisor to get access to river. Easy access from parking area
1005 - Begin unloading equipment
1113 - check meters w/ stream water

Sediment 2	DO - 8.03
blank	DO - 7.96
sediment 1	DO - 7.93
QA/QC	DO - 8.05 @ 1:25 = 7.32

Location Date 8/25/09

Project / Client

~1120 - insert logging probes in sediment 1, Sediment 2, Blank
seal seems good
battery / pumps running

~1130 ~~[illegible]~~ connected rugged reader to sediment 1 for field check
(see next page)

~1135 connected rugged reader to Sediment 2 for field check
(see next page)

~1:30 pulled equip

retested dark bottle

checked & emptied blank

Location * LOG is thru off? Date 8/25/09

Project / Client BD recording

time	DO SED 2	Temp	DO SED 1	Temp	
11:33	7.35	71.09	7.42	71.29	
11:45	7:35	71.48	7.34	71.37	
12:00	7.26	71.62	7.40	71.93	cap
12:15	7.11	72.00	7.53	72.54	- tightened
12:30	7.01	72.33	7.90	73.1	reset!
12:45	6.92	72.69	7.78	73.38	
1:00	6.80	73.10	7.69	73.65	
1:15	6.69	73.45	7.60	73.94	

36.5ft across - measure x 3ft

Flow -	Total Depth	Flow @ 6/10
.3	.7	0
6	1	.27
9	1	.5
12	.8	.39
15	.8	.51
18	.6	.56
21	.6	.35
24	.5	.1
27	.4	.07

@ 1:24

QC → 7.38

Location SITE 4 - West Chicago WWTP Date 8/25/09

Project / Client

3:25 - Started tests for sediment 1, sediment 2, & Blank

3:30 - Donnie & Brian walked stream to id good sediment locations

3:50 - Put probes in chambers

3:55 Hooked up Battery

Stream Gage - West Chicago - Total Width = 68

Width (ft)	Total Depth (ft)	Flow (fps)
8	0.50	0
14	0.60	0.10
20	1.40	0.45
26	1.50	0.83
32	1.55	0.52
38	1.70	0.34
44	1.70	0.23
50	1.65	0
56	2.0	0
62	1.85	0

Location West Chicago WWTP Date 8/25/09

Project / Client

SOD Measurements

Time	SED 2 DO	SED 2 Temp	SED 1 DO	SED 1 Temp
1610	7.90	76.85	8.82	76.98
1620	7.65	76.84	8.54	76.97
1630	7.48	76.82	8.29	76.98
1640	7.34	76.84	8.11	76.95
1650	7.15	76.83	7.84	76.96
1700	7.01	76.81	7.66	76.95
1710	6.86	76.78	7.46	76.91

1600 - Blank QC DO = 9.98 mg/L

Note: Location approximately 100m upstream of the West Chicago WWTP outfall. Silty substrate with considerable woody debris. Sediment nearer the Left Bank is finer with organic decomposition odor.

1715 Blank in stream SOD chamber reading DO = 9.38 temp = 77.17

1820 - Blank QC DO = 9.37 mg/L

1825 - Home Depot for supplies

AJordan 8/25/09

Location McDonald Forest Preserve Date 8/26/09

Project / Client SOD Sampling

0900 - On site SOD-3 - McDonnell Forest Preserve.
Weather - Rain, 70°F
Crew - B. Bennett, D. Jordan
Task: Continue with SOD sampling.
0915 - Set up probes to run test, 1 minute intervals.
0920 - QC Blank collected - DO = 6.54 mg/L @ 72.68°F
~~0930~~ 0940 - SOD Chambers set 100 ft US of bridge
BB 0955 - Start SOD data collection.

SOD Measurements Table

Time	SED 1 DO	SED 1 Temp	SED 2 DO	SED 2 Temp
~~1000~~	~~7.63~~	~~73.21~~	~~7.66~~	~~73.20~~ DJ
~~1010~~	~~7.65~~			DJ
1010	3.46	73.29	2.75	73.27
1020	3.16	73.34	2.40	73.32
1030	2.95	73.40	2.10	73.40
1040	2.77	73.45	1.86	73.43
1050	2.62	73.51	1.67	73.46
1100	2.47	73.54	1.46	73.47
1110	2.35	73.55	1.32	73.50
1120	2.22	73.56	1.21	73.50
1130	2.10	73.56	1.11	73.52
1140	2.00	73.57	1.02	73.52

Location SOD-3 McDowell Grove FP Date 8/26/09
Project / Client SOD SAMPLING - IEPA

Stream gage at SOD-3 - McDowell Forest Preserve
Total Width =

WIDTH (FT)	DEPTH (FT)	VEL (FPS)

stream too deep to gage

Note: Site is approximately 150-200 ft upstream of McDowell grove low-head dam, water backed up with some current still visible. Area inundated with Duckweed/Mosquito Fern and other aquatic ~~plant~~ macrophytes. SOD chambers placed near left bank in very thick, soft sediment. Water is approximately 2-3 ft deep at chambers, some current visible in vicinity of chambers. Stream approx 90 ft wide and greater than 4 ft deep in places.

1040 photos 100_3727-100-3729

Location SOD-3 / SOD-#2 Date 8/26/09
Project / Client SOD Sampling - IEPA

1147 SOD Chamber blank reading
temp: 73.38 DO: 6.24
1210 QC Blank check
temp = 74.11°F DO = 5.55 mg/L
1215 offsite
1305 Arrive at Naperville site
@ Knoch Knolls Park - SOD #2
- Plan to go downstream of parking lot to look for suitable location. Stream level appears to be slightly elevated. Stream somewhat channelized, good flow.
1323 - QC blank collected ⇒ DO = 6.59 mg/L @ 71.10°F
1425 - Meters placed in SOD chambers

SOD Measurements Table

Time	DO (SED1)	Temp	DO (SED2)	Temp
1440	3.64	71.98	4.04	71.83
1450	3.17	71.92	3.29	72.10
1500	2.94	71.97	2.95	72.18
1510	2.77	72.03	2.67	72.23
1520	2.58	72.05	2.45	72.29
1530	2.43	72.06	2.30	72.32
1540	2.27	72.10	2.13	72.35
1550	2.17	72.08	2.02	72.36
1600	2.05	72.08	1.89	72.38

Location SOD-#2 Naperville Date 08/26/09
Project / Client IEPA SOD sampling

1610	DO SED 1	Temp	DO SED 2	Temp
	1.95	72.09	1.78	72.38

DJ

stream gage at SOD-4 Naperville
total width = ~~118 ft~~ DJ 107 ft

width (ft)	Depth (Ft)	Velocity (FPS)
8	1.10	0.41
17	1.00	0.02
26	1.10	0.72
35	1.25	1.29
44	1.30	1.51
53	1.10	1.41
62	1.70	1.62
71	1.75	1.60
80	1.8	0.42
89	1.7	1.01
98	2.0	0.18

SOD Blank DO: 7.32
temp: 72.02
photos 100_3729 (30 DJ) - 100_3732

Location SOD-#2 Date 8/26/09
Project / Client IEPA SOD sampling

1646 QC Blank
DO: 5.54
Temp: 71.69
Note: streambed of site is mostly gravel and cobble, except in back-water areas. SOD chambers were in fairly deep soft sediment, 1-2 ft. deep. organic material present. Chambers were approximately 300 yards ds of parking lot.
1650: offsite
1652: In route to locate SOD-#1, on main stem for tomorrows sampling

SR
8/26/09

Location: SOD-1 Date: 8/27/09

Project / Client: SOD Sampling - IEPA

945: Arrive at potential sampling location for SOD-5 near Book Rd. Dupage River mainstem is very high.

Note: Access at Book Road where road closed sign heading north. Steven McCraken filed a special use permit with the Will County Forest Preserve District, but no confirmation given.

1015. Contact B. Dimeviant about flooded stream conditions and the inability to locate suitable sampling area. She left message with J. Clark of IEPA and we contacted S. McCraken about possible alternatives. Awaiting return calls from both parties. Most likely W. Branch locations will be at elevated flow as well.

1020 - Photos: 2 pics of Flooded DuPage R. Mainstem at Book Road access.
100_3733 - 100_3734
photo at bridge crossing of Dupage River: 100_3735.

Location SOD Study Date 9/29/09
Project / Client Naperville WRP

0900 - On site Naperville WRP to meet with Joe Plawnik about access to Du Page mainstem.
Crew: Brian Bennett, Scott Banjavcic
Weather: Cloudy 50°F
0905 - Found decent location approximately 100m upstream of discharge. Begin preparing equipment.
Back up blank DO: 9.031 mg/L @ 945am
1030 - SOD chambers set, let settle for ≈ 20 min
1055 - All chambers are operating. Begin
1100 - Measurements on SOD-2 started

Time	SOD #2 Temp	DO	Time	SOD #1 Temp	DO
1100	13.94°C	2.39	1115	14.04	8.35
1110	14.05	2.81	1125	14.12	8.22
1140	14.28	5.19	1135	14.18	8.12
1150	14.31	5.96	1155	14.30	7.93
			1205	14.35	7.83
			1215	14.42	7.73
			1225	14.48	7.65
			1235	14.53	7.58

Location SOD Study Date 9/29/09
Project / Client Naperville WRP

Note: The sediment at this location has some fine, some sand, not much organic material (leaves, sticks, etc). Good seal on both chambers. Only 1 handheld available so swapping between units for manual measurement + note taking. All 4 probes were reading similar DO values, however probe on SOD #2 appears to be reading
1235 - Photos of Site Upstream x2, Downstream
1240 - Stop sampling, turn off pumps and then stop meters at SOD-1, SOD-2, and in-stream blank
1309 - Final reading on back-up QC probe is 8.58 mg/L @ 12.17°C, full 1 minute reading test also recorded.

Note: Chamber dimensions:
Diameter = 1.87 ft
Area = 2.7646 ft²
Height = 0.75 ft
Volume = 2.059842

B [signature] 9/29/09

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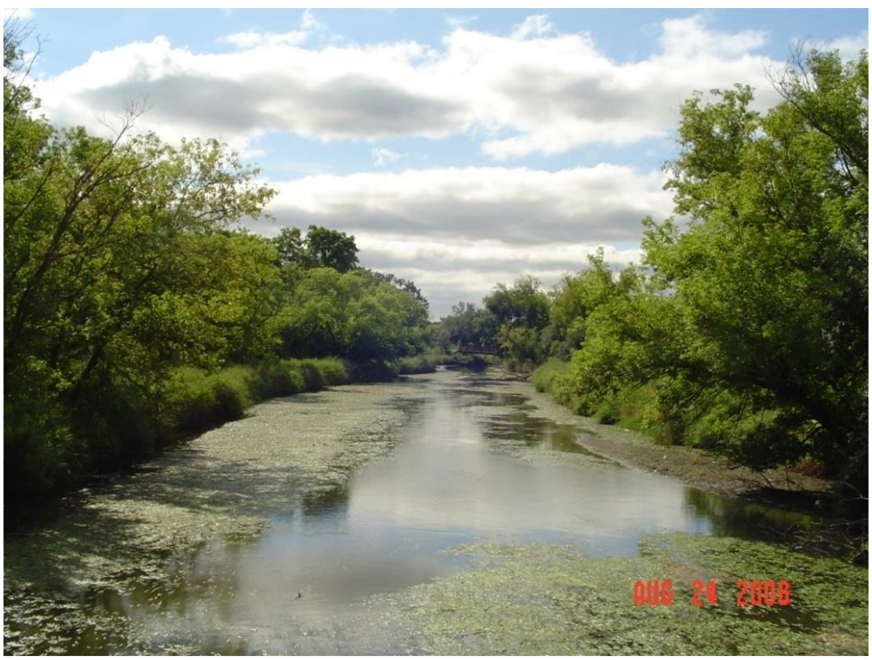
Appendix C

Site Photographs

Provided by AECOM

DuPage River (IL_GB-11) at Route 52



West Branch DuPage River (IL_GBK-05) at Geneva Road

West Branch DuPage River (IL_GBK-09) at Route 64

Salt Creek (IL_GL-10) at Route 19

Salt Creek (IL_GL) at Route 58

Appendix D

Public Comments and Responsiveness Summary

Stage One Responsiveness Summary

This responsiveness summary responds to substantive questions and comments received during the public comment period from January 16, 2009 through April 17, 2009 postmarked, including those from the January 28, 2009 public meeting discussed below.

What is a TMDL?

A Total Maximum Daily Load (TMDL) is the sum of the allowable amount of a pollutant that a water body can receive from all contributing sources and still meet water quality standards or designated uses. This TMDL is for the DuPage River/Salt Creek watersheds. In Illinois, developing a TMDL is a three stage process and this is a stage one report which contains the watershed characteristics, impairments and potential sources. After the stage one report, stage two and stage three will proceed. Stage two would include additional monitoring and stage three is the required modeling, allocations and reductions for each TMDL impairment and would also include an implementation plan.

Background

The DuPage River and Salt Creek watersheds drain approximately 332,600 acres and lies mainly in Cook, DuPage and Will counties. Land use in the DuPage River watershed is 65% urban, 21% agriculture and 10% forest while in Salt Creek it is 85% urban and 12% forest. Waters impaired in this watershed are DuPage River, East Branch DuPage, West Branch DuPage, Spring Brook, Salt Creek, Addison Creek and Churchill Lagoon. The DuPage River is listed on the Illinois EPA 2008 Section 303(d) List as being impaired for chloride, fecal coliform, dissolved oxygen and silver. East Branch is impaired for fecal coliform and pH. West Branch is impaired for dissolved oxygen, fecal coliform, silver, manganese and pH. Spring Brook is impaired for dissolved oxygen and fecal coliform. Salt Creek is impaired for fecal coliform and pH. Churchill Lagoon is impaired for phosphorus. The Clean Water Act and USEPA regulations require that states develop TMDLs for waters on the Section 303(d) List. Illinois EPA develops TMDLs allocations for impairments with numeric water quality standards, but some non-numeric standards may be addressed through the implementation plan. Best Management Practices (BMPs) put in place for TMDL impairments may reduce other parameters associated with it.

Public Meetings

A stage one public meeting was held in Elmhurst on January 28, 2009. The Illinois EPA provided public notices for all meetings by placing an ad in the local newspapers in the watershed; the Chicago Daily Herald, The Will-South DuPage Report and the Central Cook Suburban. These notices gave the date, time, location, and purpose of the meetings. It also provided references to obtain additional information about this specific site, the TMDL Program and other related issues. Individuals and organizations were also sent the public notice by first class mail. An additional stakeholder meeting was held March 31, 2009 in Plainfield, IL. The draft TMDL Report was available for review at the Elmhurst City Hall and on the Agency's web page at http://www.epa.state.il.us/water/tmdl .

The first public meeting on January 28, 2009 started at 6:00 p.m. and was attended by approximately 50 people. The second stakeholder meeting on March 31, 2009, started at 10:00 am and was attended by 20 people. The meeting record remained open until midnight, April 17, 2009.

There will be a public meeting for the stage three TMDL report in the future and a responsiveness summary will be developed for this meeting also.

Questions and Comments

1. The stakeholders in the watershed were not given the opportunity to provide input on how the stage 1 report was to be conducted. Many of the same issues discovered in the first TMDLs are also appearing in this report. Why were we not given the opportunity to provide input in the early stages of planning and conducting the report?

   Response
   The Illinois EPA published the Illinois Integrated Water Quality Report and Section 303(d) List- 2006 in June of 2006. This document lists all the waters for TMDL development in the next two years. All of the segments for this TMDL were listed in Table C-29 of the Integrated Report. The Illinois EPA holds the first public meeting at the beginning of the TMDL process- in stage one. The basic watershed information is completed in this stage and presented to the public. This is also the stage we request any other relevant data in the watershed and public input. Illinois EPA also participates in the DuPage River Salt Creek Workgroup and keeps the Workgroup updated on TMDL issues.

2. The water quality standard for fecal coliform is "based on a minimum five samples taken over a 30 day period". However, Illinois EPA does not have the appropriate number of samples and therefore has elected to use an alternative water quality standard. Illinois EPA should obtain the necessary data to use the more preferred standard for assessment purposes.

   Response
   Illinois EPA does sample at the frequency required by one part of the standard. Stations that are assessed for primary contact in this watershed are sampled approximately monthly. If available, five years of data are used for the primary contact assessments. For this TMDL, most of the assessments were based on data that were received from outside sources. From those stations sampled by outside sources, Illinois EPA will accept sampling at the correct frequency when the standard is applied- May through October. If their data become available this year, they will be used for the TMDL. The DRSC Workgroup is developing a sampling plan for this watershed as part of the implementation process.

3. The report does not state how the effect of animals on fecal coliform will be addressed. Illinois EPA stated in the public meeting that they would try to use some data that have been gathered in other states but the data may not be comparable to this watershed and therefore assumptions may have to be made. This will greatly decrease the reliability of the modeling and ultimately the wasteload allocations and TMDL. Therefore, it is imperative that Illinois EPA obtain the appropriate data and perform the necessary studies to properly account for the effect of wildlife on fecal coliform.

   Response
   Illinois EPA will be addressing the bacteria impairments using the load duration curve analysis. Bacteria data and flow data are the basis of this analysis. Loads are ranked per flow and one can which flow periods in which there are exceedences of fecal coliform bacteria. By using this approach, sources can be tracked by the flow period. For example, if point sources are causing the majority of the problem, exceedences will be seen even in low flow periods when there is no precipitation causing runoff. If the main problem is runoff related, exceedences will be seen in high and medium flow periods only. The analysis also shows the exceedences that are due to storm flows. Exceedences due to wildlife would be expected in high to high-medium flows. Illinois EPA is not aware of any livestock facilities in this watershed and does not have adequate estimates of wildlife populations in this area. If anyone is aware of these data, Illinois EPA would like to obtain this information.

4. Through studies performed by DRSCW, it has been clearly shown that sediment oxygen demand (SOD) has a profound effect on the QUAL-2K model for DO. This model is very sensitive to SOD and therefore SOD monitoring data are critical when modeling for DO. Illinois EPA must obtain the required SOD data in order to properly perform water quality modeling for DO.

   Response
   In response to suggestions made at the Stage One Public Meeting, Illinois EPA will be obtaining SOD samples from the West Branch DuPage River.

5. Illinois EPA is going to use monthly monitoring reports from publicly owned treatment works (POTWs) to provide data for the QUAL-2K model when studying the DO parameter. However, Illinois EPA should use actual data that are readily available.

   Response
   Illinois EPA typically uses the designed average flow (DAF) for NPDES facilities discharging in the watershed. It was brought to our attention at the meeting that this may over-estimate loads from these sources and flow data obtained from the individual facilities would best represent loads in the model. NPDES facilities are not required to give Illinois EPA this flow information, but Illinois EPA will work with facilities to obtain it.

6. The Report does not state how it will address wet weather flow. Illinois EPA should obtain the necessary wet weather data to determine how they are going to address wet weather flows.

   Response
   See response to question 4 for information on how the load duration curves determine wet weather exceedance events. See response to question 4 for information on how the load duration curves determine wet weather exceedance events. The QUAL-2K model assumes steady and non-uniform flow, which means that flow doesn't change over time. However, the QUAL-2K can be run under various flow conditions, for example, dry and wet condition, provided that the pollutant loads are available for these flow conditions. The representative wet weather flows can be used in QUAL-2K to evaluate how a waterbody responds to pollutant loads induced by stormwater runoff.

7. There was very limited data for manganese, with only two violations out of forty-five observations. One violation was extremely high indicating a possible faulty test. What efforts were taken after the sample was analyzed to ensure accuracy and reliability of the results? Are forty-five observations enough to be statistically significant?

   Response
   Illinois EPA did look at the manganese data for West Branch DuPage River (segment GBK-14) and found the extremely high data sample was magnesium which was then deleted from the dataset. There is still one exceedance of manganese which violates the water quality standard and requires a TMDL. According to the water quality standard for manganese, it is a toxic pollutant and one exceedance will result in a listing of impairment for a waterbody (refer to Table C-3 in the 2008 Integrated Report).

8. The DRSCW has monitored chlorides last year and these data shows more violations then Illinois EPA's data. Illinois EPA should include the chloride data in their assessment and in future modeling.

   Response
   Illinois EPA has received these data and will be using it as it applies to stream assessments and in the TMDL model.

9. The report does not state how it will account for naturally occurring phosphorus in the modeling. Illinois EPA should obtain the appropriate local data and perform the necessary studies that properly account for phosphorus as it naturally occurs in this watershed rather than basing it on non-comparable studies and assumptions.

   Response
   The only waterbody that we are doing a phosphorus TMDL on is Churchill Lagoon. Illinois EPA gives TMDL allocations to parameters with numeric water quality standards. Phosphorus as it applies to all lakes has a standard of 0.05 mg/L and takes into account background concentrations. As it turns out, there is a possibility that the dam might be removed for this waterbody. Therefore, the standard would not apply to this water and a TMDL would not be applied since no phosphorus standard has been adopted for streams. We will have more information in stage three of the TMDL process.

10. Instituting TMDLs, if done properly, should improve the water chemistry of our streams. However, they will do very little in improving the aquatic and wildlife habitat without making other improvements like streambank restorations, dam removals, wetland or riparian creation, etc. Instituting TMDLs will shift limited municipal resources towards compliance in meeting TMDL requirements, away from stream corridor improvements. This will have a substantial impact in our ability to make meaningful improvements to our lakes and streams.

    Response
    The outcome of TMDLs is allocations and can result in reductions from point sources and nonpoint sources. Through the NPDES permit program, the TMDL can reduce limits on point sources, but Illinois EPA does not have regulatory authority to make an entity or person apply nonpoint source Best Management Practices (BMPs) on their land. The TMDL recommends BMPs that can be established in the watershed to reduce pollutant loads and we recommend stakeholders begin watershed planning to see where it is feasible for BMPs to be installed. There are some watersheds that already have stakeholder groups formed (e.g., DRSCW) and are ready for planning to begin and there are other watersheds that use the TMDL to begin the process of planning. One tool the agency has is the 319 Nonpoint Source Program in which groups can get funding for watershed planning. There will be more information in the stage 3 implementation plan.

11. Page ES-1 reads, "Waterbodies included on the 303(d) list require Total Maximum Daily Load (TMDL) development." This statement is not entirely true. For example, an impaired water could be deemed to be impaired as the result of a natural cause, such as being classified into Category 4C.

    Response
    The 303(d) List is considered Category 5 in the Integrated Report. All Category 5 impairments require a TMDL. 4c is separate category and a TMDL will not be developed for these.

12. Should TSS and Sedimentation/siltation be included in Table 1-4, as no water quality standard criteria exist for those parameters?

    Response
    Yes, these parameters had TMDLs developed previously. The Agency no longer develops TMDLs for any parameter lacking a numeric standard. The Agency believes parameters with numeric standards have been through a rigorous approval process and wasteload allocations can apply.

13. While DuPage County recognizes the limited data complications present during this TMDL development process and how these pose difficulties in determining the geometric mean, the County has strong objection to changing the single sample maximum criterion (SSM) from 400 colony forming units (cfu) to 200 cfu. Making such a change would alter the risk level from 0.8% to approximately 0.55%. While

the proposed SSM criterion change is stated to be an implicit margin of safety (MOS), the change goes far beyond the MOS and completely changes the bacteria criterion against which the bacteria data are being assessed. A more appropriate reference to the implicit MOS would be to simply reference the load duration analysis itself, particularly that the percent reduction will be required from the greatest difference between recorded bacteria data and bacteria loads, calculated from flow data. The model should also provide calculated post-reduction daily bacteria levels, which would allow one to verify if the GM, theoretically, is being met.

Response
Illinois EPA is not changing the assessment methodology for fecal coliform. It is still assessed using the geometric mean of 200 cfu/100ml and a single sample maximum of 400 cfu/100ml. The allocations for NPDES wasteloads will be based on the permit limit of 400 cfu/100ml. If the facility is meeting their permit limit, no change will be required. We are required by USEPA to use the 200 cfu/100 ml for fecal coliform as the target load for the stream water quality. The post reduction bacteria levels are required to be under this target.

14. It is not clear to DuPage County why IEPA is pursuing a TMDL that includes the chloride, manganese, and silver parameters. Table C-3 in the IL 2008 Integrated Assessment (page 59) states that for toxic parameters, including these three, the “most recent consecutive three years of data are used.” Looking at the data for the chloride and silver parameters, it is obvious that there are ten or more observations for each of the two parameters. Therefore, again referencing Table C-3, even a moderate impairment would require that two or more observations in the most recent consecutive three years of data exceed the applicable acute toxicity standard. Based on these data which indicate only one excursion in the applicable time period, the assessment units should not be impaired for chloride and silver and these parameters should not be included in the TMDL report.

    Response
    Chloride, manganese and silver are all three toxic parameters and one exceedance of the water quality standard indicates moderate impairment (refer to Table C-3 in the 2008 Integrated Report).

15. There are concerns over the way in which IEPA prioritizes its watersheds for TMDL development. While it is certainly important for public water supply areas to be addressed initially, the fact that IEPA bases prioritization on a sum of the total impairments with numerical criteria is questionable. More attention should be given to the available data (focusing on both quality and quantity of the data) and localized groups in the watershed seeking to enact the implementation plan included in a developed TMDL report rather than simply seeking to produce a report that includes all impairments for all assessment units within a single watershed. Again, single parameter TMDL reports should be considered if the existing data at the time of development are only sufficient enough for that particular parameter. Such a limitation allows for more focused analysis and implementation on that particular parameter for which a reliable TMDL report has been developed.

    Response
    As part of our prioritization effort, we are required to rank impaired waters by the severity of pollution. Severity of pollution is determined by summing the impairments in the waterbodies. The watersheds with more impairment were identified and listed with higher priority than those listed with fewer causes of impairment. Illinois EPA, along with many other states and following the recommendations of USEPA, develops TMDLs on a watershed basis. Implementation can take place on a single water segment or on a larger scale. Those decisions would be made by local stakeholders.

16. It does not seem logical that waste load allocations are going to be assigned for the phosphorus impairment at Churchill Lagoon. There are active plans to restore the lagoon into a free flowing stream, meaning that the phosphorus standard will no longer be applicable at this site. DuPage County

recommends that IEPA pursue moving that assessment unit into category 4B next assessment cycle, as measures taken will allow the waterway to meet applicable water quality standards within a reasonable period of time without the need for a TMDL report.

Response
As stated in the response to comment 9, if the lake standard for phosphorus will no longer be applicable to the waterbody, the TMDL will not proceed. The water will be assessed using the stream methodology.

17. Page 6-2 reads, "Stormwater dischargers are required to meet the percentage reduction or the existing in-stream standard for the pollutant of concern, whichever is less restrictive." Where is this requirement stated? References attached to statements such as this one would be appreciated.

Response
The statement is removed to the report since it is not applicable to the State of Illinois.

18. Page 1-8, Table 1-2. "Potential source(s)" of fecal coliform should include waterfowl. These animals have been shown to be significant sources of FC in lakes and streams (see *Characterization of E.coli Levels at 63rd Street Beach*, R. L. Whitman, et al, USGS, 2001 and *Effect of Waterfowl on Indicator Bacteria Populations in a Recreational Lake in Madison*, WI, J.H. Standridge, et al., Applied and Environmental Microbiology, September 1979). This is especially important in reach GBK-14 which has nearly stagnant flow during dry weather periods and is frequented by Canada Geese and other waterfowl. DNA fingerprinting of FC should be conducted in FC impaired reaches to determine if the impairment is from a human source, and if not, the impairment should be attributed to background conditions. If conducted following the TMDL, bacteria source tracking should precede any actions required to meet a wasteload allocation (WLA).

