Final Report

Total Maximum Daily Loads for West Branch DuPage River, Illinois

Submitted to

Illinois Environmental Protection Agency

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

October 2004

Prepared by

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In association with

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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WW-16J

23 SEP 2004

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Marcia T. Willhite , Chief
Bureau of Water
Illinois Environmental Protection Agency
1021 North Grand Ave. East
P.O. Box 19276
Springfield, IL 62794-9276

Dear Ms. Willhite:

The United States Environmental Protection Agency (U.S. EPA) has reviewed the final Total Maximum Daily Load (TMDL) for West Branch DuPage River Segments (GBK05, GBK07, GBK09, and GBK12) including supporting documentation and follow up information. IEPA's submitted TMDLs address the presence of elevated levels of chloride that impairs the General Use in Segment GBK05, Segment GBK07, Segment GBK09, and Segment GBK12 of the West Branch DuPage River. Based on this review, U.S. EPA has determined that Illinois's TMDLs for chloride meet the requirements of Section 303(d) of the Clean Water Act and U.S. EPA's implementing regulations at 40 C.F.R. Part 130. Therefore, U.S. EPA hereby approves Illinois's 4 TMDLs for the impaired West Branch DuPage River Segments (GBK05, GBK07, GBK09, and GBK12). The statutory and regulatory requirements, and U.S. 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 this submitted TMDL, and look forward to future TMDL submissions by the State of Illinois. If you have any questions, please contact Mr. Kevin Pierard, Chief of the Watersheds and Wetlands Branch at 312-886-4448.

Sincerely yours,

Jo Lynn Traub
Director, Water Division

Enclosure

Executive Summary

This report discusses the development of total maximum daily loads (TMDLs) for the West Branch DuPage River, located mainly in DuPage County and a tributary to the DuPage River in the greater Chicagoland area. The 1998 Illinois Section 303(d) List identified the West Branch of the DuPage River as impaired for nutrients, ammonia, metals, salinity, total dissolved solids (TDS), chlorides, suspended solids, siltation, pathogens and habitat alterations. The 2000 305(b) Report updated these potential causes of impairment to be phosphorus, nitrogen, nitrates, salinity, total dissolved solids (TDS), chlorides, flow alterations, habitat alterations, copper and suspended solids. The Agency has adopted a policy of developing TMDLs only on potential causes of impairment that have a water quality standard, which, in this case, were salinity, TDS, chlorides and copper.

This report describes and presents the methods and procedures used to develop a chloride TMDL for the West Branch DuPage River. The West Branch DuPage River watershed covers 127.2 square miles of northeastern Illinois. It is located in the Des Plaines hydrologic unit code (HUC 7120004). Almost one third (32.8 percent) of the land use in the watershed is residential; agriculture accounts for about 17 percent of the land use. Nearly 14 percent of the total watershed area is impervious surfaces (based upon 1990 land use data). There are 14 major point sources in the watershed, of which half are wastewater treatment plants.

The U.S. Environmental Protection Agency's Hydrologic Simulation Program Fortran watershed model, Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) analysis system, was used to characterize the watershed and evaluate TMDL allocations. Spatial data (land use and cover, hydrographic and topographic data, and best management practices [BMP] information), monitoring data (water quality, flow, and weather information), and pollutant source data were used to develop input parameters for the watershed models.

TMDLs are the sums of individual waste load allocations (WLAs) for point sources, load allocations (LAs) for both nonpoint sources and natural background, and a margin of safety. This definition is denoted by the following equation:

$$\text{TMDL} = \Sigma\ \text{WLAs} + \Sigma\ \text{LAs} + \text{MOS}$$

The chloride TMDL for the West Branch DuPage River watershed was developed to achieve full compliance with Illinois water quality standards (WQS). Data analysis showed only one clear violation of the WQS standard, that occurred in January 1997 but a clear trend of elevated chloride concentrations in the winter months and a handful of observations very close to the WQS of 500 mg/L. The total waste load allocation for point sources was calculated to be 44.77×10^6 lb/year, assuming a 400 mg/L chloride concentration and historical point source flow rates with an allowance for increased flows from future growth. This estimate was made based on observed data from three wastewater treatment plants in the watershed. The load allocation for the West Branch DuPage River watershed was estimated to be 13.71×10^6 lb/year. The margin of safety (MOS) was assumed implicit in the modeling by conservative assumptions in model setup. Implementation of the TMDL will be based upon the WQS and United States Environmental Protection Agency guidance. The primary cause of chloride WQS exceedances is winter deicing activities. The model simulations conducted in support of the chloride TMDL indicate that a chloride WQS exceedance occurs approximately two times per year on average. A model run was also made in which the chloride concentration for point source discharges was set to zero. The results show no exceedance of the chloride water quality standard under existing land use nonpoint source conditions is theoretically possible, but that there is very little difference in the number of exceedances over the range of zero to over 400 mg/L point source discharge concentrations.

There were no Concentrated Animal Feeding Operations (CAFOs) identified in this watershed. CAFOs were also not identified as contributors of chloride, the pollutant for which this TMDL was developed, and will not be addressed in this TMDL.

Chloride, TDS and salinity (as measured through specific conductance) are three related issues of water quality. TDS can be directly correlated to chloride and the specific conductivity of water is proportional to TDS. Hence, it is assumed, by addressing the chloride impairments in the West Branch DuPage River the TDS and salinity problems will also be addressed.

Copper data used for the 303(d) listing was reviewed. The data review showed only one violation in the last decade, in October 1996, representing less than 0.3 percent of the observed data. The average copper value for the observed data was 10.7 µg/L. Based on the provided data and analysis copper is recommended for delisting and removal from the 303(d) list.

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Acronyms and Abbreviations

AS	acute standard
BASINS	Better Assessment Science Integrating Point and Nonpoint Sources
BMP	best management practices
cfs	cubic feet per second
CS	chronic standard
CWA	Clean Water Act
DCDS	DEC Stormwater Management Division
DEC	DuPage County Department of Environmental Concerns
DEM	digital elevation models
EIA	effective impervious area
GIS	geographic information system
GU	general use
HSPF	Hydrologic Simulation Program Fortran
IDNR	Illinois Department of Natural Resources
IEPA	Illinois Environmental Protection Agency
µmho	micromho
MOS	margin of safety
MWRDGC	Metropolitan Water Reclamation District of Greater Chicago
NCDC	National Climatic Data Center
NIPC	Northeastern Illinois Planning Commission
NOAA	National Oceanographic and Atmospheric Administration
PRISM	parameter-elevation regressions on independent slopes model
R-squared	coefficient of determination
RF3	reach file version 3
STP	sewage treatment plant
TDS	total dissolved solids
TMDL	total maximum daily loads
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WDM	Watershed Data Management
WLA	waste load allocation
WQS	water quality standards
WWTP	wastewater treatment plant

1. Introduction

1.1 Background

Section 303(d) of the Federal Clean Water Act (CWA) and the U.S. Environmental Protection Agency's (USEPA's) Water Quality Planning and Management Regulations (40 CFR Part 130) require states to identify water bodies that do not meet water quality standards (WQS) applicable to their designated use classifications and to develop total maximum daily loads (TMDLs) for those water bodies. The TMDL process establishes the allowable pollutant loads or other quantifiable parameters for a water body based on the relationship between pollutant sources and instream conditions. By following the TMDL process, states can establish water quality based controls to reduce pollution from point and nonpoint sources and restore and maintain water quality (USEPA 1991).

Located in DuPage County, Illinois with small parts in Will (south), Cook (north), and Kane (west) counties, the West Branch DuPage River was placed on the Illinois 303(d) list of impaired waters for chloride exceedances. A chloride TMDL was established for the West Branch to determine options to address the current chloride WQS exceedances. Copper also was evaluated for one segment of the West Branch for this report.

This document presents the chloride TMDL developed for the West Branch DuPage River and describes the methods and procedures used to develop the TMDL for impaired segments in the watershed.