Response
Bacteria source tracking uses genetic and/or phenotypic test to identify bacteria strains that are host specific so that the host animal and source of the fecal contamination can be identified. The disadvantage is that a reference library of genetic or phenotypic fingerprints for bacteria isolated from known sources (sewage, livestock and wildlife) is needed to identify the sources. This is a very time consuming and expensive component of the study. Without a large reference library the tracking is very unreliable. Illinois EPA will not include source tracking in the TMDL process, but local stakeholders could use this as part of their watershed plans and/or implementation process.

19. Do all monitoring entities collecting data in the DuPage River/Salt Creek watershed have Quality Assurance Project Plans (QAPPs) and Standard Operating Procedures (SOPs) for their monitoring programs?

Response
Yes, data from DRSCW, Lake County Health Department, MWRGDC, Sierra Club, and Wheaton Sanitary District have QAPPs and SOPs. Data from these entities are used for water quality assessments and therefore require both.

20. What is meant by the phrase "….compliance was measured at the surface of the stream….?" Were all water quality constituents, including dissolved oxygen, measured at the surface? At what depth were the samples collected?

Response
Dissolved oxygen is measured at one foot below the surface of the water using a sonde unit probe. Water is collected for other parameters using a grab sample that is collected uniformly from the bottom to the top of the water.

21. Monitoring stations WW_109 and WW_21 in segment GL-19 are listed incorrectly on the map. The District does not have an ambient monitoring location identified as WW_21. Monitoring station WW_21 should be identified as WW_24 and is located at the point on the map where WW_109 is indicated. Monitoring station WW_24 is located where WW_21 is indicated.

Response
Illinois EPA used latitude and longitude information from the MWRDGC website. If these are incorrect, new location information needs to be obtained. Illinois EPA received data from MWRDGC with monitoring data for station WW_21 (Salt Creek at First Avenue) from January 2001 until April 2002. WW-24 (Salt Creek at Wolf Road) has data from January 2001 until May 2007. WW_109 (Salt at Brookfield Road) has data from July 2002 until May 2007.

22. TMDL segments need to be better defined. It is practically impossible to determine from the maps where the segments begin and end. Segments should be defined by geographical features or, preferably, latitude and longitude coordinates.

Response
Illinois EPA will be more specific in the final stage 1 draft report. Individual maps of each impaired segment will be included along with a table that includes latitude and longitude coordinates for each monitoring station.

23. Despite the fact that the Illinois EPA identified the West Branch DuPage River as impaired due to zinc concentrations, no TMDL will be developed for this pollutant. The text of the report does not discuss the issue of zinc impairment of the West Branch DuPage River. This issue is only addressed as a footnote to Table 1-1. Based upon the identification of zinc impairment, the Illinois EPA has begun to place zinc limits in NPDES permits for municipal plants discharging to this river including the Village of Hanover Park Sewage Treatment Plant. Without conducting the formal TMDL process for zinc, there can be no assurance that the Illinois EPA's strategy will eliminate zinc impairment of the West Branch DuPage River. After extensive sampling and investigation of zinc concentrations within the Hanover Park sewer service area, it has been determined that the domestic concentrations of zinc are nearly the same as the industrial discharge concentrations. The domestic sewage accounts for roughly 80% of the WWTP flow while industry discharge only accounts for 20%. Even if industry is limited to zero discharge of zinc, the effluent would not meet the monthly zinc effluent limit of 0.046 mg/L. The technology to remove zinc and the cost associated with such an upgrade are significant. There is a concern that scarce tax dollars will be spent on point source control of zinc without solving the impairment.

Response
Domestic and industrial discharges are both considered point sources. The NPDES program has been established for control of point source discharges. This program is relied upon for reductions if there are impairments only due to point sources.

24. There is a single exceedance of manganese for segment GBK-14. That exceedance occurs during a period of relatively high sampling (4 year period accounting for perhaps 30 of the sample points). It would be of interest to know what the flow rates were when the outlier was sampled and see what proportion of the samples were collected under similar flow regimes. With one exceedance, the parameter does not meet the guideline for an impairment set out in the 2008 Integrated Assessment Report. In addition, it is our information that the standard for manganese is being revised for the State of

Illinois. In our assessment with the new standard, there is no exceedance. The TMDL for this parameter should be suspended.

Response
According to our assessment methodology (2008 Integrated Report on page 59, Table C-3) for aquatic life designated use, a single exceedance violates the chronic toxic standard for manganese. Once this standard is violated, the water body is impaired. Illinois EPA is in the process of developing new manganese standards, but this is in the initial stages. The Illinois Pollution Control Board must review and approve any changes to water quality standards before they can be utilized in Illinois EPA water quality assessments. In regards to flow analysis, as part of the stage 3 development a load duration curve will be utilized and this takes into account flow at the time each sample was taken. This can determine the flow regime in which violations take place and sources that attribute at that flow regime.

25. The two exceedences for chloride do not meet the standards set out in the 2008 Integrated Report for an impairment. However, there is DRSCW data that shows multiple exceedences for multiple sites and violations were correlated to storms. In addition, the Bioassessment plan found TDS higher than 1000 mg/L in several tributaries during summer months; chloride is most likely the bulk of these dissolved ions. We are satisfied that chloride levels are exceeded across the program area during winter months but also in a more limited area, warm weather periods, and that the principle source is winter de-icing compounds. Since you had poor data and there are de-icing operation already underway in the upper DuPage and Salt, a TMDL should not be completed for chloride. It is unlikely that such a development will contain more detailed analysis or recommendations than the 2007 DRSCW Chloride Usage Education and Reduction Study which was a completed due to the chloride TMDL allocations on the West and East Branches of DuPage.

Response
Please refer to the response for comment 14. Chloride is also a toxic chemical and falls under the same assessment as manganese. As required by the Clean Water Act, Illinois EPA will develop a TMDL. As with manganese, load duration curves will be utilized for chloride. Illinois EPA will have information in the implementation plan on the de-icing program/ chloride reduction study.

26. The silver data presented do not meet the standard set out in the Integrated Report. The Bioassessment study looked at 19 sites of the West Branch DuPage and all sites exceeded threshold levels, but did not exceed the probably effects levels as did PCBs found in sediment. Silver may be a problem, but not a priority at this time.

Response
Please refer to the response for comment 14. Silver is also a toxic chemical and falls under the same assessment protocol as manganese. Illinois EPA will not be developing a TMDL for PCBs in sediment as there are no standards for this parameter in sediment.

27. While agriculture may be an important source of nutrient loading, in terms of the Upper DuPage and Salt Creek the small proportion of the area with agriculture use means its effect should not be exaggerated. A more important source of nutrient loading is residential landscaping areas that are the dominant land use management practice in the areas and may produce up to 41% of the NPS phosphorus loadings in tributary watersheds (loadings in tributary watersheds Upper DuPage River Watershed Plan Update). This land use is ignored in chapter 5.3.

Response
While the Salt Creek watershed has only twelve percent agriculture land use, the DuPage River as over twenty percent. Residential areas are not ignored in the analysis. Urban Low/Medium Density which

represents residential areas comprise 30 percent in the DuPage River watershed and almost 47 percent in Salt Creek watershed.

28. Non-point source impairments are strong concerns for the ultimate health of the watershed. Wastewater plants in the region have already reached the point of cost effective treatment for these parameters. Significant investment in wastewater treatment will produce minimal benefit to the watershed. If additional improvements are required at wastewater plants, their carbon footprints are likely to increase thereby adversely affecting the quality of air in the region. We would highly encourage focusing on non-point sources.

    Response
    The TMDL will focus on all sources of pollutants and Illinois EPA is required to have allocations for both point and non-point sources in the watershed.

29. There has been substantial modification of the cross section of the West Branch of the DuPage River over the last few years, and additional modifications are anticipated over the next two or three years. During construction, the entire river flow is pumped around the construction site. It is well documented that when the water is inside pipes, organics remove DO from the water. This means that lower than normal DO levels should be occurring in the River whenever bypass pumping is being conducted on the River. In addition, a multi-year thorium removal project is expected to require two or three more years to complete. As a result, DO sampling of the river during this period will not be representative of the River's natural DO level after the work has been completed. IN addition, the dam in McDowell Woods Forest Preserve was removed in fall of 2008, and the dam in Warrenville is scheduled for removal in 2009. Removal of the dams is expected to increase DO levels in the previously impounded sections as well as downstream.

    Response:
    Regular monitoring of these waterways will continue and this includes DO. Assessment of the results should help focus the need and nature of any BMPs needed.

30. Based on a recent study on Salt Creek, significant phosphorus reductions in the Egan Plant's effluent did not have a measurable impact on either the algae biomass or DO. Egan supplies approximately 50% of the effluent received by Salt Creek. Studies have found a very strong correlation between habitat and diversity in fish and macro-invertebrate populations, suggesting that, at this time, habitat is the primary limiter in our streams and rivers. Therefore, we believe that a focus on habitat, rather than phosphorus removal, would be the most cost effective approach for improving aquatic life in local waterways.

    Response:
    As we are only in the water characterization stage, Illinois EPA has not done a source analysis. The stage 3 modeling will look at the permitted facilities and see if reductions need to be made by nonpoint and/or point sources. The TMDL Implementation Plan will be utilizing the biological study that was developed for this watershed and habitat improvement BMPs (best management practices) will be discussed.

31. Copper was identified as a municipal point source impairment for Spring Brook. We must ask that this be removed. Effluent sampling from the municipal point source that discharges to it does not show impairment. Please note that the January 4, 2006 data point was off by a factor of 10. That datum should have been recorded as 0.011 mg/L instead of 0.11 mg/L.

    Response:
    The municipal point source provided data for this assessment and the correction was made for the sampling data for January 4, 2006. According to these data, there was a sample from July 6, 2005 that

exceeded the chronic standard of 0.020 mg/L. According to our copper standard, this exceedance indicates moderate impairment in the stream.

32. Does the regular dissolved oxygen standard apply to all waters or does the enhanced protection standard apply to some of the waters in this watershed?

Response:
Language has been added to the report on waters with enhanced dissolved oxygen protection. Basically DuPage River segments GB-11, GB-16 and West Branch DuPage River segment GBK-02 are waters with enhanced protection for dissolved oxygen. These waters were assessed using the more stringent enhanced protection standard. Segment GB-16 is the only segment that is impaired for dissolved oxygen according to the enhanced protection standard.

Stage 3 Responsiveness Summary

DuPage River/Salt Creek Watershed
Total Maximum Daily Load

The responsiveness summary responds to questions and comments received during the public comment period from April 24, 2019, through May 24, 2019.

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. **The DuPage River\Salt Creek 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 **DuPage River\Salt Creek Watershed** located in northeastern Illinois and is approximately 520 mi2 (332,600 acres). The watershed includes the DuPage River (USGS HUC 0712000408) and Salt Creek (USGS HUC 0712000404) which are within Cook, Kendal, Will, Gundy, and DuPage counties. The DuPage River originates from two branches in the northern most part of the watershed. The West Branch DuPage River and East Branch DuPage River are approximately 35 miles and 25 miles long, respectively. Both branches flow south until they meet around Bolingbrook, creating the main branch of the DuPage River. The DuPage River approximately runs an additional 30 miles before the confluence with the Des Plaines River near the town of Channahon, IL. Spring Brook, another tributary to the DuPage River, flows southwest for approximately 5.5 miles before the confluence with the West Branch DuPage River.

Salt Creek and Addison Creek are 40 miles and 6.5 miles long, respectively, prior to their confluence approximately 3 miles upstream of the Des Plaines River. The Des Plaines River flows southwest, and after its confluence with the DuPage River, joins the Illinois River, a major tributary of the Mississippi River.
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 DuPage River (IL_GB-11), a Fecal Coliform TMDL was developed for DuPage River (IL_GB-11, and ILGB-16), for West Branch DuPage River (IL_GBK-05, IL_GBK-09, and IL_GBK-14), for Spring Brook (IL_GBKA, and IL_GBKA-01), for East

Branch DuPage River (IL_GBL-10), for Salt Creek (IL_GL-09, IL_GL-10, and IL_GL-19), and for Addison Creek (IL_GLA-02).

These waterbodies are listed as impaired per the 2008 -2018 Draft Illinois Integrated Water Quality Reports and Section 303(d) List.

Illinois EPA contracted with TetraTech (a TMDL Consultant) to prepare the TMDL report for the DuPage River\Salt Creek Watershed project.

Public Meetings

A stage one public meeting was held in Elmhurst, IL on January 28, 2009. The Illinois EPA provided public notices for all meetings by placing an ad in the local newspapers in the watershed; the Chicago Daily Herald, The Will-South DuPage Report and the Central Cook Suburban. These notices gave the date, time, location, and purpose of the meetings. It also provided references to obtain additional information about this specific site, the TMDL Program and other related issues. Individuals and organizations were also sent the public notice by first class mail. An additional stakeholder meeting was held March 31, 2009 in Plainfield, IL. The draft TMDL Report was available for review at the Elmhurst City Hall and on the Agency's web page at: https://www2.illinois.gov/epa/topics/water-quality/watershed-management/tmdls/Pages/reports.aspx#dupsalt.

The draft Stage 3 public meeting was held on April 24, 2019, at 9:30 am, at the Village Hall in the Village of Lombard, IL. Approximately 63 people participated in the public meeting and the public comment period ended at midnight on May 24, 2019.

Illinois EPA provided public notice for all meetings by placing a display-ad in the Lombardian (the local newspaper in the Village of Lombard). In addition, a direct mailing was sent to DuPage River Salt Creek Workgroup (DRSCW), NPDES Permittees, and 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 The Conservation Foundation, DuPage County Stormwater Management, Village of Lombard, Village of Plainfield, and electronically on the Agency's webpage: www2.illinois.gov/epa/public-notices/Pages/general-notices.aspx.

Questions & Comments

1. Page 35, Figure 15: The placement of the District's monitoring station WW_89 (Walnut Lane on West Branch DuPage River) is incorrect. WW_89 should be located in the upper part of river segment GBK-09. The GPS coordinates for WW_89 are N 41° 59' 45.02", W-88° 08' 10.87".

   Response: Station WW_89 has been relocated as specified.

2. Page 37, Figure 17: The placement of the District's monitoring station WW _18 (Devon Avenue on Salt Creek) is incorrect. WW_18 should be located in the lower part of river segment GL-10. The District's monitoring station WW_79 (Higgins Road on Salt Creek) is not depicted on the map figure. WW_79 is located in the lower part of river segment GL. The GPS coordinates for WW_18 are N 41 ° 59' 34.27", W -87° 59' 42.99". The GPS coordinates for WW _79 are N 42° 01' 53.70", W -88° 00' 40.40".

   Response: Station WW_18 relocated as specified and station WW_79 added to Figure 17.

3. Page 38, Table 13: Segment GL-10 lists station WW_79, which is incorrect. WW _79 is actually in river segment GL. The summary statistics provided for segment GL-10 should be redone, excluding the data for station WW_79, in order to more accurately assess the FC impairment for that river segment.

   Response: Fecal coliform data collected at station WW_79 removed from summary statistics as specified. WW_79 data also removed from the fecal coliform TMDL for GL-10 and the load duration curve (Figure 45) and TMDL summary tables (Table 55 and 56) have been updated; including the load reductions presented in Table 55 and Table 63.

4. Page 40, Figure 20: Time series data points are provided for river segments GL and GL-10. This figure should be double-checked to be sure that data from station WW_79 is not incorrectly being attributed to segment GL-10.

   Response: Time series data points reviewed for segments GL and GL-10. No changes needed, data were collected at WW_79 beginning in 2008, which is not included on the figure in question.

5. Page 48, Section 5.3: The District's Westchester Pump Station is not listed or identified in Figure 31 as an existing NPDES permit discharge to Addison Creek.

   Response: This discharge has been added throughout the document. Figures, tables and text in Section 5.3, Section 6.3.1, Section 7.11, Section 7.12 and Appendix E have been updated.

6. Page 155: The first paragraph makes an incorrect reference to the East Branch DuPage River in the first sentence and should actually be referencing the West Branch DuPage River.

   Response: Text updated in report as noted.

Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago
100 EAST ERIE STREET CHICAGO, ILLINOIS 60611-3154 312.751.5600

John P. Murray, P.E.
Director of Maintenance and Operations
312.751.5101 f: 312.751.5145
john.murray@mwrd.org

May 22, 2019

Mr. Abel Haile
Manager, Planning (TMDL) Unit
Watershed Management Section, Bureau of Water
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

Dear Mr. Haile:

Subject: DuPage River/Salt Creek Watershed TMDL Draft Stage 3 Report

The Metropolitan Water Reclamation District of Greater Chicago (District) acknowledges receipt of the notification of TMDL Development and Potential NPDES Implications dated March 26, 2019. The District has reviewed the subject document and offers the following comments:

- Page 35, Figure 15: The placement of the District's monitoring station WW_89 (Walnut Lane on West Branch DuPage River) is incorrect. WW_89 should be located in the upper part of river segment GBK-09. The GPS coordinates for WW_89 are N 41° 59' 45.02", W -88° 08' 10.87".

- Page 37, Figure 17: The placement of the District's monitoring station WW_18 (Devon Avenue on Salt Creek) is incorrect. WW_18 should be located in the lower part of river segment GL-10. The District's monitoring station WW_79 (Higgins Road on Salt Creek) is not depicted on the map figure. WW_79 is located in the lower part of river segment GL. The GPS coordinates for WW_18 are N 41° 59' 34.27", W -87° 59' 42.99". The GPS coordinates for WW_79 are N 42° 01' 53.70", W -88° 00' 40.40".

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- Page 155: The first paragraph makes an incorrect reference to the East Branch DuPage River in the first sentence, and should actually be referencing the West Branch DuPage River.

If you have any questions, please contact Ms. Fay Costa of my staff at 312.751.6553.

Very truly yours,

John P. Murray

EJS FC
EJS:FC
c: Morakalis/Podczerwinski/O'Connor/Serafino

Appendix E

QUAL2K Model Reports

DuPage River (Segment GB-16) QUAL2K Model, Illinois

April 7, 2017

PREPARED FOR

Illinois EPA
1021 North Grand Avenue East
PO Box 19276
Springfield, IL 62794

PREPARED BY

Tetra Tech
One Park Drive, Suite 200
PO Box 14409
Research Triangle Park, NC 27709

Pictured: DuPage River (Lower DuPage River Watershed Coalition)

TETRA TECH

1.0 INTRODUCTION

The DuPage River is located within the Chicago metropolitan area south of Naperville. The DuPage flows south to join the Des Plaines River which becomes the Illinois River at the confluence, flowing south to the Mississippi River. River segment GB-16 of the DuPage River is impaired for low dissolved oxygen (DO) concentrations, and extends approximately 10 miles (16 kilometers) downstream from the confluence of the East and West Branches of the DuPage River (Figure 1). The water quality standard for DO varies throughout the year, with a minimum concentration requirement of 5.0 mg/l from March to July, and 4.0 mg/l from August to February according to the Illinois Environmental Protection Agency.

QUAL2K is a one-dimensional steady-state river water quality model frequently used for simulating DO (Chapra et al., 2012). QUAL2K assumed a well-mixed stream channel (both vertically and laterally), and employs a diel, or 24-hour period, heat budget which can be used to model DO on an hourly basis. A QUAL2K model was developed and calibrated to DO data for the DuPage River segment GB-16 which was observed in early August, 2006. The model was setup and calibrated based on data availability for 8/1/2006. Model parameterization and assumptions were based on a combination of observed flow and water quality data as well as best professional judgement.

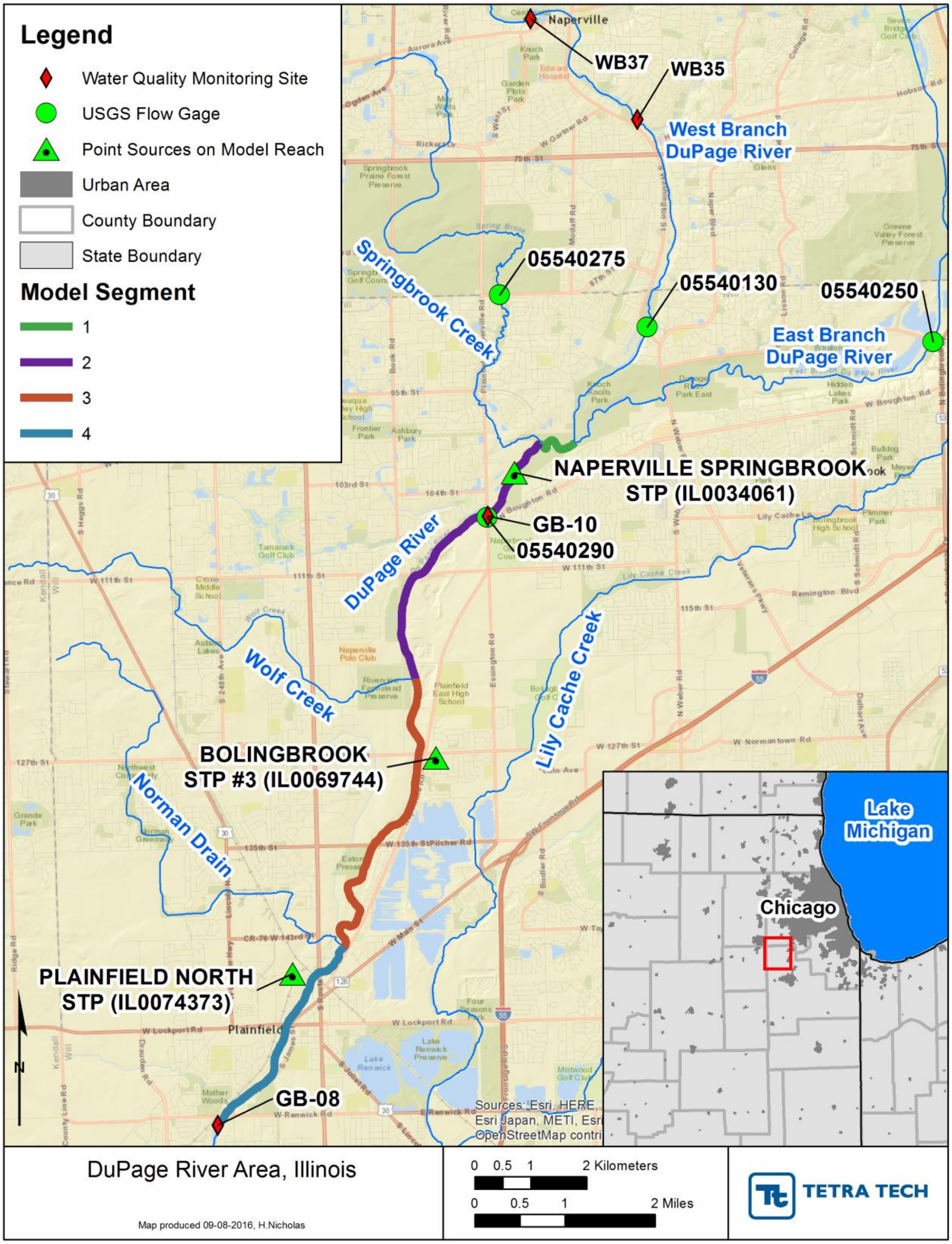

Figure 1. GB-16 of the DuPage River in the Chicago, Illinois area

2.0 QUAL2K MODEL SETUP

2.1 MODEL DATE SELECTION

The selection of the date on which to setup, run, and calibrate the DuPage River QUAL2K model was driven by data availability. Water quality grab samples have been conducted by Illinois EPA at sites GB-10, GB-10, WB35, and WB37 in the model vicinity. There is also USGS flow data available at sites 05540290, 05540275, 05540130, 05540250 which were used to parameterize the reach hydraulics. The key data that was used to identify the calibration date for the model was based on the only continuous dissolved oxygen sampling data available, which was at site GB-08 from 7/24/2006 – 8/2/2006 on 30-minute sampling intervals. Based on the data availability of continuous DO data, the model was setup and calibrated for 8/1/2006.

2.2 MODEL SEGMENTATION AND REACH INPUTS

The DuPage River segment of-interest was subdivided into four model reaches. All model reaches were assigned identical hydraulic properties due to a lack of field-specific data to suggest otherwise. The river was segmented at each major tributary inflow, and elevation data were assigned using a 3-meter digital elevation model (DEM) obtained from USDA Data Gateway. Each model reach is further broken down in the model elements. Table 1 and Figure 1 summarize the reach segmentation for GB-16.

Table 1. Reach segmentation for GB-16 QUAL2K model

Reach	Description	Reach Length (km)	Number of 0.1-km Elements	Upstream Elevation (m)	Downstream Elevation (m)
1	West and East Branch DuPage River confluence to Spring Brook	0.85	9	190.73	189.93
2	Spring Brook to Wolf Creek	5.35	54	189.93	185.37
3	Wolf Creek to Norman Ditch	5.78	58	185.37	181.71
4	Norman Ditch to GB-08 sample site	4.10	41	181.71	178.88

Stream hydraulics were simulated using the rating curve method within QUAL2K, and were identical for all model reaches. QUAL2K employs power equations to relate mean velocity (*U*) and depth (*H*) to flow for the elements in a reach: $U = aQ^b$ and $H = \propto Q^{\beta}$, such that *a*, *b*, ∝, and β are empirical coefficients determined from velocity-discharge and stage-discharge rating curves. USGS provides a rating curve for its gage 05540290 (DuPage River near Plainfield, Illinois) which is located along the DuPage River segment of-interest. The relationship between gage height, stream discharge, and USGS field measurements of depth and velocity at this location were used to determine the model inputs as follows: 0.2506 for *a*, 0.3449 for *b*, 0.1237 for ∝, and 0.4322 for β.

Inputs related to bottom algae coverage and prescribed reaeration rates drive diurnal DO cycling within the system, so those parameters were developed during the model calibration process (Table 2). In-stream DO concentrations are very sensitive to sediment oxygen demand (SOD), for which the prescribed bottom coverage percentage and rate work in tandem to approximate. SOD monitoring was conducted along the West Branch and mainstem DuPage River during the Illinois EPA Stage 2 TMDL process in 2009. SOD was measured by CDM at the DuPage River at Naperville 100 yards upstream of the WWTP discharge (as well as upstream locations along the West Branch) and the observed temperature-corrected SOD rate at this location was 5.58 $g/m^2/d$. This observed SOD rate was used in the model for the entire segment, although the percent SOD coverage was estimated through the calibration process. SOD rates along the West Branch ranged from 2.04 to 4.88 $g/m^2/d$. SOD rates have been reported from 0.56 to 8.08 $g/m^2/d$ in northeastern Illinois (Butts, 1974). The sediment diagenesis model computes SOD and nutrient fluxes in-stream in addition to the prescribed SOD rate and coverage observed under existing conditions.

The bottom algae coverage was estimated through the calibration process as well, but was based in part on anecdotal evidence from the 2012 Biological and Water Quality Study of the Lower DuPage River Watershed report conducted by the Midwest Biodiversity Institute. This bioassessment report for the DuPage River details the “lush macrophyte growth” along this section of the DuPage River, as well as “pooled or sluggish” nature of flow in this extent, which was used to inform the reaeration rate of 0.95 /d.

Table 2. Reach rate inputs

Parameter	Input
Prescribed Reaeration (/d)	0.95
Bottom Algae Coverage	90%
Bottom SOD Coverage	15%
Prescribed SOD ($g/m^2/d$)	5.58
Bottom Algae Max Growth Rate (/d)	1.30
Bottom Algae Respiration Rate (/d)	0.30
Bottom Algae Excretion Rate (/d)	0.001
Bottom Algae Death Rate (/d)	0.10
Bottom Algae Growth Model	First-order
Bottom Algae Carrying Capacity (mgA/m^2)	150

2.3 METEOROLOGICAL INPUTS

Metrological inputs to the QUAL2K model are air temperature, dew point temperature, wind, cloud cover, and shade. In order to represent generic summer conservative conditions, the GB-16 model was set up to assume clear skies (0% cloud cover for all reaches at all hours, also suggested by local meteorological data) and full sun (0% shade for all reaches at all hours, which is bolstered by an analysis of aerial imagery and local observation). Hourly inputs for air and dew point temperatures and wind speed were applied to all reaches based on observed data on 8/1/2006 at nearby West Chicago DuPage Airport (NOAA WBAN 94892). Average conditions that day were 30.3°C air temperature, 24.4°C dew point, and wind speed 11 mph.

2.4 HEADWATER INPUTS AND INITIAL CONDITIONS

The headwater reaches for this model are the West and East Branches of the DuPage River. Because there is not sufficient observed data to parameterize these headwater reaches uniquely, they were modeled as a single headwater inflow. Observed flow on 8/1/2006 at USGS gages on either branch (05540130 West Branch DuPage River near Naperville, IL and 05540250 East Branch DuPage River at Bolingbrook, IL) were combined for a single model input (Table 3). Water quality input parameters for the headwaters were based on limited observed water quality data at two sampling sites along the West Branch DuPage River (WB35 and WB37) which were sampled by the DuPage River Salt Creek Workgroup (DRWCW), as well as observations of water quality conditions immediately downstream of the confluence as measured by the 2012 bioassessment report, and conditions at water quality site GB-10. The East and West Branches of the DuPage River are described in the bioassessment report as being largely effluent-dominated streams, which is why nutrient levels such as nitrate are considerably high compared to streams which are not effluent-dominated. The bioassessment report found that, for example, effluent composed 76% of total flow in the East Branch DuPage River in September 2007.

Within the model, the downstream extent was not a prescribed boundary.

Table 3. Headwater inputs

Parameter	Model Input
Flow Rate (m^3/s)	1.926
Elevation (m)	191.00
Hydraulic Formula	Rating Curve
Water Temperature (°C)	29.0
Conductivity (µmhos)	936
Inorganic Solids (mgD/L)	8.6
Dissolved Oxygen (mg/L)	8.0
CBODslow (mgO_2/L)	1.0
CBODfast (mgO_2/L)	1.0
Organic Nitrogen (µgN/L)	600.0
NH4-Nitrogen (µgN/L)	95.0
NO3-Nitrogen (µgN/L	6000.0
Organic Phosphorus (µgP/L)	100.3
Inorganic Phosphorus (µgP/L)	1124.8
Alkalinity (mg/L)	232.0
Phytoplankton (mgA/L)	4.82
pH	8.15

2.5 POINT SOURCE INPUTS

Point sources explicitly modeled includes three tributaries: Spring Brook, Wolf Creek, and Norman Ditch, as well three NPDES-permitted municipal wastewater treatment facilities which discharge directly into the modeled reach: Naperville Springbrook STP (IL0034061), Bolingbrook STP #3 (IL0069744), and Plainfield North STP (IL0074373) (Table 4). There are numerous other point sources located upstream of the impaired reach, but the combined impact of these other point sources was estimated based on the assumed headwater water quality conditions. Permitted point source water quality inputs were based on reported monthly averages for August 2006 based on discharge monitoring records (DMRs), and an assumed total phosphorus (TP) concentration of 4000 µg/L and phosphorus speciation (organic and inorganic phosphorus) based on municipal wastewater generalizations. These WWTPs currently have TP limits of 1000 µg/L which were not in place during 2006. Reported 5-day carbonaceous biochemical oxygen demand ($CBOD_5$) concentrations were multiplied by two which is considered the accepted relationship between measured $CBOD_5$ and QUAL2K “Fast $CBOD_{ultimate}$” concentration. For reference, the monitored monthly average $CBOD_5$ concentrations for Naperville, Bolingbrook, and Plainfield WWTPs were 1, 3, and 3.3 mg/L respectively, therefore the model inputs for fast $CBOD_{ultimate}$ were 2, 6, and 6.6 mg/L for these constituents. The Illinois Environmental Protection Agency provides data from permitted point sources via the Discharge Monitoring Report (DMR) system, which are summarized in Table 5, Table 6, and Table 7.

Point source model inputs for tributaries were developed using limited observed data. Observed flows were available from the USGS gage 05540275 on Spring Brook, which were used to estimate area-weighted flows for both Wolf Creek and Norman Ditch. Water quality sampling was available from the same USGS gage on 8/2/2006 (day after the calibration date) for parameters such as water temperature, dissolved oxygen, and conductivity. Tributary nutrient concentrations were populated using a combination of Spring Brook USGS concentrations as well as available monitoring from the bioassessment report. There were no diffuse sources included in the QUAL2K model.

Table 4. Point source inputs

Parameter	Spring Brook	Wolf Creek	Norman Ditch	IL0034061 (Naperville STP)	IL0069744 (Bolingbrook STP #3)	IL0074373 (Plainfield North STP)
Location (km)	15.25	9.89	4.10	14.51	8.39	2.93
Inflow (m^3/s)	0.0907	0.0438	0.0591	0.8706	0.0784	0.1257
Water Temperature (°C)	29.0	29.0	29.0	29.0	29.0	29.0
Specific Conductance (µmhos)	950	850	850	n/a	n/a	n/a
Dissolved Oxygen (mg/L)	9.1	9.1	9.1	6.1	6.1	6.1
Slow CBOD (mg/L)	1.0	1.0	1.0	0.0	0.0	0.0
Fast CBOD (mg/L)	0.0	0.0	0.0	2.0	6.0	6.6

Parameter	Spring Brook	Wolf Creek	Norman Ditch	IL0034061 (Naperville STP)	IL0069744 (Bolingbrook STP #3)	IL0074373 (Plainfield North STP)
Inorganic Suspended Solids (mg/L)	4.8	8.6	8.6	1.0	4.0	14.4
Ammonia Nitrogen (µgN/L)	50	100	100	100	110	490
Organic Nitrogen (µgN/L)	340	390	390	500	500	500
Nitrate+ Nitrite Nitrogen (µgN/L)	210	470	470	15,000	15,000	15,000
Organic Phosphorus (µgP/L)	7	9	9	1,108	1,108	1,108
Inorganic Phosphorus (µgP/L)	49	101	101	2,892	2,892	2,892

Table 5. IL0034061 Naperville STP data summary (DMR data 2006-2015), units all mg/l

Parameter	Statistic	Maximum	Minimum	Average
$CBOD_5$	Daily Maximum	20.00	1.00	3.95
	Monthly Average	5.00	1.00	2.00
DO	Daily Minimum	9.00	5.10	7.04
	Minimum Weekly Average	8.80	5.50	7.13
	Monthly Average Minimum	9.60	5.90	7.42
Flow	Daily Maximum	65.66	17.39	31.65
	Monthly Average	30.74	14.34	21.16
NH_3	Daily Maximum	3.50	0.10	0.65
	Monthly Average	0.90	0.10	0.26
	Weekly Average	0.30	0.10	0.20
TN	Daily Maximum	28.40	11.50	18.11
TP	Daily Maximum	5.00	1.50	2.86
TSS	Daily Maximum	68.00	2.00	7.01
	Monthly Average	10.00	1.00	2.78

Table 6. IL0069744 Bolingbrook STP #3 data summary (DMR data 2006-2015), units all mg/l

Parameter	Statistic	Maximum	Minimum	Average
$CBOD_5$	Monthly Average	12.00	1.00	2.48
	Weekly Average	39.50	1.00	3.71
FLOW	Daily Maximum	9.60	2.00	4.69
	Monthly Average	4.51	1.31	2.74
NH_3	Daily Maximum	13.00	0.03	0.99
	Monthly Average	2.65	0.03	0.22
TN	Daily Maximum	29.00	2.20	10.70
DO	Daily Minimum	7.90	5.60	6.40
	Minimum Weekly Average	8.50	6.28	7.20
	Monthly Average Minimum	8.60	6.00	7.27
TP	Monthly Average	25.50	0.80	7.69
TSS	Monthly Average	41.00	1.00	4.21
	Weekly Average	109.00	1.00	7.96

Table 7. IL0074372 Plainfield North STP data summary (DMR data 2006-2015), units all mg/l

Parameter	Statistic	Maximum	Minimum	Average
$CBOD_5$	Monthly Average	14.50	1.74	4.41
	Weekly Average	40.90	2.00	5.97
DO	Daily Minimum	9.40	4.77	6.79
	Minimum Weekly Average	8.67	5.13	6.86
	Monthly Average Minimum	9.00	6.05	7.33
Flow	Daily Maximum	12.55	2.96	5.90
	Monthly Average	6.07	2.52	3.67
NH_3	Daily Maximum	11.00	0.08	1.38
	Monthly Average	1.98	0.03	0.39
TN	Daily Maximum	17.20	1.87	11.03
TP	Monthly Average	1.60	0.42	0.75
TSS	Monthly Average	44.70	1.80	12.20
	Weekly Average	60.60	2.50	17.58

3.0 QUAL2K MODEL RESULTS

Based on the model setup detailed above, the QUAL2K model was built for the Lower DuPage River segment GB-16. The model was calibrated to DO concentrations measured every half-hour at the downstream end of the segment (site GB-08 in Figure 1; Model Element 41 of Reach 4) on the calibration date of 8/1/2006. Key calibration parameters included parameters for which the assumed initial conditions and rates had the most uncertainty. For example, there was little data to inform the water temperature within the model, as well as bottom algae and SOD percent coverages. Some of these parameters will be discussed further in sensitivity analysis results in Section 4.0.

3.1 MODEL RESULTS

A reasonable fit between the observed DO data and the QUAL2K simulated DO concentrations was achieved based on the aforementioned setup. The observed DO minimum, maximum, average, and median were achieved in the model results quite well, which suggests that the model adequately approximates the system based on the available data (Table 8, Figure 2). The DO results are compared to the water quality standard of 4.0 mg/l which applies from August – February.

The relative locations of point source inputs can be seen along the longitudinal plot of DO concentrations modeled along the full extent (Figure 3). DO concentrations dip on a scale relative to flow at the input of each point source due to increased nutrient concentrations and decreased DO concentrations. In general there is a slight increase in DO occurring along the reach length due to the presence and growth of bottom algae within the stream. The wide range of minimum and maximum DO concentrations seen in Figure 3 are indicative of the observed diel swing in DO concentrations over the course of 24 hours, as depicted in Figure 2.

Table 8. Model and observed dissolved oxygen concentrations, Reach 4 Element 41

Statistic	Observed DO	Modeled DO	Percent Error
Minimum	3.86	3.86	-0.11%
Maximum	13.70	13.61	-0.67%
Average	8.37	8.23	-1.64%
Median	7.83	7.82	-0.12%

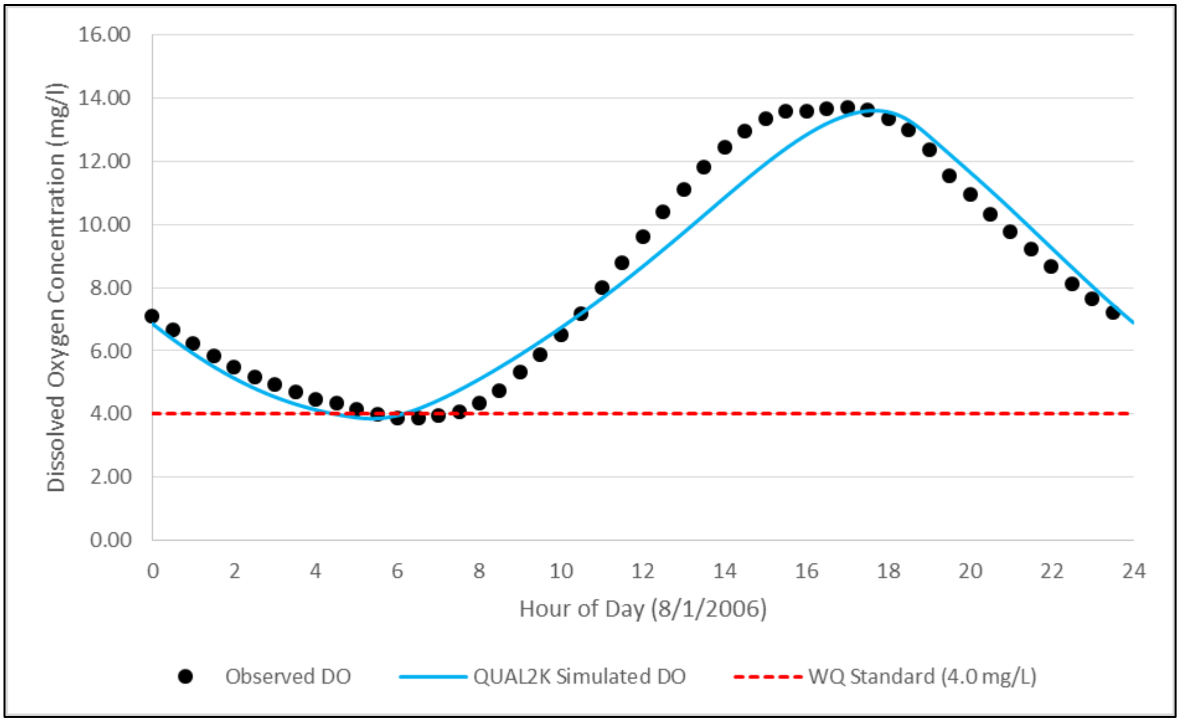

Figure 2. Observed and modeled diel dissolved oxygen concentration results, Reach 4 Element 41

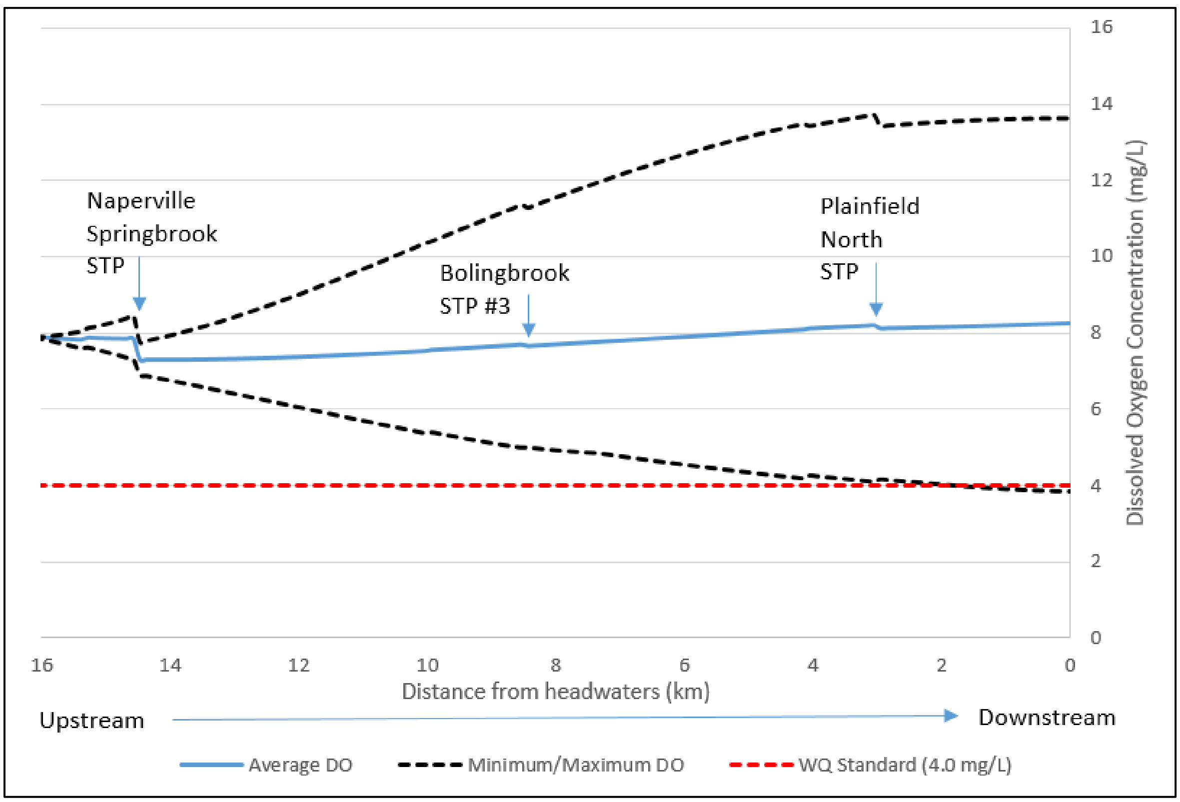

Figure 3. Modeled average, minimum, and maximum dissolved oxygen concentrations along the entire model extent

4.0 MODEL SENSITIVITY AND SCENARIOS

4.1 MODEL SENSITIVITY

A number of sensitivity analyses were conducted to see how to model would respond to changes in certain initial conditions, rates, and inputs. Sensitivity analyses included the following, as well as their relative impact on the calibrated diel DO at reach 4, element 41 (Table 9, Figure 4). Diel DO cycling is most impacted by bottom algae and sediment oxygen demand parameters based on this sensitivity analysis.

Table 9. Sensitivity analyses descriptions and results

Run	Sensitivity Run Description	Impact
1	Decrease headwater total phosphorus to zero	Small decrease in average, minimum, and maximum DO (min DO 3.82 mg/L) due to less in-stream photosynthesis in response to less in-stream nutrient availability.
2	Decrease headwater temperature by 2 degrees C	Small decrease in average and maximum DO, small increase in DO minimum (min DO 3.96 mg/L). The decline in average DO and paired increase/decrease in min/max DO is due to the lower temperature resulting in slightly less bottom algae proliferation in the system which impacts the diurnal range of DO.
3	Increase headwater DO by 2 mg/L	Increase in average, maximum, and minimum DO (min DO 4.39 mg/L).
4	SOD coverage doubled to 30%	Large decrease in average, maximum, and minimum DO (min DO 2.35 mg/L).
5	SOD rate decreased by half	Large increase in average, maximum, and minimum DO (min DO 4.62 mg/L).
6	Decrease bottom algae coverage by half	Increase in minimum DO, and large decrease in average and maximum DO due to a decrease in diel amplitude (min DO 4.85 mg/L). When algae is removed from the system there is a dampening of the diurnal DO fluctuation so both maximum and minimum DO are closer to the mean, which also decreases due to the decrease in in-stream photosynthesis.

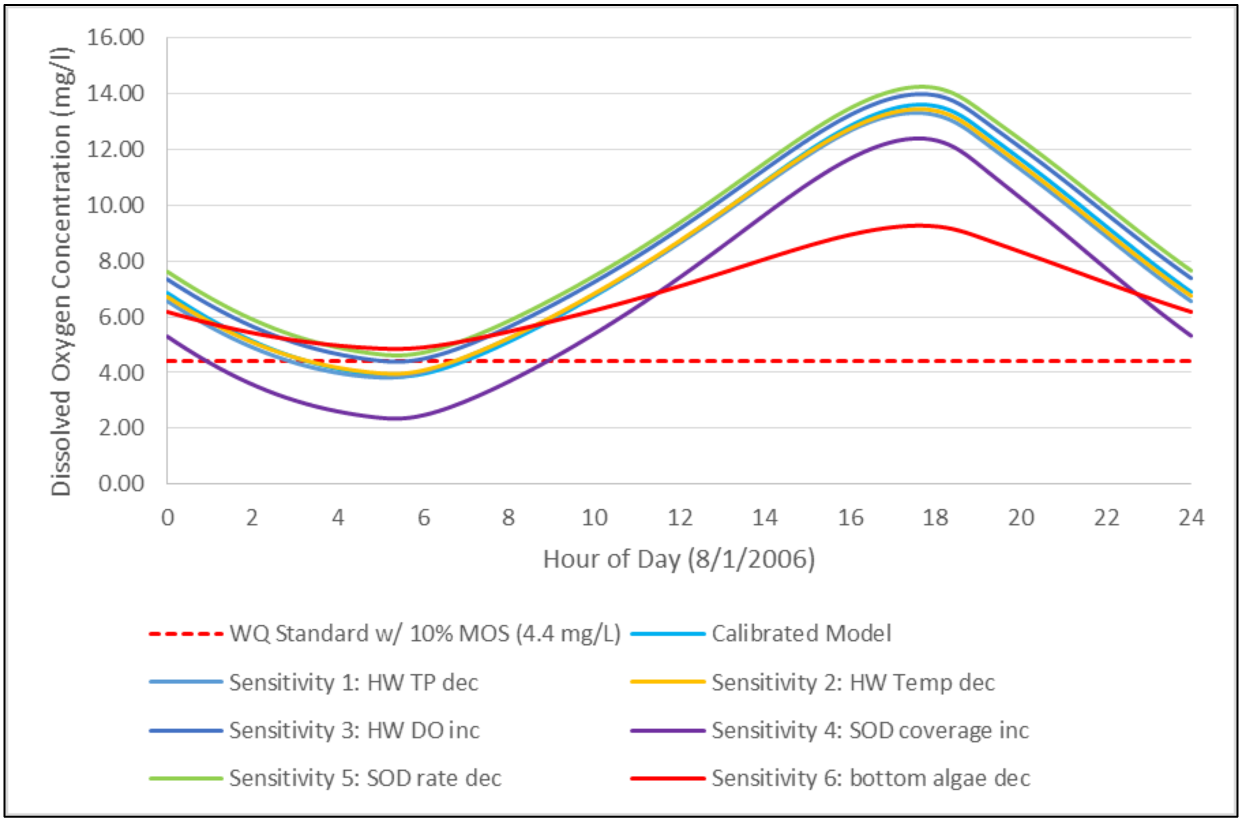

Figure 4. Model sensitivity of diel DO to various parameter changes

4.2 MODEL SCENARIOS

Various model scenarios (Table 11) were considered in order to estimate the impact of critical conditions along the Lower DuPage River (GB-16) in regards to stream conditions and point source discharges. By creating a condition at which point sources are discharging their respective allowable effluent flows and concentrations, scenarios will be used to estimate in-stream DO compared to the DO standard. For these scenarios, an explicit margin of safety was added by increasing the minimum DO concentration by 10%, resulting in a minimum DO concentration target of 4.4 mg/L.

Under the calibrated model conditions, the observed minimum DO on 8/1/2006 was 3.86 mg/L, which is below the water quality standard of 4.0 mg/L. A critical condition scenario was developed for which the three permitted point sources were modeled at their monthly average permit limits (Table 10). Under these conditions, headwater flows were decreased to the seven-day ten-year (7Q10) low flow condition of 1.699 cms (Illinois State Water Survey, 2003), while flows at the three point sources were increased to 1.31 cms, 0.18 cms, and 0.33 cms, respectively for Naperville STP, Bolingbrook STP, and Plainfield STP (Table 10). Under existing conditions, minimum DO concentrations were below 4.0 mg/L; increasing WWTP effluent flows and nutrient concentrations to permit limits exacerbated the condition, resulting in a large decrease in DO throughout the system (Scenario 1).

Table 10. NPDES point source permit monthly average concentration limits

Parameter	Naperville WWTP (IL0034061)	Bolingbrook WWTP (IL0069744)	Plainfield WWTP (IL0074373)
Design Average Flow, cms (MGD)	1.31 (30.0)	0.18 (4.2)	0.33 (7.5)
Suspended solids (mg/L)	12	25	25
$CBOD_5$ (mg/L)[1]	10	20	20
Ammonia (µg/L)	1400	1500	1500
Total Phosphorus (mg/L) [2]	1	1	1
DO (mg/L)	6.0	6.0	6.0

[1]These values are the existing permit limits; recall, as detailed in Section 2.5, that a concentration of $CBOD_5$ is multiplied by two for the model input of fast $CBOD_{ultimate}$ as per model input requirements.
[2]Original permits allowed maximum discharge of 4.0 mg/L TP, but the facilities are currently being updated to account for a new 1.0 mg/L TP effluent limit. TP concentration is split for model input as and assumed 72.3% dissolved phosphorus, and 27.7% organic phosphorus.

Scenario 2 and 3 include the same permitted conditions as Scenario 1, although certain modifications were made to meet the water quality standard with the margin of safety. Both Scenarios 2 and 3 include decreasing in-stream prescribed SOD to 2.04 g/m^2/d which was the lowest observed SOD along the West Branch DuPage River, increased point source DO to 6.5 mg/L which can be attained through aeration, headwater TP decreased to 1 mg/L, and decreased Bolingbrook and Plainfield $CBOD_5$ concentrations to the same limit as Naperville WWTP (inputs detailed in Table 11). The key differences between Scenarios 2 and 3 are the ways in which the WQS is achieved, either by decreasing the Naperville WWTP $CBOD_5$ to 7.5 mg/L with an in-stream SOD coverage of 7.5% (Scenario 2), or by maintaining existing $CBOD_5$ limits and decreasing SOD coverage to 5% (Scenario 3). The results of these scenarios as compared to the calibrated model are seen in Figure 5.

Table 11. Model scenarios

Scenario	Scenario Description
1	Critical conditions: • Headwater flow decreased to 1.699 cms • Headwater DO decreased to 6 mg/L • Point source flows and water quality changed to details in Table 10
2	Scenario 1 with the following modifications to meet WQS with MOS: • SOD rate reduced to 2.04 g/m^2/d • Point source minimum DO increased to 6.5 mg/L • Bolingbrook and Plainfield WWTPs $CBOD_5$ decreased to 10 mg/L • Headwater TP decreased to 1 mg/L • *Naperville WWTP* $CBOD_5$ *decreased to 7.5 mg/L* • *SOD coverage decreased by half to 7.5%*
3	Scenario 1 with the following modifications to meet WQS with MOS: • SOD rate to 2.04 g/m^2/d • Point Source DO minimum increased to 6.5 mg/L • Bolingbrook and Plainfield WWTPs $CBOD_5$ decreased to 10 mg/L

Scenario	Scenario Description
	• Headwater TP decreased to 1 mg/L • *Naperville WWTP $CBOD_5$ unchanged* • *SOD coverage decreased to 5.0%*

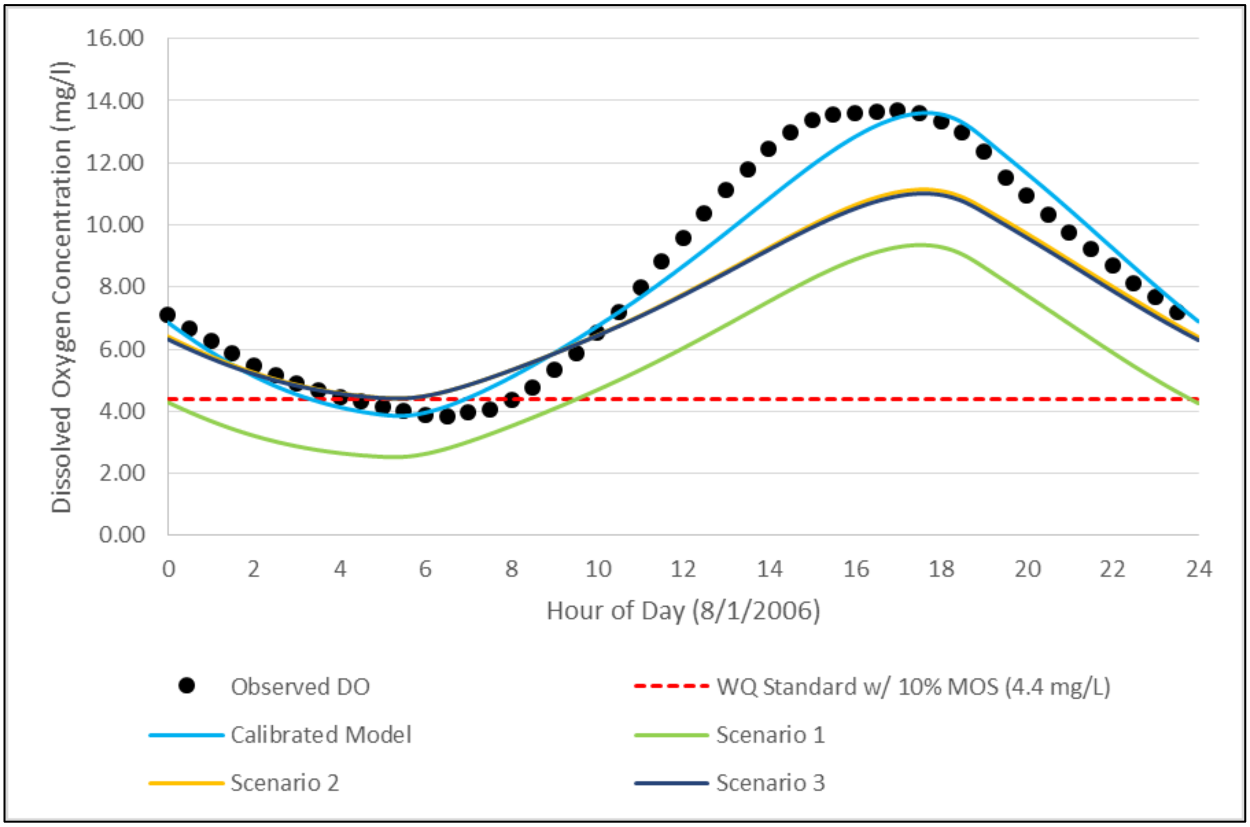

Figure 5. Model scenarios diel DO compared to observed data and calibrated model

In the calibrated model, SOD is prescribed at a baseline of 5.58 $g/m^2/d$ due to upstream conditions (this rate has been observed). In Scenario 1, the in-stream SOD increases dramatically longitudinally due to the point source inputs to a downstream average condition of approximately 9.35 $g/m^2/d$. The average in-stream SOD downstream of point source influence in Scenarios 2 and 3 are 4.60 and 5.62 $g/m^2/d$ respectively due to differing in-stream prescribed SOD conditions and effluent characteristics.

4.3 TMDL ALLOCATIONS

Two TMDL scenarios (Scenario 2 and 3) are used to demonstrate allocations that meet the loading capacity in the stream based on critical conditions during which the DO standard is met with a 10% margin of safety (Table 12). Point source reductions are needed to meet the minimum DO concentration. Since there are different pollutant combinations that can result in the same in-stream DO condition, point source facilities can consider the different options as part of TMDL implementation.

An example load calculation from Scenario 2 of Total Phosphorus for the Naperville STP point source is provided below:

$$Load = Flow \times Concentration$$

$$Naperville\ STP\ flow: 1.31\ cms$$

$$Naperville\ STP\ total\ phosphorus: 1.0\ mg/l$$

$$Naperville\ STP\ TP\ Load = 1.31\frac{m^3}{s} \times 1.0\ \frac{mg}{L} \times unit\ conversion\ \left(\frac{86400\ s}{d} \times \frac{1000\ L}{m^3} \times \frac{1\ lb}{453592\ mg}\right)$$

$$Naperville\ STP\ TP\ Load\ (Scenario\ 2) = 250\ \frac{lbs}{d}$$

Table 12. TMDL load and wasteload allocations (Scenarios 2 and 3)

Location	Total Phosphorus Load (lbs/day)	Total Ammonia Load (lbs/day)	$CBOD_5$ Load (lbs/day)
Scenario 2			
In-Stream at Downstream Boundary	583	372	3169
In-Stream at Headwater Boundary	324	34	486
Point Source: IL0034061 (Naperville STP)	250	349	1872
Point Source: IL0069744 (Bolingbrook STP #3)	34	51	343
Point Source: IL0074373 (Plainfield North STP)	63	94	629
Spring Brook Tributary	1	1	17
Norman Ditch Tributary	1	1	8
Wolf Creek Tributary	1	1	11
Scenario 3			
In-Stream at Downstream Boundary	600	371	3730
In-Stream at Headwater Boundary	324	34	486
Point Source: IL0034061 (Naperville STP)	250	349	2496
Point Source: IL0069744 (Bolingbrook STP #3)	34	51	343
Point Source: IL0074373 (Plainfield North STP)	63	94	629
Spring Brook Tributary	1	1	17
Norman Ditch Tributary	1	1	8
Wolf Creek Tributary	1	1	11

5.0 REFERENCES

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West Branch DuPage River Headwaters (GBK-14) QUAL2K Model

Cook County, Illinois

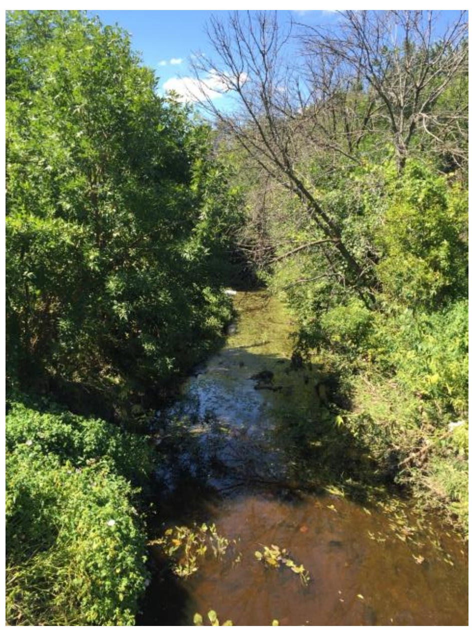
April 7, 2017

PREPARED FOR

Illinois EPA
1021 North Grand Avenue East
PO Box 19276
Springfield, IL 62794

PREPARED BY

Tetra Tech
One Park Drive, Suite 200
PO Box 14409
Research Triangle Park, NC 27709



Pictured: West Branch DuPage River at Springinsguth Road (DuPage River/Salt Creek Work Group)

TETRA TECH

1.0 INTRODUCTION

The West Branch DuPage River originates in the Village of Schaumburg and flows south to join the DuPage River and eventually the Illinois River. The West Branch DuPage River reach of-interest is a headwater reach (GBK-14) which flows from approximately West Schaumburg Road down to the Hanover Park Wastewater Treatment Plant. River segment GBK-14 is 3.83 miles (6.16 kilometers) long, and is impaired for low dissolved oxygen (DO) concentrations (Figure 1). There are limited data available in the area related to water sources, flow, and water quality. The DuPage River Salt Creek Workgroup collected additional data in 2016 to support this modeling effort. The Illinois EPA's water quality standard for DO for this reach varies throughout the year, with a minimum concentration requirement of 5.0 mg/l from March to July and a 4.0 mg/l from August to February. GBK-14 was modeled in an effort to simulate existing in-stream conditions, identify potential causes of impairment, and run scenarios under which water quality standards may be met.

QUAL2K is a one-dimensional steady-state river water quality model frequently used for simulating DO (Chapra et al., 2012). QUAL2K assumes a well-mixed stream channel (both vertically and laterally), and employs a diel, or 24-hour period, heat budget which can be used to model DO on an hourly basis. A QUAL2K model was developed and calibrated for the GBK-14 for based on data availability for 9/3/2016. Model parameterization and assumptions were based on a combination of observed flow and water quality data as well as best professional judgement.

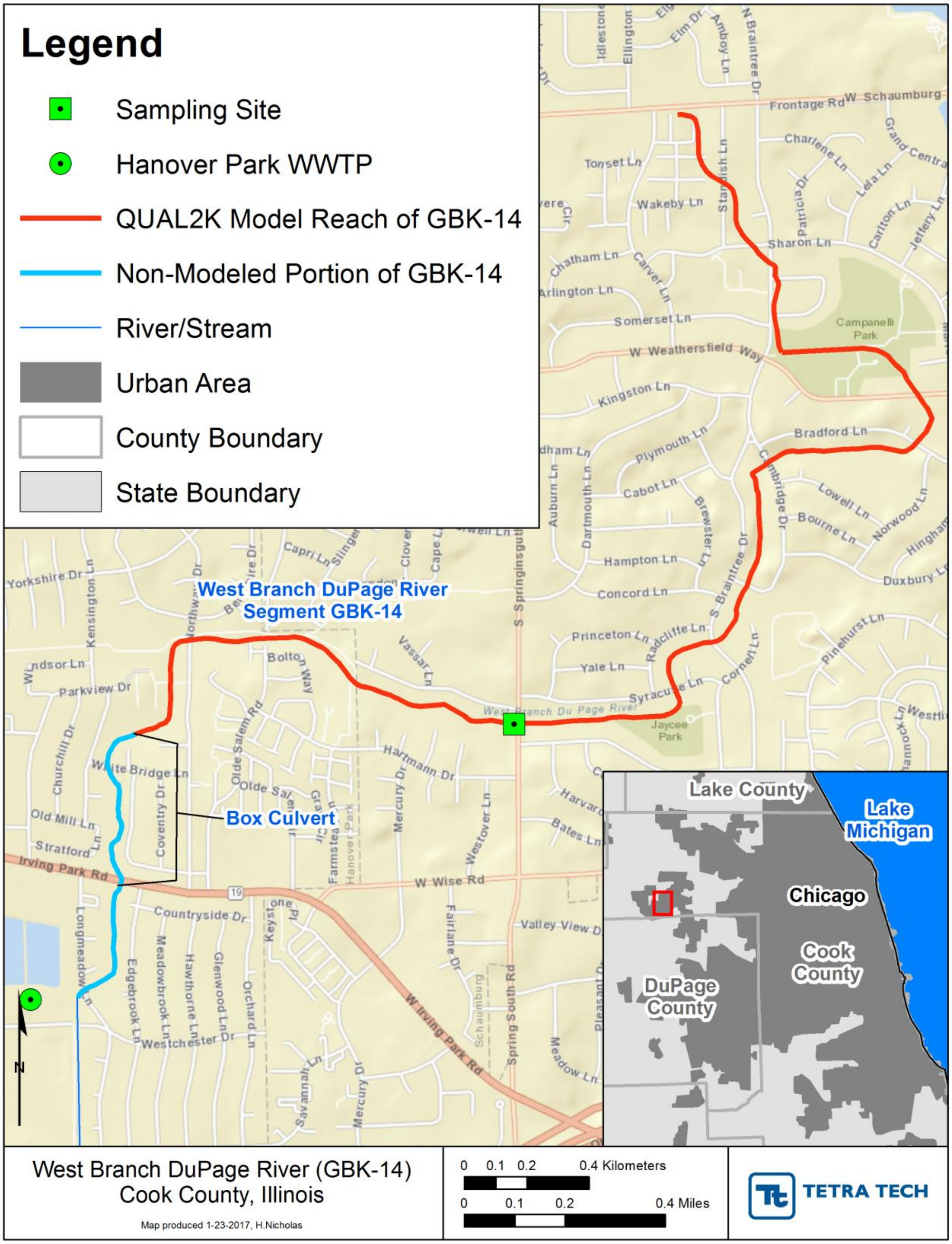


Figure 1. West Branch DuPage (GBK-14) in Cook County, Illinois

2.0 SUMMARY OF AVAILABLE DATA

There are three sources of available water flow and water quality data associated with reach GBK-14:

1. Sediment oxygen demand (SOD) sampling conducted by CDM upstream of the Hanover Park WWTP during the Illinois EPA Stage 2 TMDL process in 2009. Observations at this site found channel bed sediments had an SOD of 1.96-2.11 g/m^2/d, with an average of 2.04 g/m^2/d (CDM, 2009).

2. The DuPage River Salt Creek Workgroup (DRWCW) conducted a sampling effort in September 2016 including the following items at the crossing of Springinsguth Road: channel cross-sectional surveys, velocity measurements, and algae surveys on 9/2/2016 and 9/6/2016, water quality samples on 9/2/2016, 9/6/2016, and 9/7/2016 which were analyzed for a suite of parameters including: DO, CBOD, pH, alkalinity, nutrients, chlorophyll a, and dissolved solids. A continuously-recording data sonde was deployed at the Springinsguth Road location as well that recorded specific conductivity, DO, pH, and water temperature at hourly increments from 9/1/2016 to 9/7/2016.

3. The Metropolitan Water Reclamation District of Greater Chicago (MWRD) collected a single water quality sample on 9/6/2016 at the Springinsguth Road sampling site that was analyzed for a suite of water quality parameters including: DO, CBOD, temperature, pH, alkalinity, nutrients, chlorophyll a, fecal coliform, and a variety of metals, salts, and solids.

These data observations from September 2016 will be used to parameterize and calibrate the QUAL2K model for GBK-14 and are summarized in Appendix A.

3.0 QUAL2K MODEL SETUP

3.1 MODEL SEGMENTATION AND REACH INPUTS

In the QUAL2K model, a river may be segmented into different reaches if those reaches are anticipated to have differences from one another in regards to reach hydraulic properties, atmospheric inputs, or stream shading. While there are some visually apparent variability along GBK-14 in regards to stream shading and channel width, without any calibration data to inform the impacts of these differences on the channel, a single model reach may be used to approximate the average conditions of the entire reach. For this reason, the West Branch DuPage River segment GBK-14 was modeled as a single reach.. The modeled river segment flows from headwaters at W Schaumburg Road down to the entrance of the box culvert north of Irving Park Road. Reach GBK-14 was truncated in the modeling environment at the box culvert entrance because there is not flow or water quality data downstream of that point to inform model development and calibration. It may be possible that the box culvert serves to reaerate the stream due to a change in channel geometry while the stream flows underground at this point, but without data the impacts cannot be known. The model reach was assigned hydraulic properties developed from the single Springinsguth Road survey site and adjusted during calibration to capture the reach characteristics. Elevation data were assigned using a 1-meter LiDAR-derived digital elevation model (DEM) obtained from the Illinois Height Modernization Program. The model reach was segmented into 52 internal 0.1-

kilometer computational elements. Table 1 and Figure 1 summarize the reach segmentation and hydraulic properties for GBK-14.

Table 1. Reach hydraulic properties for GBK-14 QUAL2K model

Model Input	Reach 1
Description	GBK-14 headwaters from W Schaumburg Road to the entrance of the box culvert
Reach Length (km)	5.15
Count of 0.1-km Elements	52
Upstream Elevation (m)	243.34
Downstream Elevation (m)	238.64
Hydraulic Model	Manning Formula
Channel Slope	0.0001
Manning's "n"	0.065
Bottom Width (m)	6.50
Water Depth (m)	0.14
Side Slopes	0 (assumed rectangular channel)

Stream hydraulics were simulated using the Manning Formula. QUAL2K approximates stream flow using the following input parameters for this hydraulic model: channel slope, Manning's "n", bottom width, and channel side slopes. Observations of water depth, velocity, and discharge were taken on 9/2/2016 and 9/6/2016 which were used as bounding data for calibration of reach hydrology. Model inputs for slope, bottom width, and Manning's n were approximated based on the channel surveys, and calibrated to observed hydraulics. Note that a Manning's n of 0.065 reflects slow-moving, very low flow conditions. Low flow conditions are most easily highlighted by the observed average water depths on 9/2/2016 and 9/6/2016 which were 0.51 and 0.21 feet deep (0.16 and 0.06 meters) respectively.

Inputs related to bottom algae coverage and prescribed reaeration rates drive diurnal DO cycling within the system, so those parameters were developed during the model calibration process and bolstered by in-stream water quality sampling and algae observations (Table 2). In-stream DO concentrations are very sensitive to sediment oxygen demand (SOD), for which the prescribed bottom coverage percentage and rate work in tandem to approximate. The observed SOD rate of 2.04 $g/m^2/d$ from the 2009 CDM sampling was used in the model, with a bottom coverage rate determined through calibration to be 44%. The sediment diagenesis model computes SOD and nutrient fluxes in-stream in addition to the prescribed SOD rate and coverage observed under existing conditions. For reference, SOD rates have been reported from 0.56 to 8.08 g/m2/d in northeastern Illinois (Butts, 1974). High SOD values are typically related to effluent-dominated streams in the DuPage area. Because there are no upstream WWTPs discharging to GBK-14, carbonaceous biochemical oxygen demand (CBOD) present in the stream is likely to be "slow CBOD" or refractory, slow-decaying CBOD raster than the labile effluent-associate "fast CBOD".

Note that most other reach rate inputs were estimated and identified based on in-stream calibration efforts (Table 2). All in-stream parameterization related to sediment and nutrient fluxes were modeled conservatively since there is no available information on decay and settling rates along GBK-14. Phytoplankton parameters were held at model defaults.

Table 2. Reach rate inputs for GBK-14 QUAL2K model

Parameter	Input	Note
Prescribed Reaeration (/d)	1.1	Developed during calibration in tandem with SOD coverage to meet observed average DO at Springinsguth Road
Bottom Algae Coverage	50%	Developed during calibration
Bottom SOD Coverage	46%	Developed during calibration in tandem with prescribed reaeration coverage to meet observed average DO at Springinsguth Road
Prescribed SOD ($g/m^2/d$)	2.04	Observed
Slow CBOD Oxidation Rate (/d)	0.04	Developed during calibration
Fast CBOD Oxidation Rate (/d)	0.00	Fast CBOD is associated with effluent discharge; there is no fast CBOD assumed present
Bottom Algae Max Growth Rate (/d)	9.0	Developed during model calibration largely to capture the observed diurnal range in DO concentration due to in-stream photosynthesis and respiration
Bottom Algae Respiration Rate (/d)	1.0	
Bottom Algae Excretion Rate (/d)	0.1	
Bottom Algae Death Rate (/d)	0.1	
Bottom Algae Growth Model	Zero-order	

3.2 LIGHT AND HEAT RATES

For the most part, light and heat parameters were held at model default values. The solar shortwave radiation model chosen was the Ryan-Stolzenbach, with an atmospheric transmission coefficient of 0.70. The atmospheric longwave emissivity model chosen was the Brutsaert model which can be appropriate for calculating air emissivity in warm conditions. Through calibration, the wind speed function for evaporation and air convection/conduction was chosen to be Adams 1 which is used to estimate the impact of wind on air and water temperatures. Some sediment thermal heat properties (sediment thermal diffusivity, sediment density, sediment heat capacity) were increased in order to attain water temperature calibration based on naturally occurring sediment conditions (Lapham, 1989).

3.3 METEOROLOGICAL INPUTS

Metrological inputs to the QUAL2K model are air temperature, dew point temperature, wind, cloud cover, and shade (Table 3). Hourly air and dew point temperatures were obtained for the calibration date of 9/3/2016 from the Chicago O'Hare International Airport (NOAA WBAN 94846). Hourly wind speed was estimated as zero to be conservative for dry, summer, stagnant conditions. Hourly cloud cover has an impact on the range (minimum and maximum) water temperatures attain throughout the day. The cloud cover was estimated at 75% during calibration in order to achieve the relative low diurnal variation in observed water temperatures. The average effective shade has a large impact on stream temperature as well, and the estimated shade for the entire model reach was 60%.

Table 3. Hourly variable meteorological inputs for model date 9/3/2016

Hour	Air Temperature (°C)	Dew Point Temperature (°C)
12:00 AM	18.9	14.4
1:00 AM	18.9	13.9
2:00 AM	17.8	13.9
3:00 AM	16.1	12.8
4:00 AM	15.0	12.8
5:00 AM	14.4	12.8
6:00 AM	15.0	12.8
7:00 AM	17.8	13.3
8:00 AM	19.4	13.3
9:00 AM	21.1	13.9
10:00 AM	22.2	13.9
11:00 AM	23.3	12.2
12:00 PM	23.9	12.8
1:00 PM	23.9	11.7
2:00 PM	23.9	11.7
3:00 PM	24.4	11.7
4:00 PM	23.3	12.8
5:00 PM	22.8	12.8
6:00 PM	21.7	13.9
7:00 PM	20.6	13.9
8:00 PM	19.4	14.4
9:00 PM	19.4	14.4

Hour	Air Temperature (°C)	Dew Point Temperature (°C)
10:00 PM	18.9	15.0
11:00 PM	17.8	15.0

3.4 HEADWATER INPUTS AND INITIAL CONDITIONS

Water quality samples from the Springinsguth Road site were used to parameterize and calibrate the model. The headwaters of GBK-14 are represented with median observed water quality for nearly all parameters (Table 4). Within the model, the downstream extent was not a prescribed boundary, and there were no diffuse or point sources included in this model.

Table 4. Headwater inputs for GBK-14 QUAL2K model

Parameter	Model Input	Note
Flow Rate (m^3/s)	0.038	Flow was estimated on 9/2/2016 as 0.047 m^3/s and on 9/6/2016 as 0.012 m^3/s at the sampling site. Linear interpolation between these two dates was used to estimate flow on 9/3/2016 as 0.038 m^3/s.
Elevation (m)	243.35	Estimated from LiDAR data
Hydraulic Model	Manning Formula	Inputs same as Reach 1
Water Temperature (°C)	19.4	Average observed water temperature at 9/3/2016 at the sampling site.
Conductivity (µmhos)	1062.5	Average observed conductivity at 9/3/2016 at the sampling site.
Inorganic Solids (mgD/L)	3.0	Median of observed data on 9/2, 9/6, and 9/7.
Dissolved Oxygen (mg/L)	5.5	Headwater DO conditions are unknown, so they have been conservatively set to the summer water quality standard of 5.0 mg/L with an added 10% margin of safety.
CBODslow (mgO_2/L)	2.5	Median of observed data on 9/2, 9/6, and 9/7 is 2.40 mg/L. There is likely CBOD oxidation occurring in-stream, so headwater conditions were estimated slightly higher.
CBODfast (mgO_2/L)	0.0	Assumed zero.
Organic Nitrogen (µgN/L)	2580.0	Median of observed data on 9/2, 9/6, and 9/7.
NH4-Nitrogen (µgN/L)	50.0	Median of observed data on 9/2, 9/6, and 9/7.
NO3-Nitrogen (µgN/L	360.0	Median of observed data on 9/2, 9/6, and 9/7.

Parameter	Model Input	Note
Organic Phosphorus (µgP/L)	30.0	Median of observed data on 9/2, 9/6, and 9/7.
Inorganic Phosphorus (µgP/L)	610.0	Median of observed data on 9/2, 9/6, and 9/7.
Phytoplankton (µgA/L)	1.6	Median of observed data on 9/2, 9/6, and 9/7.
Alkalinity (mg/L)	214.5	Median of observed data on 9/2, 9/6, and 9/7.
pH	7.2	Median of observed data on 9/2, 9/6, and 9/7.

4.0 QUAL2K MODEL RESULTS

Based on the model setup detailed above, the model was calibrated to DO concentrations and water temperature measured every hour at the location of the sampling site at Springinsguth Road on the calibration date of 9/3/2016. This sampling site corresponds with model reach element 37. Various other water quality parameters such as nutrients were considered to be conservative in the system (no gains or losses) because there were no upstream or downstream measurements relative to the Springinsguth Road sampling site to inform decay rates or in-stream processes. This conservative assumption is reasonable because the nutrient concentrations observed were quite small and do not appear to have a significant impact on the system. Observed hourly water temperature, DO, conductivity, and pH data used for calibration on 9/3/2016 for element 37 are detailed in Table 5.

Table 5. Observed hourly water temperature water quality constituents on 9/3/2016

Hour	Water Temp (°C)	DO (mg/L)	Conductivity (umhos)	pH
12:00 AM	19.71	3.65	1041	7.21
1:00 AM	19.45	3.64	1044	7.21
2:00 AM	19.23	3.71	1047	7.2
3:00 AM	19.01	3.70	1050	7.19
4:00 AM	18.81	3.70	1053	7.18
5:00 AM	18.61	3.77	1057	7.18
6:00 AM	18.4	3.74	1061	7.17
7:00 AM	18.22	3.77	1060	7.16
8:00 AM	18.04	3.78	1055	7.16
9:00 AM	18.03	3.81	1054	7.16
10:00 AM	18.18	3.86	1052	7.17
11:00 AM	18.51	3.91	1053	7.19
12:00 PM	18.91	3.89	1057	7.2
1:00 PM	19.34	3.92	1065	7.2

Hour	Water Temp (°C)	DO (mg/L)	Conductivity (umhos)	pH
2:00 PM	19.78	3.96	1067	7.24
3:00 PM	20.11	3.93	1070	7.24
4:00 PM	20.37	3.91	1076	7.26
5:00 PM	20.59	3.91	1087	7.24
6:00 PM	20.68	3.87	1087	7.26
7:00 PM	20.65	3.70	1085	7.23
8:00 PM	20.51	3.65	1077	7.24
9:00 PM	20.37	3.59	1070	7.22
10:00 PM	20.22	3.55	1067	7.22
11:00 PM	20.05	3.55	1066	7.21

4.1 MODEL RESULTS

A reasonable fit between the observed DO data and the QUAL2K simulated DO concentrations was achieved based on the aforementioned setup. The observed DO minimum, maximum, average, and median were achieved in the model results quite well, which suggests that the model adequately approximates the system based on the available data (Table 6, Figure 2). There is also a good fit between modeled and observed water temperature. By approximating the observed range of minimum and maximum water temperature and DO suggests that the model inputs associated with weather conditions and in-stream chemistry are reasonably simulated at the calibration point.

The modeled longitudinal changes in dissolved oxygen as compared with observed data are depicted in Figure 3. In general there is a decrease in DO occurring along the reach length which may be due to a number of factors such as low reaeration, high SOD, low channel gradient, low flow volume, or unknown variables such as unknown discharges. There is a large amount of uncertainty associated with the upstream and downstream ends of the simulated portion of GBK-14 due to lack of data. Note that if headwater DO is significantly higher or lower than the assumed concentration of 5.5 mg/l, then in-stream DO sources and demands may not be simulated properly relative to the existing conditions.

Model calibration was achieved based on prioritization of measured hydraulics, diel water temperature, and diel DO data. Observed hydraulic data used for hydrology calibration were velocity measurements of 0.036 and 0.063 m/s, and average depth measurements of 0.064 and 0.155 meters. These measurements serve to bracket to model flows appropriately, for which modeled velocity was 0.04 m/s, and stream depth was 0.14 meters.

Table 6. Simulated and observed DO (mg/L) and water temperature (°C), model element 37, calibrated model

Statistic	Observed DO	Modeled DO	Percent Error in DO	Observed Water Temperature	Modeled Water Temperature	Percent Error in Temperature
Minimum	3.6	3.7	4.6%	18.0	17.5	-2.9%
Maximum	4.0	3.8	-5.2%	20.7	21.1	2.2%
Average	3.8	3.7	-1.0%	19.4	19.3	-0.6%

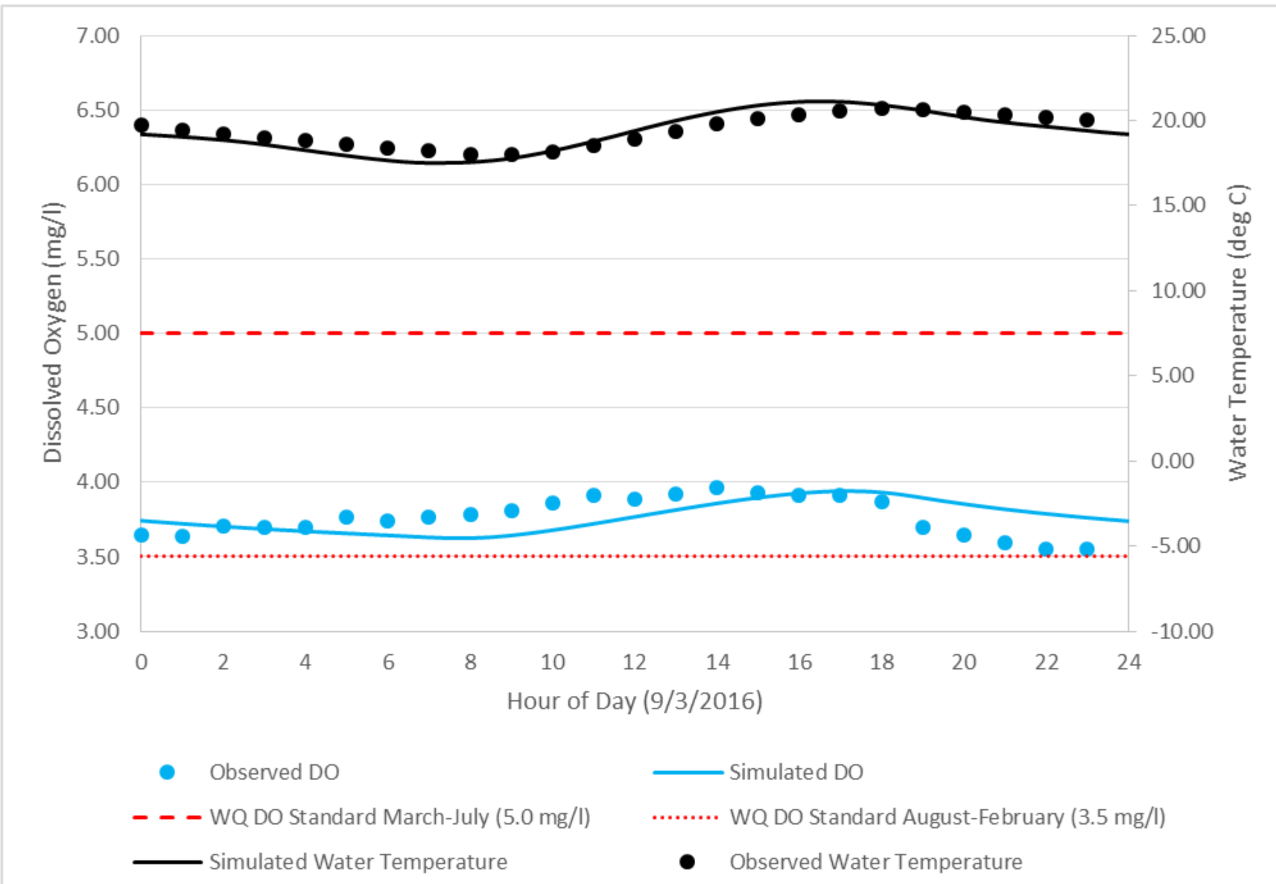


Figure 2. Observed and modeled diel DO and water temperature results, model element 37

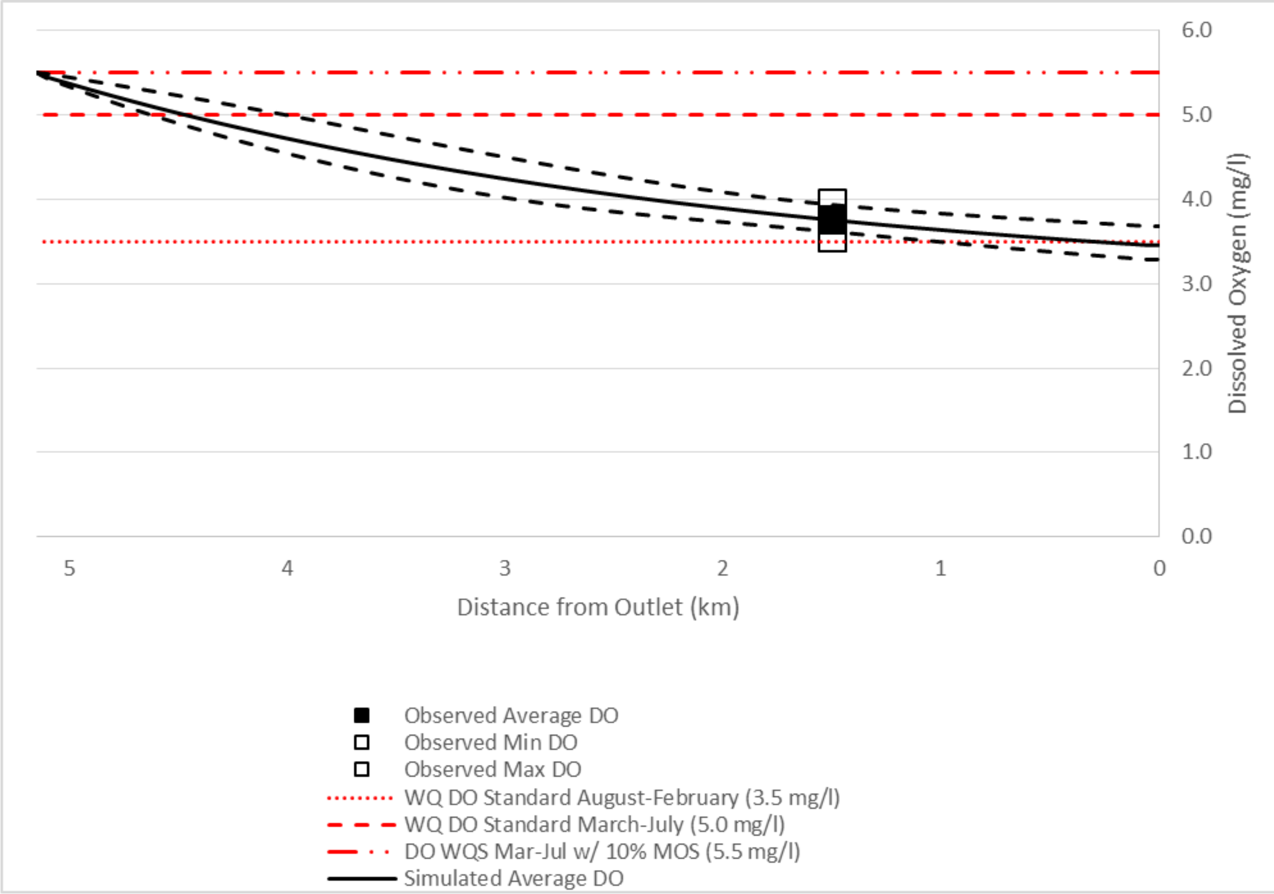


Figure 3. Modeled and observed average, minimum, and maximum dissolved oxygen concentrations along the entire model extent on 9/3/2016

5.0 MODEL SCENARIOS

Several model scenarios were considered in order to estimate the impact of different conditions on DO within GBK-14 and to help inform the primary causes of low dissolved oxygen in the stream. By changing reach conditions such as increasing reaeration or decreasing SOD along the channel, these scenarios were compared to the more conservative in-stream minimum DO concentration of 5.0 mg/l which typically applies March to July. Although the calibration date is in 9/3/2016, it is a conservative approach to attain the more rigorous water quality standard (WQS) of 5.0 mg/l with a 10% margin of safety for scenario purposes.

Observed DO concentrations on 9/3/2016 were well below the conservative water quality standard of 5.0 mg/l for all hours of the day. The observed maximum was 4.0 mg/l DO, while the calibrated model estimated a maximum DO concentration of 3.8 mg/l at the calibration point. The observed and simulated minimum DO were 3.6 and 3.7 mg/l respectively which do not attain the less stringent standard of 4.0 mg/l. Scenarios were developed and compared against the more conservative water quality standard plus a 10% margin of safety (5.5 mg/l). For all scenarios, a headwater DO concentration of 5.5 mg/L was established in order to meet the WQS with MOS along the entire reach. Based on model development, the primary causes of impairment are likely a combination of very low flows, low levels of reaeration, and high SOD compared to the rate and volume of water in the stream. The presence of nutrients, algae, and macrophytes in the system do not appear to be having a large impact due to the very small diurnal DO fluctuation observed and the relatively low concentrations of these constituents.

The list of scenarios and the resulting longitudinal DO and temperature statistics are seen below (Table 7, Figure 4). Alternative scenarios were also run for the following conditions, although none produced attainment of the WQS with MOS for the entire reach:

- Increased headwater DO concentration (headwater DO would have to be increased to greater than 15 mg/l in order for the entire reach to attain the WQS with 10% MOS)
- Increased stream shading (increased stream shade to 100% reduce water temperatures by about 3 °C and increased DO saturation by nearly 1 mg/l but did not have an impact on simulated DO)
- Decreased slow CBOD concentration (reduce CBOD from 2.5 mg/l to zero increases average in-stream DO by about 1%)

The scenarios which were able to attain the criteria were those involving:

- Increased reaeration (increased from 1.1 to 2.1 /d)
- Reduced SOD (decreased by half from 2.04 to 1.02 $gO_2/m^2/d$)
- Combination of increased reaeration (increased 35%) and reduced SOD (decreased 35%)
- Increased streamflow (increased headwater streamflow from 0.038 to 0.110 m^3/s)

The QUAL2K model indicates that the minimum instream DO during critical conditions is very sensitive to headwater DO concentrations, SOD rates, and intrinsic channel reaeration which is a function largely of channel slope, shape, and velocity.

Table 7. Model scenario descriptions and statistics for the entire model extent.

Scenario	Description	Dissolved Oxygen (mg/L)			Water Temperature (°C)		
		Min	Max	Mean	Min	Max	Mean
Observed[1]	Existing conditions	3.6	4.0	3.8	18.0	20.7	19.4
Baseline	Calibrated model	3.3	5.5	4.2	17.4	21.6	19.3
1	Increased Reaeration	5.5	6.0	5.7	17.4	21.6	19.3
2	Reduced SOD	5.5	6.1	5.7	17.4	21.6	19.3
3	Increased Reaeration and Reduced SOD	5.5	6.2	5.8	17.4	21.6	19.3
4	Increased Streamflow	5.5	5.8	5.6	17.9	21.0	19.3

[1]Observed conditions at Springinsguth Road are assumed to be representative of the entire reach.

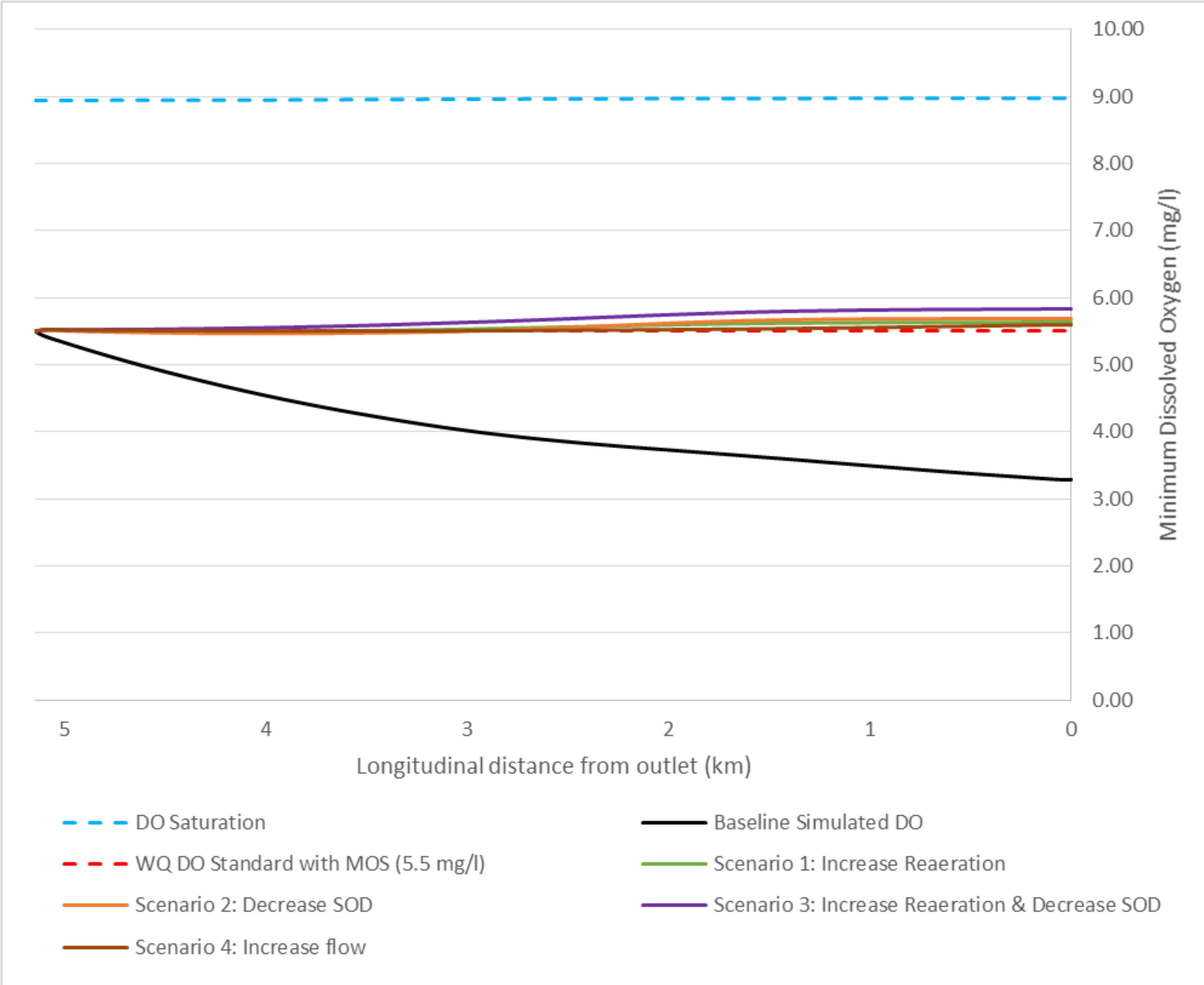


Figure 4. Model scenarios longitudinal minimum DO compared to calibrated model

6.0 TMDL ANALYSIS

Loading capacity is the allowable amount of loading from all pollutant sources that can deplete DO in GBK-14 and still meet the water quality standard of 5.0 mg/L with 10% MOS. The total maximum daily load (TMDL) uses QUAL2K to calculate the pollutant loads that can meet the DO standard.

6.1 DISSOLVED OXYGEN DEFICIT BACKGROUND

DO saturation concentration (DO_{sat}) is an important consideration when estimating assimilative capacity for DO. The value of DO_{sat} declines with increasing water temperature. In segment GBK-14, average water temperature was observed as 19.4 °C at the sampling site. DO_{sat} for this average temperature is approximately 8.96 mg/L, which means the total assimilative capacity of the stream is limited by the relationship between relatively high water temperatures and relatively low dissolved oxygen saturation.

In order to achieve high concentrations of DO in water it is essential to maintain low temperatures, however low temperatures do not cause low DO, they only allow for the capacity to achieve low DO under specific conditions. The capacity of a water body to assimilate loads of pollutants that affect the oxygen balance varies as a function of water temperature. Thus, the assimilative capacity for oxygen-demanding pollutants (or other processes that deplete DO) declines with increasing temperature.

The difference between DO_{sat} and the actual DO concentration is known as the dissolved oxygen deficit (DOD). DOD is a measure of the impacts of all DO-depleting sources and also has units of mg-DO/L. The loading capacity for DO is the difference between DO_{sat} (a function of temperature) and the water quality standard with margin of safety of 5.5 mg/L, expressed as DOD. This is the allowable amount of loading from natural conditions that is acceptable to meet water quality standards that protect beneficial use. DOD allocations are the amount of loading are the amount of loading that can be attributed to a given source (i.e., SOD or headwater inflow DO) in order to meet the water quality standard.

A high DOD indicates the presence of significant causes of DO depletion. DOD may also be negative, if DO concentration exceeds DO_{sat} (as often happens during periods of active photosynthesis in dense algal mats). The ideal situation is for DOD to be zero or close to zero. This would indicate the smallest deviation from the natural equilibrium level of DO_{sat}. Because DO_{sat} varies as a function of temperature, DOD also varies with temperature (Figure 5).

Like DO itself, DOD can be converted to a load basis by multiplying by flow:

$$DOD\left[\frac{kg}{d}\right] = (DO_{sat} - DO)\,[mg/L]\; x\; Q\,[cfs]\; x\; 2.447[conversion\ factor]$$

The conversion factor is the result of the following unit conversions: seconds to days, cubic feet to liters, and milligrams to kilograms. DOD provides a basis for treatment of the different factors that alter DO in West Branch DuPage River, namely reaeration and in-stream SOD conditions.

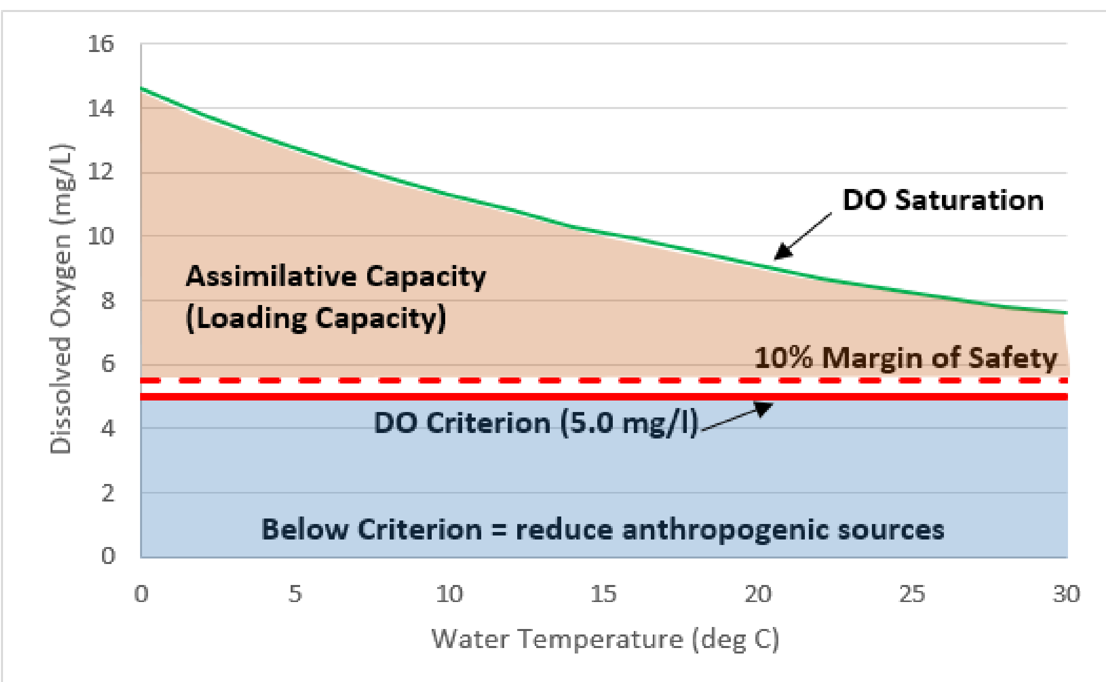


Figure 5. Assimilative capacity as a function of DO saturation.

DOD is a useful metric to look at different sources affecting DO in GBK-14. The DOD load that meets the DO standard can be calculated for a steady-state condition. Note that QUAL2K cannot be used directly to identify precise DOD impacts of oxygen-demanding sources such as CBOD, NBOD, or algal respiration, but impacts of SOD and headwater DO which dominate the system can be estimated from model output.

6.2 COMPLIANCE WITH STANDARDS

The water quality standards for West Branch DuPage River segment GBK-14 allows a minimum of 5.0 mg/L DO from March to July and 3.5 mg/L from August to February. The sampling from September 2016 shows clear evidence of not meeting the standard from 9/4/2016 to 9/8/2016 at the Springinsguth Road sampling site (Figure 6). The measured streamflow on 9/2/2016 is about twice as high as the measured streamflow on 9/6/2016, so the extreme drop in DO is likely related to the drop in flow. For the purpose of DOD calculations, the more conservative standard of 5.0 mg/l DO with a 10% MOS will be used to estimate DOD.

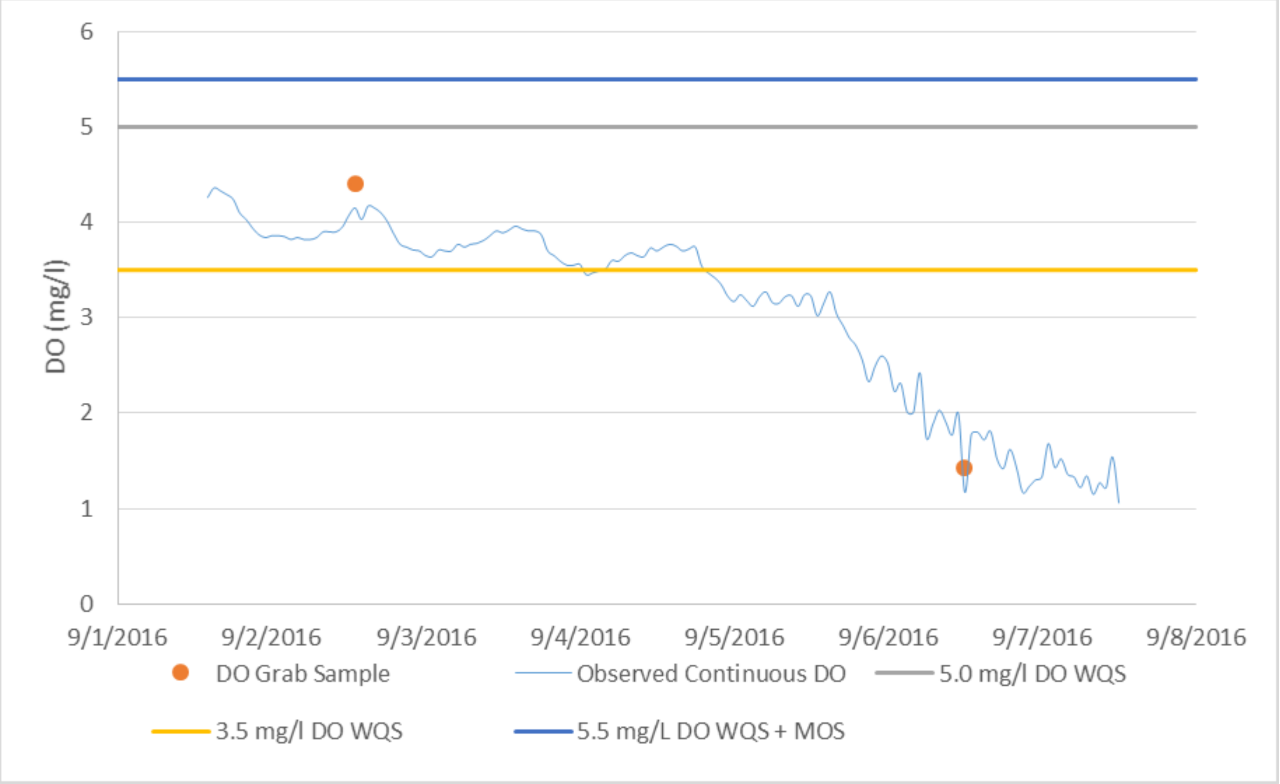


Figure 6. Observed dissolved oxygen from GBK-14 relative to WQS, September 2016

The relative importance of various processes affecting oxygen levels varies according to flow conditions, and this model was constructed under assumptions that it represents baseflow critical summer conditions relative to dissolved oxygen, water temperatures, and air temperatures. The calibrated QUAL2K model was used to assess the contributions of DOD as derived from internal sources (namely SOD), and inflow sources (DO below saturation of headwater flows), while relative impacts of aquatic biota respiration and biological oxygen demands of nitrogen and carbonaceous species cannot be expressly calculated. Based on the available data, respiration from algal species is not a significant contributor of low DO.

The QUAL2K model indicates that the minimum instream DO during critical conditions is very sensitive to headwater DO concentrations, SOD rates, and intrinsic channel reaeration which is a function largely of channel slope, shape, and velocity. DOD can be calculated for the stream as a function of simulated DO relative to DOD at the WQS with MOS. Calculations of DOD are detailed below:

1. Calculating DOD at the headwaters

   At the headwaters, the calibrated model has a minimum DO of 5.5 mg/l, and a DO_{sat} of 8.96 mg/l based on the water temperature of 19.4 °C. DOD can be calculated at the headwaters based on the equation presented in Section 6.1:

$$DOD\ at\ headwaters\ =\ (8.96\ mg/l - 5.50\ mg/l)\ x\ 1.33\ cfs\ x\ 2.44 = 11.29\ kg/d$$

2. Calculating DOD at the outlet

   At the outlet, the calibrated model has a minimum DO of 3.26 mg/l, therefore DOD can be calculated at the outlet based on the aforementioned equation:

$$DOD\ at\ outlet\ =\ (8.96\ mg/l - 3.26\ mg/l)\ x\ 1.33\ cfs\ x\ 2.44 = 18.50\ kg/d$$

3. Calculating DOD Loading Capacity

   The loading capacity for DO is the difference between DO_{sat} and the water quality standard with margin of safety of 5.5 mg/L, expressed as DOD:

$$DOD\ loading\ capacity\ =\ (8.96\ mg/l - 5.5\ mg/l)\ x\ 1.33\ cfs\ x\ 2.44 = 11.29\ kg/d$$

4. Calculating DOD Load Reductions

   Because the headwaters of the QUAL2K model are set to 5.5 mg/l, it is clear that no load reduction is required at the headwaters as the DOD there and the DOD loading capacity are equivalent.

   At the outlet of the stream, the difference between the simulated DOD and the DOD loading capacity is the necessary load reduction:

$$DOD\ Load\ Reduction = \ 18.50\frac{kg}{d} - \ 11.29\frac{kg}{d} = 7.21\frac{kg}{d}$$

The needed DOD load reduction of 7.21 kg/d is likely due to a combination of factors within the GBK-14 system. The DOD at the headwaters meets the loading capacity of the stream, but that means the stream has no additional capacity at that point. If the headwater DO is higher or lower than simulated in the calibrated model, the load capacity at the headwaters would be higher or lower respectively. Along GBK-14, the DOD is estimated to be caused be a combination of low reaeration and the presence of SOD, along with exacerbation of existing conditions due to very low flow (only several inches of stream depth). Overall, the critical conditions in GBK-14 indicate the need for a total reduction in DOD of 7.21 kg/d, which is a reduction from the existing downstream deficit (18.50 kg/d) of about 40%. Reduction of this DOD may be attained by the implementation of any of the Scenarios 1 through 4 described in Section 5.0.

7.0 REFERENCES

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APPENDIX A: WATER QUALITY AND FLOW DATA

Relevant water quality and flow data from September 2016 conducted by DRWSW and MWRD are summarized below.

Table 8. Water quality grab sample data for GBK-14

Analyte	Units	DRWSW Data			MWRD Data
		9/2/16	9/6/16	9/7/16	9/6/2016
Alkalinity	mg/L	202	208	221	221
Carbonaceous BOD	mg/L	<2	3.40	2.40	No Data
Chlorophyll-a	ug/L	4.60	4.60	53.00	1.60
Dissolved Oxygen	mg/L	No Data	1.42	No Data	3.50
Inorganic Suspended Solids	mg/L	1.60	3.00	160.00	No Data
Ammonia	mg/L	<0.1	<0.1	<0.1	0.69
Nitrite	mg/L	0.18	0.31	0.32	No Data
Nitrate	mg/L	0.58	0.36	0.30	No Data
Organic Nitrogen	mg/L	2.02	2.58	3.60	No Data
Organic Phosphorus	mg/L	0.04	0.03	Non-Detect	No Data
pH	s.u.	No Data	7.75	No Data	7.58
Orthophosphate as P	mg/L	0.10	0.11	0.35	No Data
Orthophosphate as P, dissolved	mg/L	0.27	0.10	0.08	No Data
Polyphosphate as P	mg/L	0.04	0.06	<0.02	No Data
Total Inorganic Carbon	mg/L	24.30	31.50	39.00	No Data
Total Kjeldahl Nitrogen	mg/L	2.02	2.58	3.60	2.28
Total Phosphorus as P	mg/L	0.17	0.20	0.21	0.19
Total Phosphorus as PO4	mg/L	0.52	0.61	0.65	No Data
Total Suspended Solids	mg/L	3.40	6.80	199.00	5.00
Volatile Suspended Solids	mg/L	1.80	3.80	35.00	<4
Temperature	C	No Data	No Data	No Data	23.40
Hardness	mg/l	No Data	No Data	No Data	321
Fecal Coliform	CTS/100mL	No Data	No Data	No Data	3100
Total Organic Carbon	mg/L	No Data	No Data	No Data	16.70
Total Dissolved Solids	ppm	No Data	No Data	No Data	660

Analyte	Units	DRWSW Data			MWRD Data
		9/2/16	9/6/16	9/7/16	9/6/2016
Nitrate and Nitrite	mg/l	0.76	0.67	0.62	0.65

Table 9. Continuous hourly water quality data for GBK-14 from 9/1/2016 to 9/7/2016

Parameter	Units	Minimum	Maximum	Average
Temperature	C	18.03	24.38	20.84
pH	s.u.	7.14	7.34	7.22
Conductivity	uS/cm	926	1381	1116
Dissolved Oxygen	mg/l	1.06	4.36	3.11

Table 10. Reach hydraulic data and algal summaries from September 2016

Parameter	9/2/2016	9/6/2016
Time of Day	12:40 PM	12:00 PM
Cloud Cover	15%	30%
Channel Width (ft)	15	15
Max Depth (ft)	0.65	0.35
Average Depth (ft)	0.51	0.21
Velocity (ft/s)	0.21	0.12
Flow (ft^3/s)	1.64	0.41
Algal Survey	Periphyton and planktonic algal blooms not present, rare filamentous algae, dominant macrophytes	Planktonic algal blooms not present, rare filamentous algae, common periphyton, dominant macrophytes

Spring Brook #1 (Segment GBKA) QUAL2K Model

DuPage County, Illinois

April 7, 2017

PREPARED FOR

Illinois EPA
1021 North Grand Avenue East
PO Box 19276
Springfield, IL 62794

PREPARED BY

Tetra Tech
One Park Drive, Suite 200
PO Box 14409
Research Triangle Park, NC 27709

Pictured: Spring Brook #1 (DuPage River/Salt Creek Work Group)

TETRA TECH

1.0 INTRODUCTION

Spring Brook #1 is located within the Chicago metropolitan area, largely within the city of Wheaton in DuPage County, Illinois. Spring Brook flows southwest to join the West Branch DuPage River flowing further south to the DuPage River and Illinois River. Spring Brook #1 is composed of an upstream reach (GBKA) and a downstream reach (GBKA-01). Spring Brook's headwaters are found in northeast Wheaton, however the perennial reach appears to begin at the upstream end of GBKA at West Elm Street. River segment GBKA of Spring Brook is impaired for low dissolved oxygen (DO) concentrations, and extends approximately 1.7 miles (2.75 kilometers) downstream from West Elm Street near Kelly Park in Wheaton to the road crossing of Creekside Drive near Madison Elementary School (Figure 1). The water quality standard for DO for this reach varies throughout the year, with a minimum concentration requirement of 5.0 mg/l from March to July, and 3.5 mg/l from August to February according to the Illinois Environmental Protection Agency.

QUAL2K is a one-dimensional steady-state river water quality model frequently used for simulating DO (Chapra et al., 2012). QUAL2K assumed a well-mixed stream channel (both vertically and laterally), and employs a diel, or 24-hour period, heat budget which can be used to model DO on an hourly basis. A QUAL2K model was developed and calibrated to DO data for Spring Brook #1 segment GBKA which was measured in late July 2016. The model was setup and calibrated based on data availability for 7/27/2016. Model parameterization and assumptions were based on a combination of observed flow and water quality data as well as best professional judgement.

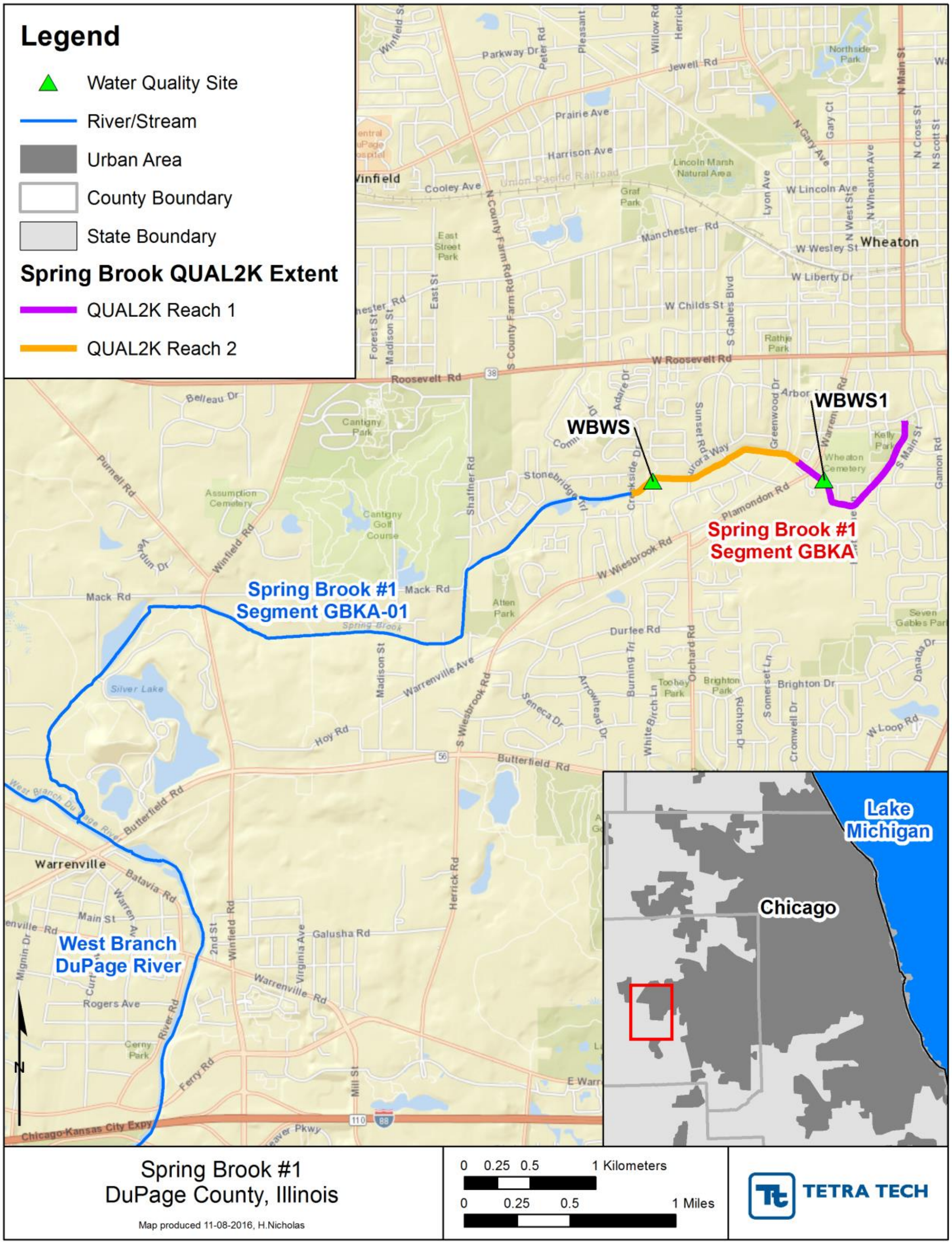

Figure 1. Spring Brook #1 in Wheaton, DuPage County, Illinois

2.0 QUAL2K MODEL SETUP

2.1 MODEL SEGMENTATION AND REACH INPUTS

The Spring Brook #1 segment of-interest GBKA was subdivided into two model reaches. Each model reach was assigned specific hydraulic properties developed from site surveying observations at single locations along each reach. The river was segmented at its halfway point, and elevation data were assigned using a 3-meter digital elevation model (DEM) obtained from USDA Data Gateway. Each model reach is further broken down into computational elements. Table 1 and Figure 1 summarize the reach segmentation and hydraulic properties for GBKA. The DuPage River Salt Creek Workgroup (DRWCW) conducted water quality sampling and surveying at two sites, WBWS1 and WBWS near the upstream and downstream extents of segment GBKA respectively (Figure 1).

Table 1. Reach segmentation for GBKA QUAL2K model

Model Input	Reach 1 (Upstream)	Reach 2 (Downstream)
Description	Spring Brook #1 from W Elm Street and Kelly Park to Illinois Prairie Path (Aurora Branch) Crossing near the Chicago Golf Club	Illinois Prairie Path (Aurora Branch) Crossing to Creekside Drive crossing near Madison Elementary School
Reach Length (km)	1.38	1.38
Number of 0.1-km Elements	14	14
Upstream Elevation (m)	220.37	219.53
Downstream Elevation (m)	219.53	218.69
Hydraulic Model	Manning Formula	Manning Formula
Channel Slope	0.0006	0.0001
Manning's "n"	0.024	0.080
Bottom Width (m)	5.18	7.32
Side Slopes	0.00	0.00

Stream hydraulics were simulated using the Manning Formula for both model reaches. QUAL2K approximates stream flow using the following input parameters for this hydraulic model: channel slope, Manning's "n", bottom width, and channel side slopes. Cross sections were measured on 7/27/2016 at both sampling locations WBWS1 (upstream, reach 1), and WBWS (downstream, reach 2). The upstream cross section was measured to have a width of 17 feet (5.18 meters) and an average depth of 4.3 inches (0.11 meters), and the downstream cross section was measured to have a width of 24 feet (7.32 meters) and an average depth of 12.31 inches (0.31 meters). Given how shallow these reaches are, and the lack of precision surveying throughout the reach, rectangular channels were assumed (side slopes of zero). Channel slopes were approximated based on elevation data as well as anecdotal evidence of very low water velocity at the downstream end of the reach. Manning's "n" roughness coefficients were determined through calibration in order to meet the approximate measurements of water depth and flow velocity.

Inputs related to bottom algae coverage and prescribed reaeration rates drive diurnal DO cycling within the system, so those parameters were developed during the model calibration process (Table 2). In-stream DO concentrations are very sensitive to sediment oxygen demand (SOD), for which the prescribed bottom coverage percentage and rate work in tandem to approximate. SOD monitoring was conducted along the West Branch DuPage River during the Illinois EPA Stage 2 TMDL process in 2009. SOD was measured by CDM at Hanover Park, which was temperature-corrected to an observed SOD of 2.04 $g/m^2/d$. Given that there are no point sources discharging along Spring Brook #1, SOD rates were adjusted during the calibration process, using the 2.04 $g/m^2/d$ as an upper bound. SOD rates have been reported from 0.56 to 8.08 $g/m^2/d$ in northeastern Illinois (Butts, 1974). The sediment diagenesis model computes SOD and nutrient fluxes in-stream in addition to the prescribed SOD rate and coverage observed under existing conditions. Note that most other reach rate inputs were estimated and identified based on in-stream calibration efforts (Table 2).

Table 2. Reach rate inputs

Parameter	Input	Notes
Prescribed Reaeration (/d)	Reach 1: 2.00 Reach 2: 0.025	Adjusted during calibration
Bottom Algae Coverage	85%	Adjusted during calibration
Bottom SOD Coverage	100%	Assumed entire streambed subject to SOD
Prescribed SOD ($g/m^2/d$)	Reach 1: 0.40 Reach 2: 2.10	Adjusted during calibration
Slow CBOD Hydrolysis and Oxidation Rates (/d)	0.00	There is no change in CBOD concentration from upstream to downstream
Fast CBOD Oxidation Rate (/d)	0.00	
Organic N Hydrolysis Rate (/d), Settling Velocity (m/d)	0.00, 0.10	Adjusted during calibration
Ammonium Nitrification Rate (/d)	0.00	Adjusted during calibration
Nitrate Denitrification Rate (m/d), Sediment Coefficient (md/)	0.00, 0.20	Adjusted during calibration
Organic P Hydrolysis Rate (/d), Settling Velocity (m/d)	0.10, 0.00	Adjusted during calibration
Inorganic P Settling Velocity (m/d)	0.00	Adjusted during calibration in tandem
ISS Settling Velocity (m/d)	0.00	
Phytoplankton Max Growth Rate (/d)	100	Adjusted in tandem during calibration, there is no change in phytoplankton
Phytoplankton Respiration Rate (/d), Excretion Rate (/d)	0.00, 0.00	

Parameter	Input	Notes
Phytoplankton Death Rate (/d), Settling Velocity (/d)	0.01, 0.001	measurements from upstream to downstream
Bottom Algae Max Growth Rate (/d)	600	Adjusted in tandem during calibration. Field sampling efforts on the calibration date describe limited algal growth, although abundant periphyton growth and filamentous algae were observed earlier in the week.
Bottom Algae Respiration Rate (/d)	0.05	
Bottom Algae Excretion Rate (/d)	0.05	
Bottom Algae Death Rate (/d)	0.10	
Bottom Algae Growth Model	Zero-Order	

2.2 LIGHT AND HEAT RATES

For the most part, light and heat parameters were held at model default values. The solar shortwave radiation model chosen was the Ryan-Stolzenbach, with an atmospheric transmission coefficient of 0.70, both of which were chosen during model calibration to observed water temperatures. The atmospheric longwave emissivity model chosen through calibration as well as the Brutsaert model which can be appropriate for calculating air emissivity in warm conditions. Through calibration, the wind speed function for evaporation and air convection/conduction was chosen to be Adams 1 which is used to estimate the impact of wind on air and water temperatures.

2.3 METEOROLOGICAL INPUTS

Metrological inputs to the QUAL2K model are air temperature, dew point temperature, wind, cloud cover, and shade (Table 3). All of these parameters aside from shade were supplied to the model from hourly observed data on the calibration date of 7/27/2016 recorded at the nearby West Chicago DuPage Airport (NOAA WBAN 94892). Wind speeds were measured at a height of 10 meters, so they were estimated at a height of 2 meters for QUAL2K model input based on the wind profile power law for neutral stability conditions:

$$Wind\ speed\ at\ 2\ meters = (Wind\ speed\ at\ 10\ meters) * \left(\frac{2}{10}\right)^{0.143}.$$

Meteorological inputs were identical for both reaches, except for shade which was estimated for each reach based on aerial imagery and calibrated based on observed water temperatures. Reach 1 is generally well-shaded by riparian vegetation, while Reach 2 sees some reach widening, and exposed channel, especially where sampling occurred near Madison Elementary School.

Table 3. Meteorological inputs for model date 7/27/2016

Hour	Air Temperature (deg C)	Dew Point Temperature (deg C)	Wind Speed at 2 meters (m/s)	Cloud Cover (%)	Reach 1 Shade (%)	Reach 2 Shade (%)
12:00 AM	21.10	17.80	0.00	0.0%	100%	100%
1:00 AM	21.10	17.80	0.00	0.0%	100%	100%
2:00 AM	20.00	17.80	0.00	10.0%	100%	100%
3:00 AM	20.00	17.20	0.00	10.0%	100%	100%
4:00 AM	18.90	17.20	2.38	10.0%	100%	100%
5:00 AM	18.90	17.20	0.00	30.0%	100%	100%
6:00 AM	21.10	18.30	0.00	30.0%	100%	80%
7:00 AM	24.40	19.40	0.00	0.0%	100%	60%
8:00 AM	26.10	19.40	0.00	0.0%	100%	40%
9:00 AM	27.80	17.80	2.38	0.0%	100%	20%
10:00 AM	28.90	18.90	5.56	0.0%	90%	20%
11:00 AM	28.90	19.40	4.77	0.0%	90%	20%
12:00 PM	30.00	17.80	4.77	0.0%	90%	20%
1:00 PM	30.00	17.20	0.00	0.0%	90%	20%
2:00 PM	31.10	17.80	7.15	0.0%	90%	20%
3:00 PM	30.60	16.70	5.56	0.0%	100%	20%
4:00 PM	30.60	18.90	5.56	0.0%	100%	40%
5:00 PM	29.40	18.90	5.56	0.0%	100%	60%
6:00 PM	28.30	19.40	3.97	0.0%	100%	100%
7:00 PM	27.20	18.90	3.97	0.0%	100%	100%
8:00 PM	26.10	18.90	3.97	0.0%	100%	100%
9:00 PM	23.90	18.90	0.00	0.0%	100%	100%
10:00 PM	23.90	18.90	0.00	0.0%	100%	100%
11:00 PM	22.80	18.90	0.00	0.0%	100%	100%

2.4 HEADWATER INPUTS AND INITIAL CONDITIONS

Water quality sampling at sites WBWS1 and WBWS near the upstream and downstream extents of segment GBKA were used to parameterize and calibrate the model. The headwaters of Spring Brook #1 are represented by observed water quality data from sampling site WBWS1 which is within the upstream model reach. From where stream segment GBKA originates below West Elm Street near Kelly Park, the stream is heavily shaded for almost the entire reach, and there are no point source inflows, therefore the water quality from WBWS1 is considered a reasonable approximation for headwater conditions (Table 4). Within the model, the downstream extent was not a prescribed boundary. There were also no diffuse or point sources included in this model.

Table 4. Headwater inputs

Parameter	Model Input	Source/Reference
Flow Rate (m^3/s)	0.123	Estimated as product of surveyed channel area (0.55 m^2) and measured flow velocity (0.224 m/s) at WBWS1
Elevation (m)	220.40	Estimated using DEM
Hydraulic Model	Manning Formula	Inputs same as Reach 1
Water Temperature (°C)	See Table 5	Observed hourly data from WBWS1
Conductivity (µmhos)	See Table 5	Observed hourly data from WBWS1
Inorganic Solids (mgD/L)	1	WBWS1 observed on 7/27/2016
Dissolved Oxygen (mg/L)	See Table 5	Observed hourly data from WBWS1
CBODslow (mgO_2/L)	1	WBWS1 observed CBOD on 7/27/2016. No wastewater plants upstream of sampling suggests CBOD is slow and not fast in nature
CBODfast (mgO_2/L)	0	
Organic Nitrogen (µgN/L)	1430	WBWS1 observed on 7/27/2016
NH4-Nitrogen (µgN/L)	50	WBWS1 observed on 7/27/2016
NO3-Nitrogen (µgN/L	1560	WBWS1 observed on 7/27/2016
Organic Phosphorus (µgP/L)	17	WBWS1 observed on 7/27/2016
Inorganic Phosphorus (µgP/L)	70	WBWS1 observed on 7/27/2016
Phytoplankton (µgA/L)	2000	WBWS1 observed chlorophyll-a on 7/27/2016
Detritus (mgD/L)	2.6	WBWS1 observed non-filterable residue on 7/27/2016
Alkalinity (mg/L)	329	WBWS1 observed on 7/27/2016
pH	See Table 5	Observed hourly data from WBWS1

Table 5. Observed hourly water quality constituents on 7/27/2016 at WBWS1 and WBWS

Hour	Water Temp (C)		DO (mg/L)		Cond (umhos)		pH	
Site	WBWS1	WBWS	WBWS1	WBWS	WBWS1	WBWS	WBWS1	WBWS
12:00 AM	19.78	22.23	5.98	3.34	1393	1580	7.44	7.69
1:00 AM	19.49	21.93	6.06	3.21	1379	1595	7.44	7.70
2:00 AM	19.21	21.67	6.11	3.20	1368	1607	7.44	7.71
3:00 AM	18.98	21.43	6.17	3.16	1366	1612	7.44	7.70
4:00 AM	18.78	21.20	6.2	3.18	1389	1618	7.45	7.72
5:00 AM	18.65	20.98	6.17	3.18	1424	1616	7.46	7.73
6:00 AM	18.55	20.78	6.15	3.23	1471	1613	7.47	7.74
7:00 AM	18.52	20.62	6.09	3.32	1489	1611	7.48	7.75
8:00 AM	18.61	20.55	6.01	3.41	1500	1607	7.47	7.76
9:00 AM	18.75	20.61	6	3.55	1516	1590	7.48	7.77
10:00 AM	18.94	20.92	5.99	3.44	1540	1577	7.48	7.78
11:00 AM	19.3	21.45	6.03	3.54	1560	1553	7.49	7.78
12:00 PM	19.68	22.07	6.08	3.78	1577	1532	7.49	7.79
1:00 PM	20.14	22.8	6.16	3.92	1589	1510	7.50	7.80
2:00 PM	20.55	23.54	6.17	4.35	1599	1478	7.50	7.80
3:00 PM	20.86	24.28	6.07	4.56	1599	1450	7.48	7.79
4:00 PM	21.1	24.72	5.85	4.58	1597	1427	7.48	7.78
5:00 PM	21.21	25.16	5.78	4.68	1604	1408	7.47	7.78
6:00 PM	21.23	25.45	5.65	4.75	1613	1393	7.46	7.79
7:00 PM	21.2	25.32	5.49	4.62	1620	1379	7.45	7.79
8:00 PM	21.07	25.05	5.41	4.50	1624	1376	7.45	7.80
9:00 PM	20.9	24.62	5.38	4.04	1628	1377	7.44	7.79
10:00 PM	20.77	24.13	5.36	3.68	1633	1383	7.44	7.78
11:00 PM	20.65	23.63	5.35	3.29	1636	1392	7.45	7.76

3.0 QUAL2K MODEL RESULTS

Based on the model setup detailed above, the QUAL2K model was built for Spring Brook #1 segment GBKA. The model was calibrated to DO concentrations and water temperature measured every hour at the downstream segment (model element 14 of reach 2) on the calibration date of 7/27/2016. To the extent possible, other water quality parameters and various nutrients such as total nitrogen and total phosphorus observed at the downstream end of the model extent were attempted to be calibrated to as well, although these constituents were not a priority, had limited data, and were not drivers of either water temperature or DO in this system.

3.1 MODEL RESULTS

A reasonable fit between the observed DO data and the QUAL2K simulated DO concentrations was achieved based on the aforementioned setup. The observed DO minimum, maximum, average, and median were achieved in the model results quite well, which suggests that the model adequately approximates the system based on the available data (Table 6, Figure 2). There is also a good fit between modeled and observed water temperature. Note that the observed diel dissolved oxygen concentrations do not produce a smooth curve, and that may be due to any number of factors that could cause a decrease in photosynthesis such as clouds passing overhead, leaf matter being trapped in the vicinity of the sensor, or any other type of atypical shading influence to the area. The timing of the simulated water temperature peak aligns with the observed air temperature peak during the day rather than the observed water temperature peak, and the simulated dissolved oxygen peak is a product of the relative coarseness of the model simulation.

The longitudinal changes in dissolved oxygen as compared with observed data are depicted in Figure 3. In general there is a decrease in DO occurring along the reach length due to the decrease in shade along the stream which leads to increased water temperatures.

Table 6. Model and observed DO (mg/L) and water temperature (deg C), Reach 2 Element 14

Statistic	Observed DO	Modeled DO	Percent Error in DO	Observed Water Temperature	Modeled Water Temperature	Percent Error in Temperature
Minimum	3.16	3.11	1.62%	20.55	19.40	5.57%
Maximum	4.75	4.79	0.79%	25.45	25.86	-1.62%
Average	3.77	3.78	-0.32%	22.71	22.26	1.99%

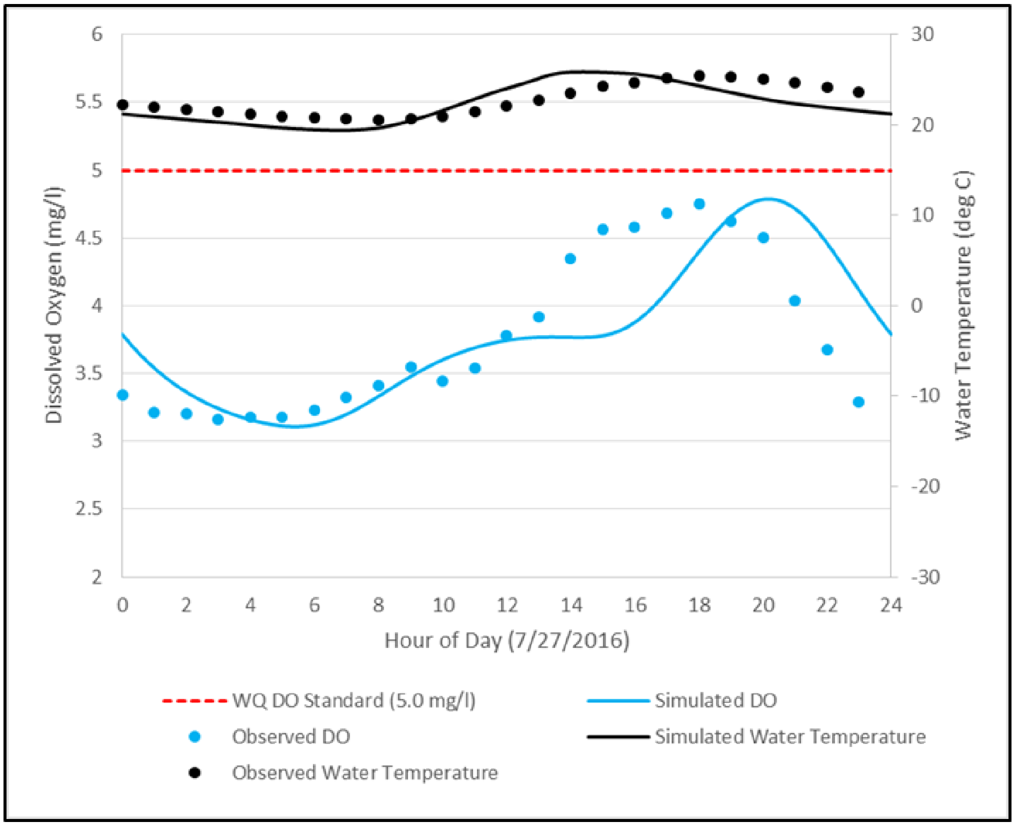

Figure 2. Observed and modeled diel DO and water temperature results, Reach 2 Element 14

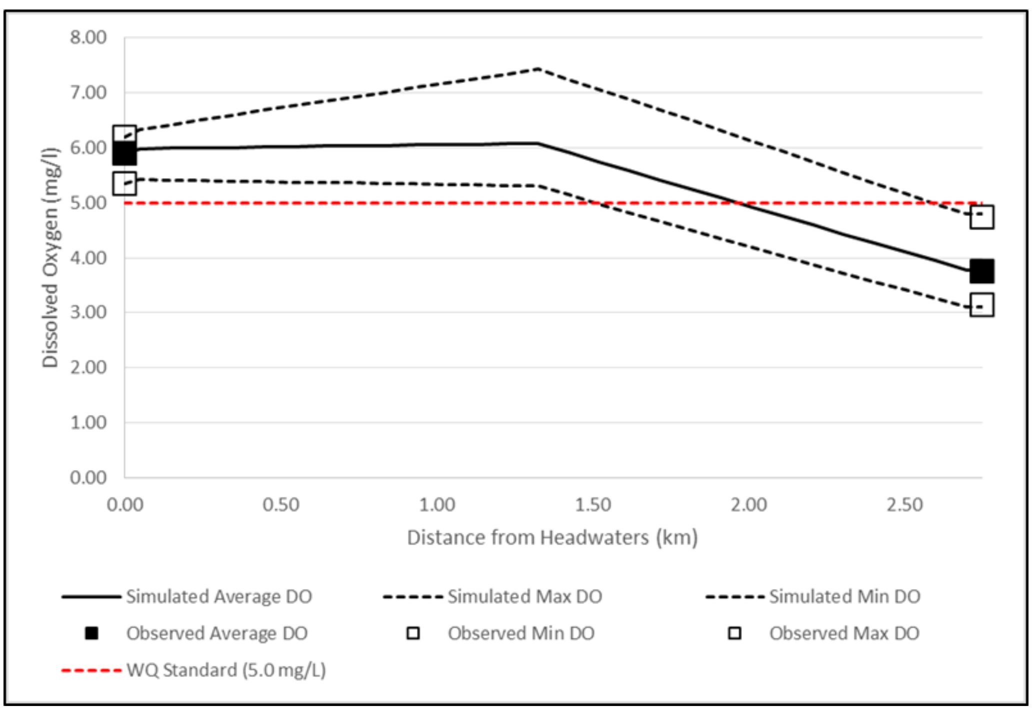

Figure 3. Modeled and observed average, minimum, and maximum dissolved oxygen concentrations along the entire model extent

Model calibration was achieved based on prioritization of measured hydraulics, diel water temperature, and diel dissolved oxygen data. Observed water velocity at the upstream end of the model and average water depth at both up and downstream sampling sites were achieved during model calibration. Observed concentrations of CBOD and chlorophyll-a were identical at both upstream and downstream sampling sites, and model calibration did achieve proper simulation of those conditions. Calibration of nutrient concentrations was achieved where possible, but given the relatively small amount of data and coarseness of the model environment, not all relative increases or decreases along the longitudinal model extent were simulated (Table 7). For example, the relative increase in ammonia and decrease in organic nitrogen observed along the model extent cannot be achieve easily because the relationship between the two constituents are simulated in tandem.

Table 7. Observed and simulated water quality data

Parameter	Upstream WBWS1 Observed on 7/27/16 (weekly observed range)	Downstream WBWS Observed on 7/27/16 (weekly observed range)	Average simulated downstream results
Water Temperature (°C), daily average	19.87 (18.52-24.63)	22.7 (19.26-25.45)	22.3
Conductivity (µmhos), daily average	1530 (88-1734)	1512 (128-1618)	1530
Inorganic Solids (mgD/L)	1.00 (1.0-18.0)	1.80 (1.0-2.8)	1.00
Dissolved Oxygen (mg/L), daily average	5.90 (5.33-7.63)	3.77 (2.66-6.98)	3.78
CBODslow (mgO_2/L)	1.00 (1.0-7.5)	1.00 (1.0-2.8)	1.00
CBODfast (mgO_2/L)	N/A	N/A	0.00
Organic Nitrogen (µgN/L)	1430 (1430-2020)	300 (300-1660)	1256
NH4-Nitrogen (µgN/L)	50 (50-240)	110 (50-300)	105
NO3-Nitrogen (µgN/L	1560 (1560-1710)	1010 (50-1060)	1042
Organic Phosphorus (µgP/L)	17 (17-39)	48 (26-48)	24
Inorganic Phosphorus (µgP/L)	65 (57-100)	75 (74-210)	63
Phytoplankton (µgA/L)	2000 (2000-50000)	2000 (2000-45000)	1989
Detritus (mgD/L)	2.60 (2.60-27.00)	3.60 (3.60-22.60)	3.59
Alkalinity (mg/L)	329 (329-343)	329 (170-329)	329
pH, daily average	7.46 (6.89-7.50)	7.76 (7.38-7.86)	7.52

4.0 MODEL SCENARIOS

Several model scenarios were considered in order to estimate the impact different conditions on dissolved oxygen within Spring Brook #1 segment GBKA. By changing reach conditions such as increased stream shade or reaeration of the channel, these scenarios were compared to the in-stream minimum DO concentration of 5.0 mg/l. Pollutant load reductions for CBOD, ammonia, and phosphorus were not included in the scenarios because the model and data do not suggest that these pollutants are causing impairment. Reductions in SOD are included in the scenarios.

Observed DO concentrations on 7/27/2016 were below the water quality standard of 5.0 mg/l for almost all hours of the day. The observed minimum was 3.16 mg/l DO, while the calibrated model estimated a minimum DO concentration of 3.12 mg/l. Given that the standard is currently not met in Reach 2 of this model under existing conditions, scenarios were developed under which the standard may possibly be met. The list of scenarios and the statistics associated with diel output at Reach 2 Element 14 as compared with observed data and calibrated model results are seen below (Table 8, Figure 4). Note that increased shade alone does not increase dissolved oxygen very much (Scenario 1), but rather in-stream SOD, reaeration, and headwater DO concentrations have the greatest impact on downstream diel DO.

Table 8. Model scenario descriptions and results

Scenario	Description	Dissolved Oxygen (mg/L)			Water Temperature (deg C)		
		Min	Max	Mean	Min	Max	Mean
Observed	Existing conditions	3.16	4.75	3.77	20.55	25.45	22.71
Baseline	Calibrated model	3.11	4.79	3.78	19.40	25.86	22.26
1	Shade increased to 100% at all hours for both reaches	3.29	3.96	3.72	18.80	20.69	19.86
2	Headwater DO concentrations increased by 2.4 mg/l every hour	5.01	6.73	5.71	19.40	25.86	22.86
3	Sediment oxygen demand rate and coverage decreased to 0.4 g/m2/d and 50% respectively	5.03	6.77	5.73	19.40	25.86	22.26
4	Increased Reach 2 reaeration to 1.85 /d	5.03	5.89	5.38	19.40	25.86	22.26
5	Reach 2 SOD coverage and rate decreased by half, and Reach 2 reaeration increased to 0.3 /d	5.02	6.59	5.65	19.40	25.86	22.26

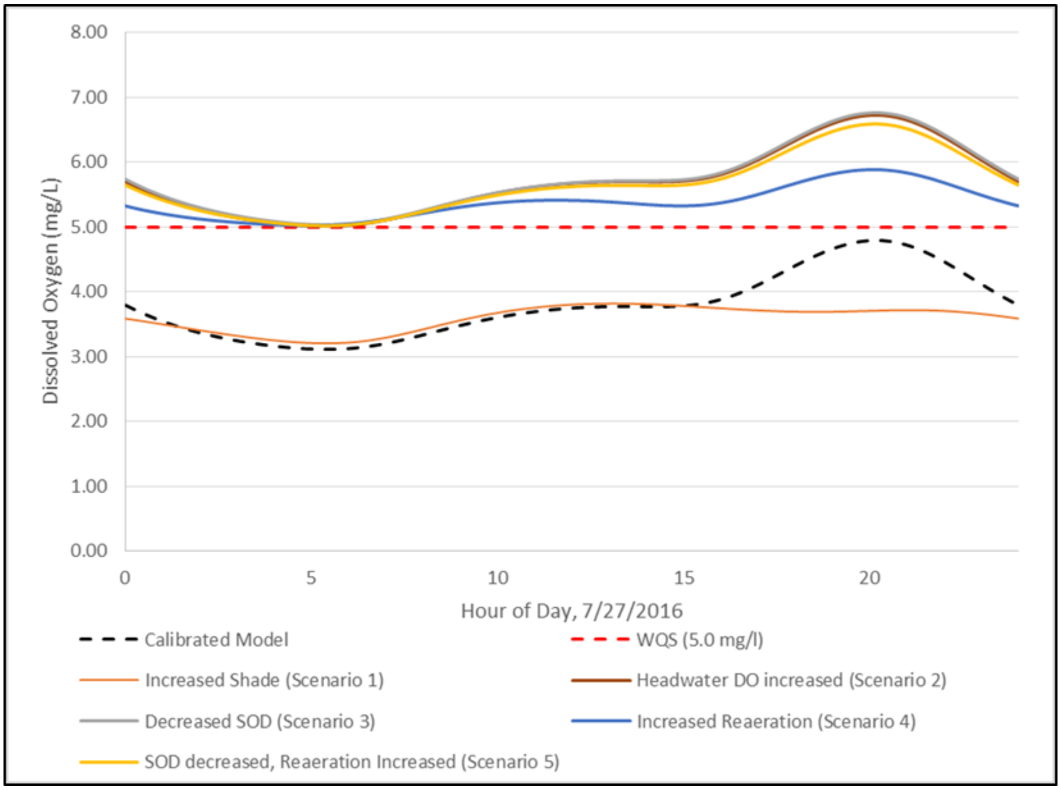

Figure 4. Model scenarios diel DO compared to calibrated model (Reach 2, Element 14)

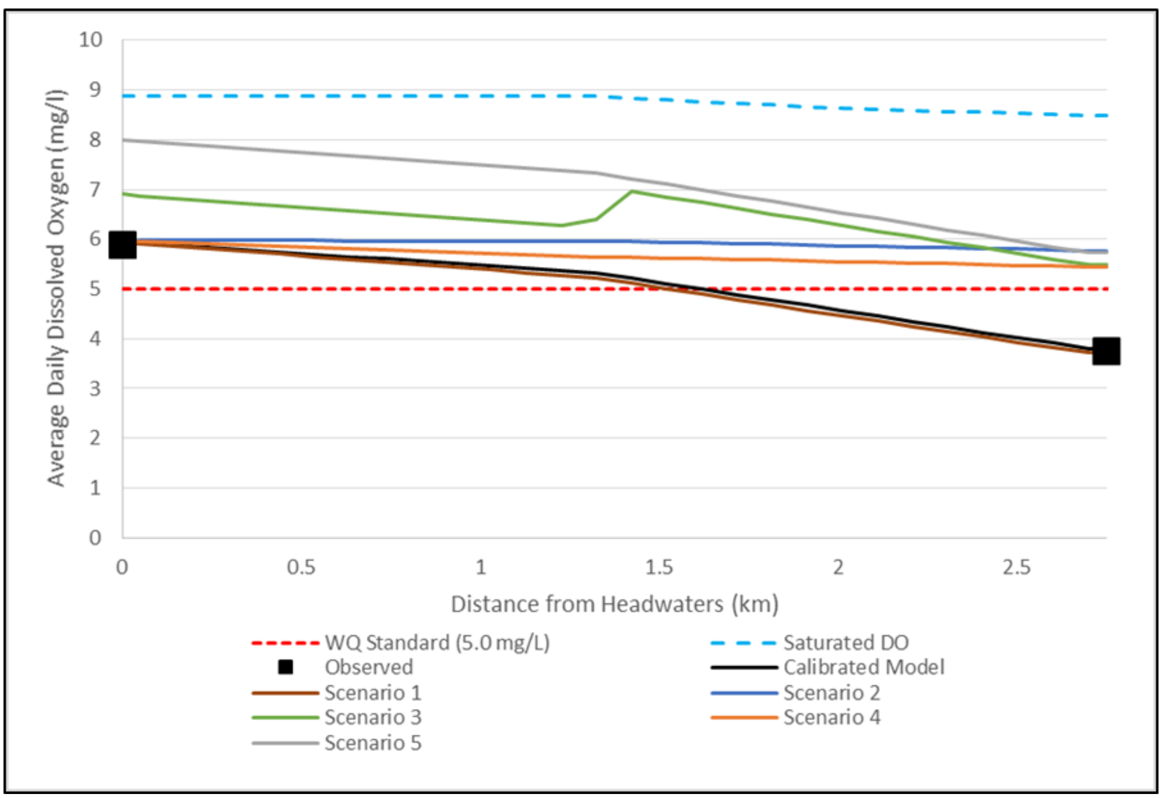

Figure 5. Model scenarios longitudinal average DO compared to calibrated model

5.0 TMDL ANALYSIS

5.1 DISSOLVED OXYGEN

The DO loading capacity and allocations are the allowable amount of loading from all sources that can deplete DO in Spring Brook from its natural state compared to the DO water quality standard of 5.0 mg/L. This is expressed as the dissolved oxygen deficit (DOD). The TMDL uses QUAL2K model results to calculate the pollutant loads that can meet the DO criteria.

5.1.1 Dissolved Oxygen Deficit Background

DO saturation concentration (DO_{sat}) is an important consideration when estimating assimilative capacity for DO. The value of DO_{sat} declines with increasing water temperature. In order to achieve high concentrations of DO in water it is essential to maintain low temperatures. In addition, the capacity of a water body to assimilate loads of pollutants that affect the oxygen balance varies as a function of water temperature. Thus, the assimilative capacity for oxygen-demanding pollutants (or other processes that deplete DO) declines with increasing temperature.

The difference between DO_{sat} and the actual DO concentration is known as the dissolved oxygen deficit (DOD). A high DOD indicates the presence of significant causes of DO depletion. DOD may also be negative, if DO concentration exceeds DO_{sat} (as often happens during periods of active photosynthesis in dense algal mats), which indicates supersaturated conditions. The ideal situation is for DOD to be zero or close to zero. This would indicate the smallest deviation from the natural equilibrium level of DO_{sat}. Because DO_{sat} varies as a function of temperature, DOD also varies with temperature (Figure 6).

Like DO itself, DOD can be converted to a load basis by multiplying by flow:

$$DOD\ \left[\frac{kg}{d}\right] = (DO_{sat} - DO)\ [mg/L]\ x\ Q\ [cfs]\ x\ 2.447[conversion\ factor]$$

The conversion factor is the result of the following unit conversions: seconds to days, cubic feet to liters, and milligrams to kilograms. DOD provides a basis for treatment of the different factors that alter DO in Spring Brook, namely the impact of headwater DO and in-stream SOD conditions.

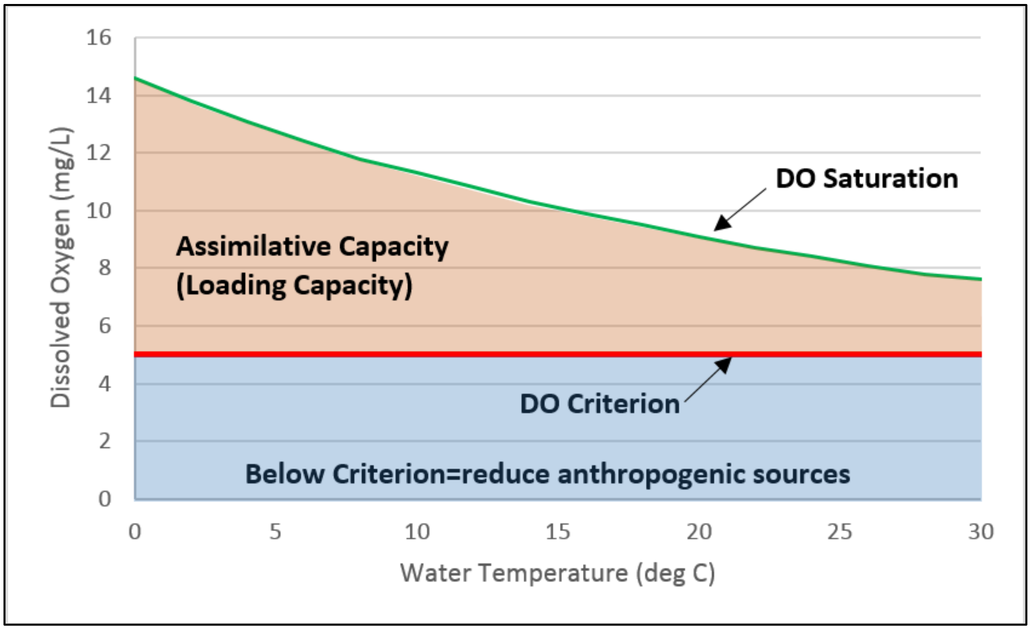

Figure 6. Assimilative capacity as a function of DO saturation.

5.1.2 Analytical Framework

DOD is a measure of the impacts of all DO-depleting sources and also has units of mg-DO/L. The loading capacity for DO is the difference between DO_{sat} (a function of temperature) and the water quality standard of 5.0 mg/L, expressed as DOD. This is the allowable amount of loading from natural conditions that is acceptable to meet water quality standards that protect beneficial use. Allocations are the amount of loading that can be attributed to a given source (i.e., SOD or headwater inflow DO) in order to meet the water quality standard.

DO_{sat} varies with temperature and salinity. In Spring Brook, average water temperature was observed as 20.5 deg C at the upstream end and 21.6 deg C at the downstream end. DO_{sat} for these average temperatures is on the order of 8.76 mg/L for Spring Brook, which means the assimilative capacity of the stream is limited by the relationship between relatively high water temperatures and relatively low dissolved oxygen saturation.

DOD is a useful metric to look at different sources affecting DO in Spring Brook, namely SOD and headwater inflow DO. The DOD load that meets the DO standard can be calculated for a steady-state condition using QUAL2K. Note that QUAL2K cannot be used directly to identify precise DOD impacts of oxygen-demanding sources such as CBOD, NBOD, or algal respiration, but impacts of SOD and headwater DO which dominate the system can be estimated from model output.

5.1.3 Compliance with Standards

The water quality standard for Spring Brook allows a minimum of 5.0 mg/L DO from March to July (standard drops to 3.5 mg/L August to February). The limited sampling shows clear evidence of DO exceedance from 7/26/2016 to 7/28/2016 at the downstream location (Figure 7).

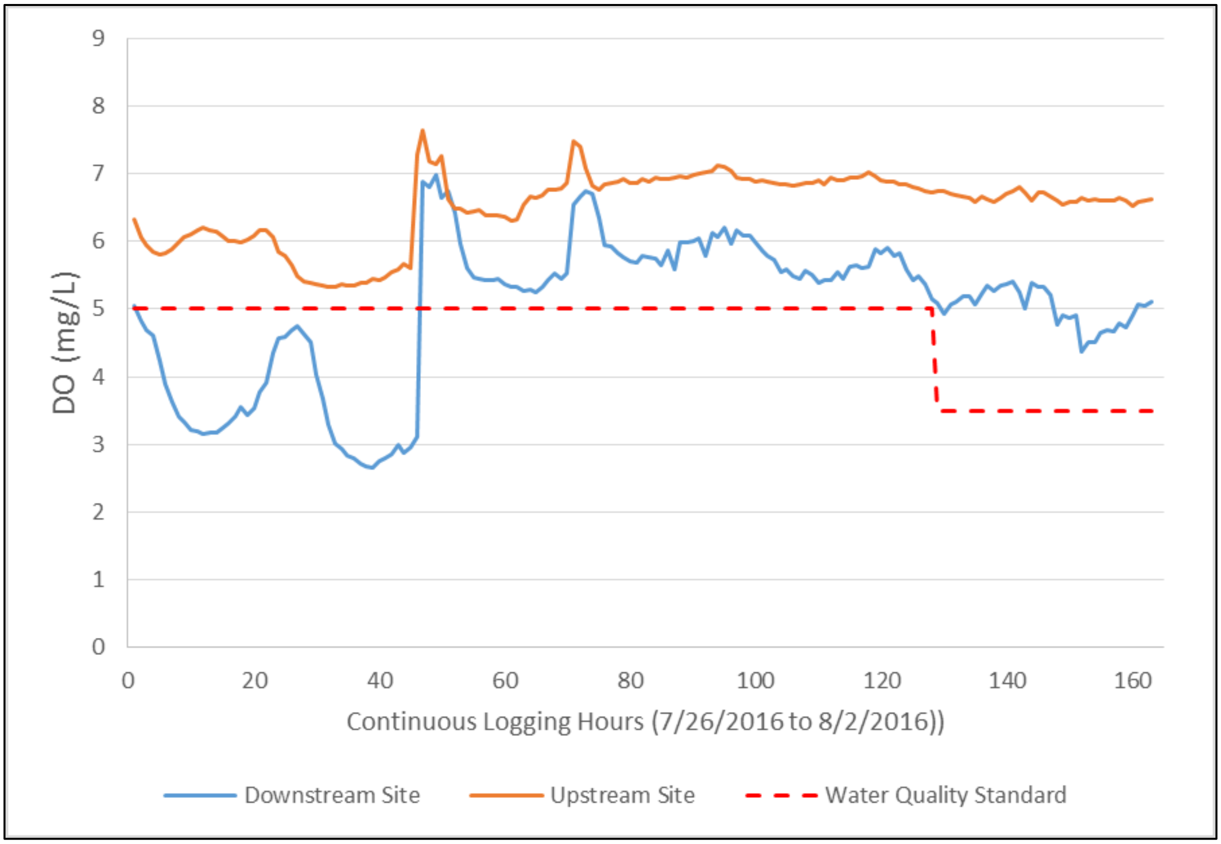

Figure 7. Observed DO at two sampling sites relative to WQS, summer 2016

The relative importance of various processes affecting oxygen levels varies according to flow conditions, and this model was constructed under assumptions that it represents baseflow critical summer conditions relative to dissolved oxygen, water temperatures, and air temperatures. The calibrated QUAL2K model was used to assess the contributions of DOD as derived from internal sources (namely SOD), and inflow sources (DO below saturation of headwater flows), while relative impacts of aquatic biota respiration and biological oxygen demands of nitrogen and carbonaceous species were approximated.

The QUAL2K model indicates that the minimum instream DO during critical conditions is very sensitive to headwater DO concentrations, SOD rates, and intrinsic channel reaeration which is a function largely of channel slope, shape, and velocity. DOD can be calculated for SOD and headwater DO for the calibrated model below (Table 9). The DOD flux from upstream can be estimated for Reach 1 as the difference between modeled DOD and SOD flux. Based on these estimates, Scenario 5 was considered for DOD calculations since reaeration and SOD are major drivers for the lack of attainment downstream at Reach 2 (Figure 8). Changes in headwater conditions for Reach 1 would also have a positive impact downstream, but since Reach 1 did not show impairment, the focus is on Reach 2.

Table 9. Calibrated model DOD calculations

Reach	Min DO (mg/L)	DO_{sat} (mg/L)	Calibrated Model DOD (kg/d)	DOD at WQS (kg/d)	DOD below WQS (kg/d)	SOD Flux (kg/d)	DOD Flux from Upstream (kg/d)
1	5.31	8.88	37.96	41.23	0 (attaining)	2.85	35.11
2	3.11	8.63	58.70	38.61	20.10	21.14	37.96

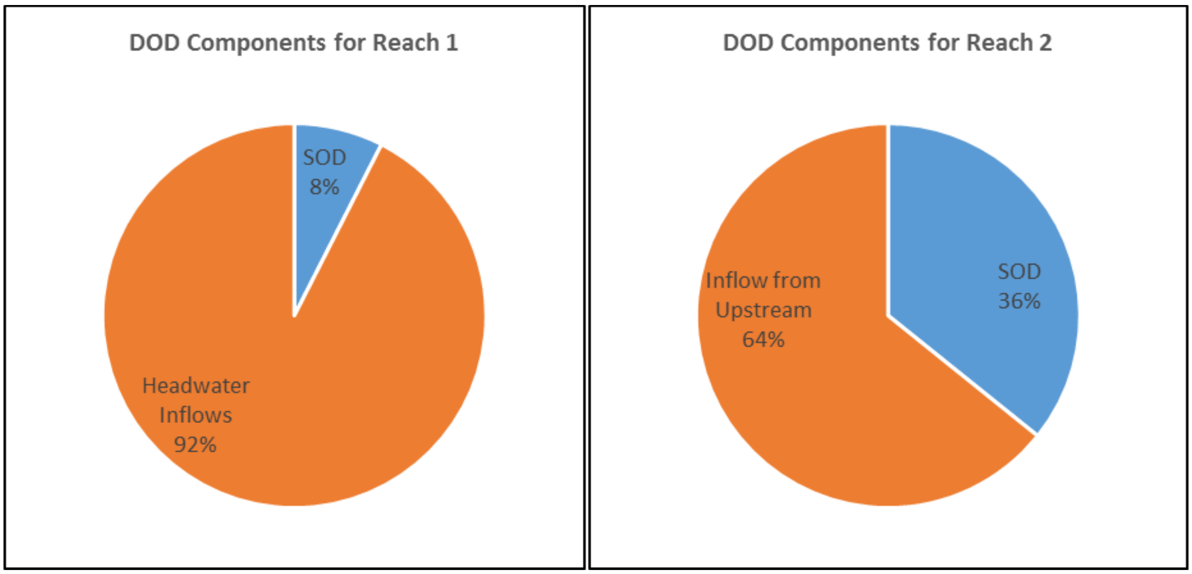

Figure 8. Calibrated model DO Deficits for Reach 1 and Reach 2

Overall, the critical conditions in Spring Brook indicate the need for a total reduction in DOD for Reach 2 of 20.10 kg/d, which is a reduction from existing conditions (58.70 kg/d) of about 34%. An entire reduction of this DOD may be attained by the implementation of Scenario 5 which includes increased reaeration (0.4 /d) and decreased SOD coverage and rate (50%, 1.05 gO2/m2/d). This scenario maintains the attainment of the WQS for Reach 1, and achieves attainment for Reach 2 (Figure 9). It is also possible to achieve the WQS for DO and the maximum allowable DOD based on that standard by exclusively decreasing SOD in Reach 2 or exclusively increased reaeration in Reach 2.

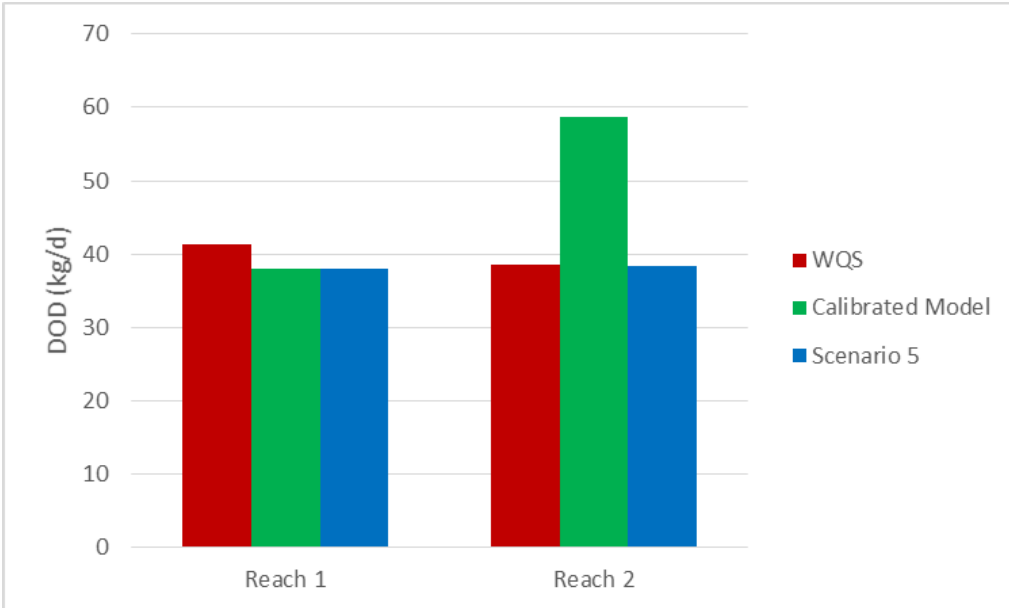

Figure 9. DO Deficits for Reach 1 and Reach 2: existing, standard, and Scenario 5

6.0 REFERENCES

Butts, T.A. 1974. Sediment Oxygen Demand in the Upper Illinois Waterway. Illinois State Water Survey Report of Investigation 76. Urbana, Illinois.

CDM. 2009. West Branch and Mainstem DuPage River Stage 2 TMDL – Sediment Oxygen Demand Monitoring. Prepared for Illinois Environmental Protection Agency.

Appendix F

Fecal Coliform and Chloride Wasteload Allocations

Permit ID	Facility	Design Average Flow (MGD)	Design Maximum Flow (MGD)	Fecal Coliform WLA (billion cfu per day)	
				High Flows – Design Maximum Flow (single sample maximum/ geomean standard)	Moist Conditions to Low Flows – Design Average Flow (single sample maximum/ geomean standard)
IL0020061	WOOD DALE NORTH STP – 001[b]	1.97	3.93	60 / 30	30 / 15
IL0021130	BLOOMINGDALE-REEVES WRF – B01[b]	3.45	8.625	131 / 65	52 / 26
IL0021547	GLENBARD WW AUTH-GLENBARD – 001	16.02	47	712 / 356	243 / 121
IL0021849	BENSENVILLE STP – 001[b]	4.7	10.0	151 / 76	71 / 36
IL0022471	GLENBARD WW AUTH-LOMBARD – 001	0.8[a]		12 / 6	12 / 6
IL0022471	GLENBARD WW AUTH-LOMBARD – 002/003 (CSOs)[c]	24.6 (maximum CSO volume, February 2014)[d]		372 / 186	--
IL0023469	WEST CHICAGO STP – B01[b]	7.64	20.3	307 / 154	116 / 58
IL0026352	CAROL STREAM STP – B01[b]	6.5	13.0	197 / 98	98 / 49
IL0027367	ADDISON SOUTH-A.J. LAROCCA STP – B01[b]	3.2	8.0	121 / 61	48 / 24
IL0027367	ADDISON SOUTH-A.J. LAROCCA STP – 004 (CSO)[c]	17.07 (maximum CSO volume, April 2013)[d]		258 / 129	--
IL0027618	BARTLETT WWTP – B01[b]	3.679	5.151	78 / 39	56 / 28
IL0028380	DOWNERS GROVE SD WTC – B01[b]	11	22.0	333 / 167	167 / 83
IL0028398	DUPAGE COUNTY-NORDIC PARK STP – 001	0.5	1.0	15 / 8	42586
IL0028428	DUPAGE COUNTY-CASCADE STP – 001	0.00585	0.0234	0.4 / 0.2	0.1 / 0.05
IL0028746	ELMHURST WWTP – 001[b]	8	20.0	303 / 151	121 / 61
IL0028967	GLENDALE HEIGHTS STP – B01[b]	5.26	10.52	159 / 80	80 / 40
IL0030813	ROSELLE STP – B01[b]	2	4	61 / 30	30 / 15
IL0030953	SALT CREEK SANITARY DISTRICT – 001/002	3.3	8.0	121 / 61	50 / 25
IL0031739	WHEATON S.D. – 001[b]	8.9	19.1	289 /145	135 / 67
IL0031844	DUPAGE COUNTY-WOODRIDGE STP – 001[b]	12	28.6	433 / 217	182 / 91
IL0032689	BOLINGBROOK STP #1 – B01[b]	2.04	4.51	68 / 34	31 / 15
IL0032735	BOLINGBROOK WRF #2 – 001	3	7.5	114 / 57	45 / 23
IL0033618	VILLA PARK WET WEATHER STP – 001/002/003/004 (CSOs)[b,c]	38.5 (maximum CSO volume, based on annual average discharge and 4 events per year)[d]		583 / 291	--
IL0033812	ADDISON NORTH STP – B01[b]	5.3	7.6	115 / 58	80 / 40

Permit ID	Facility	Design Average Flow (MGD)	Design Maximum Flow (MGD)	Fecal Coliform WLA (billion cfu per day)	
				High Flows – Design Maximum Flow (single sample maximum/ geomean standard)	Moist Conditions to Low Flows – Design Average Flow (single sample maximum/ geomean standard)
IL0034061	NAPERVILLE SPRING-BROOK WRC – 001	26.25 current, 30 future	55.13 current, 63 future	954 / 477	454 / 227
IL0034274	WOOD DALE SOUTH STP – 001[b]	1.13	2.33	35 / 18	17 / 9
IL0034479	HANOVER PARK STP #1 – B01[b]	2.42	8.68	131 / 66	37 / 18
IL0036137	MWRDGC HANOVER PARK WRP – 007	12	22	333 / 167	182 / 91
IL0036340	MWRDGC EGAN WRP – 001[b]	30	50	757 / 379	454 / 227
IL0045039	VILLAGE OF WESTERN SPRINGS CSOS – 004[c]	No reported CSO volume		0 / 0	--
IL0048721	ROSELLE-BOTTERMAN WWTF – 001	1.22	4.60	70 / 35	18 / 9
IL0052817	STONEWALL UTILITY COMPANY - STP	0.01	0.07	1.1 / 0.5	0.2 / 0.1
IL0069744	BOLINGBROOK WRF #3 – 001	2.8 current, 4.2 future	7.0 current, 10.5 future	159 / 79	64 / 32
IL0074373	PLAINFIELD NORTH STP – 001	7.5	15.0	227 /114	114 / 57
IL0076414	JOLIET AUX SABLE WWTP – 001	3.2	7.8	118 / 59	48 / 24
IL0079073	ITASCA STP – 001	3.2	8.2	124 / 62	48 / 24
IL0028053[e]	MWRDGC STICKNEY WRP CSOS – 150[c] (Westchester Pump Station)	389 (maximum CSO volume, October 2014)[d]		1,878 / 939 – discharges to GL-09 11,039 / 5,520 – discharges to GL-19 5,891 / 2,945 discharges to GLA-02	--
ILM580008[e]	LAGRANGE PARK CSOS – 001/002/003/004/005/006[c]	124 (maximum CSO volume, April 2013)[d]			
ILM580009[e]	VILLAGE OF LAGRANGE CSOS – 001/002/003[c]	No reported CSO volume			
ILM580032[e]	BROOKFIELD CSOS – 001/002/003/005/006/007[c]	341 (maximum CSO volume, April 2013)[d]			

a. 2013-2015 average DMR flows.

b. NPDES-permitted facility with excess flow outfall – excess flows not included in WLAs.

c. CSOs are only allowed to discharge 4 times per year at this level.

d. Maximum CSO volumes from 2013-2015 DMRs.

e. MWRD-permitted facilities are combined into one categorical WLA.

Permit ID	Facility Name	Design Average Flow (MGD)	Design Maximum Flow (MGD)	Chloride WLA (tons/day)	
				High Flows – Design Maximum Flow	Moist Conditions to Low Flows – Design Average Flow
IL0034061	NAPERVILLE SPRING-BROOK WRC – 001	30 (future conditions)	63 (future conditions)	131	63
IL0069744	BOLINGBROOK WRF #3 – 001	4.2 (future conditions)	10.5 (future conditions)	22	9
IL0074373	PLAINFIELD NORTH STP – 001	7.5	15.0	31	16
IL0076414	JOLIET AUX SABLE WWTP – 001	3.2	7.8	16	7
			Total	**200**	**95**

MS4	Chloride WLA (tons/day)		
	High Flows	Moist Conditions	Mid-Range Flows
ILDOT Roads	6	2	0.2
Non-ILDOT MS4s [a]	220	67	9
Total	**226**	**69**	**9..2**

a. The Non-ILDOT MS4 WLA is categorical, see section 6.3.1 for description and Appendix J for a list of MS4s.

Appendix G

NPDES Permit Special Conditions

Draft DuPage/Salt Creek Special NPDES Permit Condition XX.

1. The Permittee shall participate in the DuPage River Salt Creek Workgroup (DRSCW). The Permittee shall work with other watershed members of the DRSCW to determine the most cost effective means to remove dissolved oxygen (DO) and offensive condition impairments in the DRSCW watersheds.
2. The Permittee shall ensure that the following projects and activities set out in the DRSCW Implementation Plan (April 16, 2015), are completed (either by the permittee or through the DRSCW) by the schedule dates set forth below; and that the short-term objectives are achieved for each by the time frames identified below:

Project Name	Completion Date	Short Term Objectives	Long Term Objectives
Oak Meadows Golf Course Dam removal	December 31, 2016 (Completed)	Improve DO	Improve fish passage
Oak Meadows Golf Course stream restoration	December 31, 2017	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi
Fawell Dam modification	December 31, 2018	Modify dam to allow fish passage	Raise fiBi upstream of structure
Spring Brook restoration and dam removal	December 31, 2019	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi and fiBi
Fullersburg Woods Dam modification concept plan development	December 31, 2016 (Completed)	Identify conceptual plan for dam modification and stream restoration	Build consensus among plan stakeholders
Fullersburg Woods Dam modification	December 31, 2021	Improve DO, improve aquatic habitat (QHEI)	Raise miBi and fiBi
Fullersburg Woods Dam modification area stream restoration	December 31, 2022	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi and fiBi
Southern West Branch physical enhancement	December 31, 2022	Improve aquatic habitat (QHEI)	Raise miBi and fiBi

Southern East Branch stream enhancement	December 31, 2023	Improve aquatic habitat (QHEI), reduce inputs of nutrients and sediment	Raise miBi and fiBi
QUAL 2K East Branch and Salt Creek	December 31, 2023	Collect new baseline data and update model	Quantify improvements in watershed. Identify next round of projects for years beyond 2024.
NPS Phosphorus Feasibility Analysis	December 31, 2021	Assess NPS performance from reductions leaf litter and street sweeping	Reduce NPS contributions to lowest practical levels

3. The Permittee shall participate in implementation of a watershed Chloride Reduction Program, either directly or through the DRSCW. The program shall work to decrease DRSCW watershed public agency chloride application rates used for winter road safety, with the objective of decreasing watershed chloride loading. The Permittee shall submit an annual report on the annual implementation of the program identifying the practices deployed, chloride application rates, estimated reductions achieved, analyses of watershed chloride loads, precipitation, air temperature conditions and relative performance compared to a baseline condition. The report shall be provided to the Agency by March 31 of each year reflecting the Chloride Abatement Program performance for the preceding year (example: 2015-16 winter season report shall be submitted no later than March 31, 2017). The Permittee may work cooperatively with the DRSCW to prepare a single annual progress report that is common among DRSCW permittees.

4. The Permittee shall submit an annual progress report on the projects listed in the table of paragraph 2 above to the Agency by March 31 of each year. The report shall include project implementation progress. The Permittee may work cooperatively with the DRSCW to prepare a single annual progress report that is common among DRSCW permittees.

5. The Permittee shall develop a written Phosphorus Discharge Optimization Plan. In developing the plan, the Permittee shall evaluate a range of measures for reducing phosphorus discharges from the treatment plant, including possible source reduction measures, operational improvements, and minor low cost facility modifications that will optimize reductions in phosphorus discharges from the wastewater treatment facility. The permittee’s evaluation shall include, but not necessarily be limited to, an evaluation of the following optimization measures:

   a. WWTF influent reduction measures.

      i. Evaluate the phosphorus reduction potential of users.

      ii. Determine which sources have the greatest opportunity for reducing phosphorus (e.g., industrial, commercial, institutional, municipal, and others).

         1. Determine whether known sources (e.g., restaurant and food preparation) can adopt phosphorus minimization and water conservation plans.

         2. Evaluate implementation of local limits on influent sources of excessive phosphorus.

b. WWTF effluent reduction measures.

i. Reduce phosphorus discharges by optimizing existing treatment processes without causing non-compliance with permit effluent limitations or adversely impacting stream health.

1. Adjust the solids retention time for biological phosphorus removal.
2. Adjust aeration rates to reduce DO and promote biological phosphorus removal.
3. Change aeration settings in plug flow basins by turning off air or mixers at the inlet side of the basin system.
4. Minimize impact on recycle streams by improving aeration within holding tanks.
5. Adjust flow through existing basins to enhance biological nutrient removal.
6. Increase volatile fatty acids for biological phosphorus removal.

6. Within 24 months of the effective date of this permit, the Permittee shall finalize the written Phosphorus Discharge Optimization Evaluation Plan and submit it to IEPA. The plan shall include a schedule for implementing all of the evaluated optimization measures that can practically be implemented and include a report that explains the basis for rejecting any measure that was deemed impractical. The schedule for implementing all practical measures shall be no longer than 36 months after the effective date of this permit. The Permittee shall implement the measures set forth in the Phosphorus Discharge Optimization Plan in accordance with the schedule set forth in that Plan. The Permittee shall modify the Plan to address any comments that it receives from IEPA and shall implement the modified plan in accordance with the schedule therein.

   Annual progress reports on the optimization of the existing treatment facilities shall be submitted to the Agency by March 31 of each year beginning 24 months from the effective date of the permit.

7. The Permittee shall, within 24 months of the effective date of this permit, complete a feasibility study that evaluates the timeframe, and construction and O & M costs of reducing phosphorus levels in its discharge to a level consistently meeting a limit of 1 mg/L, 0.5 mg/L and 0.1 mg/L utilizing a range of treatment technologies including, but not necessarily limited to, biological phosphorus removal, chemical precipitation, or a combination of the two. The study shall evaluate the construction and O & M costs of the different treatment technologies for these limits on a monthly, seasonal, and annual average basis. For each technology and each phosphorus discharge level evaluated, the study shall also evaluate the amount by which the Permittee's typical household annual sewer rates would increase if the Permittee constructed and operated the specific type of technology to achieve the specific phosphorus discharge level. Within 24 months of the effective date of this Permit, the Permittee shall submit to the Agency and the DRSCW a written report summarizing the results of the study.

8. Total phosphorus in the effluent shall be limited as follows:

   a. If the Permittee will use chemical precipitation to achieve the limit, the effluent limitation shall be 1.0 mg/L on a monthly average basis, effective 10 years after the effective date of this permit unless the Agency approves and reissues or modifies the permit to include an alternate phosphorus reduction program pursuant to paragraph c or d below that is fully implemented within 10 years of the effective date of this permit.

   b. If the Permittee will primarily use biological phosphorus removal to achieve the limit, the effluent limitation shall be 1.0 mg/L monthly average to be effective 11 years after the effective date of this permit unless the Agency approves and reissues or modifies the permit to include an alternate phosphorus reduction program pursuant to paragraph c or d below that is fully implemented within 11 years of the effective date of this permit.

   c. The Agency may modify this permit if the DRSCW has developed and implemented a trading program for POTWs in the DRSCW watersheds, providing for reallocation of allowed phosphorus loadings between two or more POTWs in the DRSCW watersheds, that delivers the same results of overall watershed phosphorus point-source reduction and loading anticipated from the uniform application of the applicable 1.0 mg/L monthly average effluent limitation among the POTW permits in the DRSCW watersheds and removes DO and offensive condition impairments and meet the applicable dissolved oxygen criteria in 35 IL Adm. Code 302.206 and the narrative offensive aquatic algae criteria in 35 IL Adm. Code 302.203.

   d. The Agency may modify this permit if the DRSCW has demonstrated and implemented an alternate means of reducing watershed phosphorus loading to a comparable result within the timeframe of the schedule of this condition and removes DO and offensive condition impairments and meet the applicable dissolved oxygen criteria in 35 IL Adm. Code 302.206 and the narrative offensive aquatic algae criteria in 35 IL Adm. Code 302.203.

9. The Permittee shall monitor the wastewater effluent, consistent with the monitoring requirements on Page 2 of this permit, for total phosphorus, dissolved phosphorus, nitrate/nitrite, total Kjeldahl nitrogen (TKN), ammonia, total nitrogen (calculated), alkalinity and temperature at least once a month. The Permittee shall monitor the wastewater influent for total phosphorus and total nitrogen at least once a month. The results shall be submitted on NetDMRs to the Agency unless otherwise specified by the Agency.

10. The Permittee shall submit a Nutrient Implementation Plan (NIP) for the DRSCW watersheds that identifies phosphorus input reductions by point source discharges, nonpoint source discharges and other measures necessary to remove DO and offensive condition impairments and meet the applicable dissolved oxygen criteria in 35 IL Adm. Code 302.206 and the narrative offensive aquatic algae criteria in 35 IL Adm. Code 302.203. The NIP shall also include a schedule for implementation of the phosphorus input reductions and other measures. The Permittee may work cooperatively with the DRSCW to prepare a single NIP that is common among DRSCW permittees. The NIP shall be submitted to the Agency by December 31, 2023.

Appendix H

Land Use Classifications for STEPL Analysis

CMAP LC Codes		STEPL Classification
1111	RESIDENTIAL	Urban
1112	RESIDENTIAL	Urban
1130	RESIDENTIAL	Urban
1140	RESIDENTIAL	Urban
1151	RESIDENTIAL	Urban
1211	COMMERCIAL	Urban
1212	COMMERCIAL	Urban
1214	COMMERCIAL	Urban
1215	COMMERCIAL	Urban
1216	COMMERCIAL	Urban
1220	COMMERCIAL	Urban
1240	COMMERCIAL	Urban
1250	COMMERCIAL	Urban
1310	INSTITUTIONAL	Urban
1321	INSTITUTIONAL	Urban
1322	INSTITUTIONAL	Urban
1330	INSTITUTIONAL	Urban
1340	INSTITUTIONAL	Urban
1350	INSTITUTIONAL	Urban
1360	INSTITUTIONAL	Urban
1370	INSTITUTIONAL	Urban
1380	INSTITUTIONAL	Urban
1410	INDUSTRIAL	Urban
1420	INDUSTRIAL	Urban
1431	INDUSTRIAL	Urban
1432	INDUSTRIAL	Urban
1433	INDUSTRIAL	Urban
1450	INDUSTRIAL	Urban
1511	TRANS/COMM/UTIL/WASTE	Urban
1512	TRANS/COMM/UTIL/WASTE	Urban
1520	TRANS/COMM/UTIL/WASTE	Urban
1530	TRANS/COMM/UTIL/WASTE	Urban
1540	TRANS/COMM/UTIL/WASTE	Urban
1550	TRANS/COMM/UTIL/WASTE	Urban
1561	TRANS/COMM/UTIL/WASTE	Urban

CMAP LC Codes		STEPL Classification
1562	TRANS/COMM/UTIL/WASTE	Urban
1563	TRANS/COMM/UTIL/WASTE	Urban
1564	TRANS/COMM/UTIL/WASTE	Urban
1565	TRANS/COMM/UTIL/WASTE (Stormwater Management)	Urban
2000	AGRICULTURE	Cropland
3100	DEVELOPED OPEN SPACE	Urban
3200	DEVELOPED OPEN SPACE	Urban
3300	DEVELOPED OPEN SPACE	Forest
3400	DEVELOPED OPEN SPACE	Forest
3500	DEVELOPED OPEN SPACE	Urban
4110	Vacant Residential Land	Urban
4120	Vacant Commercial Land	Urban
4130	Vacant Industrial Land	Urban
4140	Other Vacant	Urban
4210	Under Construction, Residential	Urban
4220	Under Construction, Commercial	Urban
4240	Under Construction, Other or Unknown	Urban
5000	Water	Not used
6100	Non-Parcel Open Space	Forest
6200	Non-Parcel Water	Not used
6300	Non-Parcel Right-of-Way	Urban
6400	Non-Parcel NEC	Urban
9999	Not Classifiable	Not used

Appendix I

Annual Phosphorus, BOD, and Sediment Loading, and Developed Land Use per Model Catchment

Watershed ID	Phosphorus (lb/acre/yr)	BOD lb/acre/yr)	Sediment (ton/acre/yr)	% Developed Land Cover
EB_01	0.85	19.65	0.13	54.4
EB_02	1.00	22.31	0.16	75.2
EB_03	1.39	30.61	0.20	99.5
EB_04	1.28	29.52	0.18	99.3
EB_05	0.87	21.25	0.14	74.7
EB_06	1.36	30.53	0.20	94.6
EB_07	1.02	23.71	0.16	79.6
EB_08	1.12	25.34	0.16	99.1
EB_09	1.30	29.18	0.19	93.3
EB_10	1.15	25.47	0.17	88.8
WB_01	1.13	24.59	0.17	56.9
WB_02	1.10	26.18	0.17	47.3
WB_03	1.13	25.54	0.19	81.5
WB_04	0.94	20.93	0.14	87.3
WB_05	0.87	19.44	0.14	71.9
WB_06	1.33	26.40	0.26	79.9
WB_07	1.09	25.45	0.16	94.6
WB_08	1.18	26.68	0.19	94.4
WB_09	0.87	18.85	0.16	63.0
WB_10	1.06	22.36	0.18	85.2
WB_11	1.21	25.75	0.20	67.4
LD_01	1.33	19.03	0.50	56.0
LD_02	1.31	18.53	0.50	43.0
LD_03	1.33	29.14	0.20	79.6
LD_04	1.15	24.62	0.21	75.9
LD_05	1.22	19.45	0.37	51.4
LD_06	1.65	19.59	0.66	18.5
LD_07	1.34	21.84	0.38	63.1
LD_08	1.19	23.98	0.26	78.1
LD_09	1.26	20.11	0.36	56.5
LD_10	0.84	17.13	0.16	60.8
LD_11	1.38	24.28	0.34	64.4
LD_12	1.23	25.36	0.23	84.6
LD_13	1.27	20.34	0.38	56.9
LD_14	1.51	20.51	0.55	47.3
LD_15	1.15	23.58	0.22	81.5
LD_16	1.20	23.24	0.27	87.3
LD_17	0.85	18.81	0.13	71.9
LD_18	1.14	27.94	0.18	79.9

Appendix J

List of Municipal Separate Storm Sewer Systems

Permit ID	MS4 Name
ILR400001	Addison Township MS4
ILR400277	Addison Village MS4
ILR400282	Arlington Heights Village MS4
ILR400283	Aurora MS4
ILR400526	Aux Sable Township MS4
ILR400285	Barrington Village MS4
ILR400008	Barrington Township MS4
ILR400286	Bartlett Village MS4
ILR400288	Batavia MS4
ILR400009	Batavia Township MS4
ILR400291	Bellwood Village MS4
ILR400292	Bensenville Village MS4
ILR400166	Berkeley Village MS4
ILR400013	Bloomingdale Township MS4
ILR400295	Bloomingdale Village MS4
ILR400298	Bolingbrook Village MS4
ILR400167	Broadview Village MS4
ILR400302	Brookfield Village MS4
ILR400308	Carol Stream Village MS4
ILR400027	Channahon Township MS4
ILR400623	Channahon Village MS4
ILR400175	Clarendon Hills Village MS4
ILR400485	Cook County Highway Dept MS4
ILR400319	Crest Hill, City MS4
ILR400561	Crystal Lawn Subdivision MS4
ILR400180	Darien City MS4
ILR400040	Downers Grove Township MS4
ILR400183	Downers Grove Village MS4
ILR400502	DuPage County MS4
ILR400042	DuPage Township MS4
ILR400048	Elk Grove Township MS4
ILR400334	Elk Grove Village MS4
ILR400187	Elmhurst MS4
ILR400195	Franklin Park Village MS4
ILR400341	Geneva MS4
ILR400056	Geneva Township MS4
ILR400199	Glen Ellyn Village MS4
ILR400342	Glendale Heights Village MS4
ILR400347	Hanover Park Village MS4
ILR400063	Hanover Township MS4
ILR400354	Hillside Village MS4
ILR400355	Hinsdale Village MS4

Permit ID	MS4 Name
ILR400210	Hoffman Estates Village MS4
ILR400494	IL State Toll Highway Authority MS4
ILR400493	Illinois Department of Transportation MS4
ILR400359	Inverness Village MS4
ILR400360	Itasca Village MS4
ILR400361	Joliet MS4
ILR400071	Joliet Township MS4
ILR400259	Kane County MS4
ILR400261	Kendall County MS4
ILR400365	LaGrange Park Village MS4
ILR400364	LaGrange Village MS4
ILR400076	Leyden Township MS4
ILR400079	Lisle Township MS4
ILR400376	Lisle Village MS4
ILR400080	Lockport Township MS4
ILR400378	Lombard Village MS4
ILR400082	Lyons Township MS4
ILR400220	Lyons Village MS4
ILR400384	Maywood Village MS4
ILR400386	Melrose Park Village MS4
ILR400086	Milton Township MS4
ILR400638	Minooka Village MS4
ILR400594	NA-AU-SAY Township MS4
ILR400396	Naperville MS4
ILR400092	Naperville Township MS4
ILR400229	North Riverside Village MS4
ILR400406	Northlake MS4
ILR400407	Oak Brook Village MS4
ILR400232	Oakbrook Terrace City MS4
ILR400104	Oswego Township MS4
ILR400415	Oswego Village MS4
ILR400107	Palatine Township MS4
ILR400416	Palatine Village MS4
ILR400111	Plainfield Township MS4
ILR400426	Plainfield Village MS4
ILR400112	Proviso Township MS4
ILR400433	Rockdale Village MS4
ILR400435	Rolling Meadows MS4
ILR400436	Romeoville Village MS4
ILR400437	Roselle Village MS4
ILR400122	Schaumburg Township MS4
ILR400443	Schaumburg Village MS4
ILR400445	Shorewood Village MS4
ILR400648	South Barrington Village MS4
ILR400454	St Charles MS4
ILR400131	St Charles Township MS4
ILR400248	Stone Park Village MS4

Permit ID	MS4 Name
ILR400456	Streamwood Village MS4
ILR400141	Troy Township MS4
ILR400463	Villa Park Village MS4
ILR400274	Warrenville MS4
ILR400149	Wayne Township MS4
ILR400500	Wayne Village MS4
ILR400466	West Chicago MS4
ILR400468	Westchester Village MS4
ILR400469	Western Springs Village MS4
ILR400254	Westmont Village MS4
ILR400152	Wheatland Township MS4
ILR400470	Wheaton MS4
ILR400153	Wheeling Township MS4
ILR400272	Will County MS4
ILR400155	Winfield Township MS4
ILR400474	Winfield Village MS4
ILR400478	Wood Dale MS4
ILR400480	Woodridge Village MS4
ILR400159	York Township MS4