1.2 Organization of the Report

This report is organized to provide a structured description of:

- TMDL endpoints
- Watershed characterization and source assessment
- Water quality assessment
- TMDL approach
- Modeling approach and assumptions
- Recommended allocation scenario

The report builds upon a series of technical memorandums that have been submitted throughout the West Branch DuPage River TMDL development process. Comments received on the technical memorandums are addressed in this report.

2. Target Identification/Determination of TMDL Endpoints

The 1998 Illinois Section 303(d) List identified the West Branch of the DuPage River as impaired for nutrients, ammonia, metals, salinity, total dissolved solids (TDS), chlorides, suspended solids, siltation, pathogens and habitat alterations. The 2000 305(b) Report updated these potential causes of impairment to be phosphorus, nitrogen, nitrates, salinity, total dissolved solids, chlorides, flow alterations, habitat alterations, copper and suspended solids. In developing the 2002 Illinois Section 303(d) List, the Illinois EPA revised its prioritization method that accounts for severity of pollution and the uses to be made of such waters. Prioritization was done on a watershed basis. For a detailed explanation see Appendix E or refer to the Illinois 2002 Section 303(d) list, available at http://www.epa.state.il.us/water/watershed/reports/303d-report/index.html. Under this new prioritization process, emphasis is given to those parameters with numeric WQS. These are identified in Table 2-1 and Figure 2-1. As a result of prioritization, this study focused on copper and chloride, which have a numeric WQS.

The IEPA is aware of the other parameters previously listed and those parameters will be given attention through methods other than a TMDL and hence no further discussion of those will be provided in this document. Pending development of appropriate water quality standards as may be proposed by the Agency and adopted by the Pollution Control Board, Illinois EPA will continue to work toward improving water quality throughout the state by promoting and administering existing programs and working to innovate and create new methods of treating potential causes of impairment.

According to state classifications of Illinois water, the West Branch DuPage River is designated for general use (GU). Based on this classification, a chloride TMDL was developed, and designed to meet applicable WQS. The first part of this section outlines the different segments and the pollutants of concern for the West Branch DuPage River. The second part outlines the TMDL endpoints selected for each pollutant listed for the West Branch DuPage River under the Illinois 303(d) list. Segment GBK 11 is not included in Table 2-1, as it was not listed for copper or chloride contamination. In the original 303(d) list segment GBK 11 was listed for other pollutants that are not included under IEPA's prioritization method.

2.1 West Branch DuPage River Impaired Segments

Several segments of West Branch DuPage River do not meet the Illinois WQS. Table 2-1 presents a complete list of all segments and causes of impairments associated with numeric WQS. Figure 2-1 shows the location of the impaired segments in West Branch DuPage River.

2.2 Applicable Water Quality Standards and TMDL Endpoints

The applicable WQS was the chosen endpoint for the TMDL. Table 2-2 presents a complete list of pollutants. For the copper TMDL endpoint, the chronic standard was chosen. Compliance with the chronic standard will automatically allow the acute standard to be met since the chronic standard is more stringent.

TABLE 2-1
Segments of West Branch DuPage River That This TMDL Report Addresses and Identified Causes of Impairments

Segment Number	Copper	Salinity/TDS/Chloride
GBK 07	A	M
GBK 09	D	M
GBK 05	A	M
GBK 12	A	M

M = TMDL will be developed using HSPF
D = Request for delisting (see Section 4.4)
A = The segment was not listed for the specific cause of impairment

TABLE 2-2
Applicable Numeric Water Quality Standards and Guidelines

	Parameter	
	Copper (dissolved), µg/L as C	Chloride
STORET #	01042	00940
Water Quality Standard	Acute: Exp[A+Bln(H)], where A = -1.464, B = 0.9422, H = hardness Chronic: exp[A+Bln(H)], where A = -1.465, B = 0.8545	500 mg/L
TMDL Endpoints	Use chronic standard; dependent on water hardness	WQS*

*WQS = water quality standard

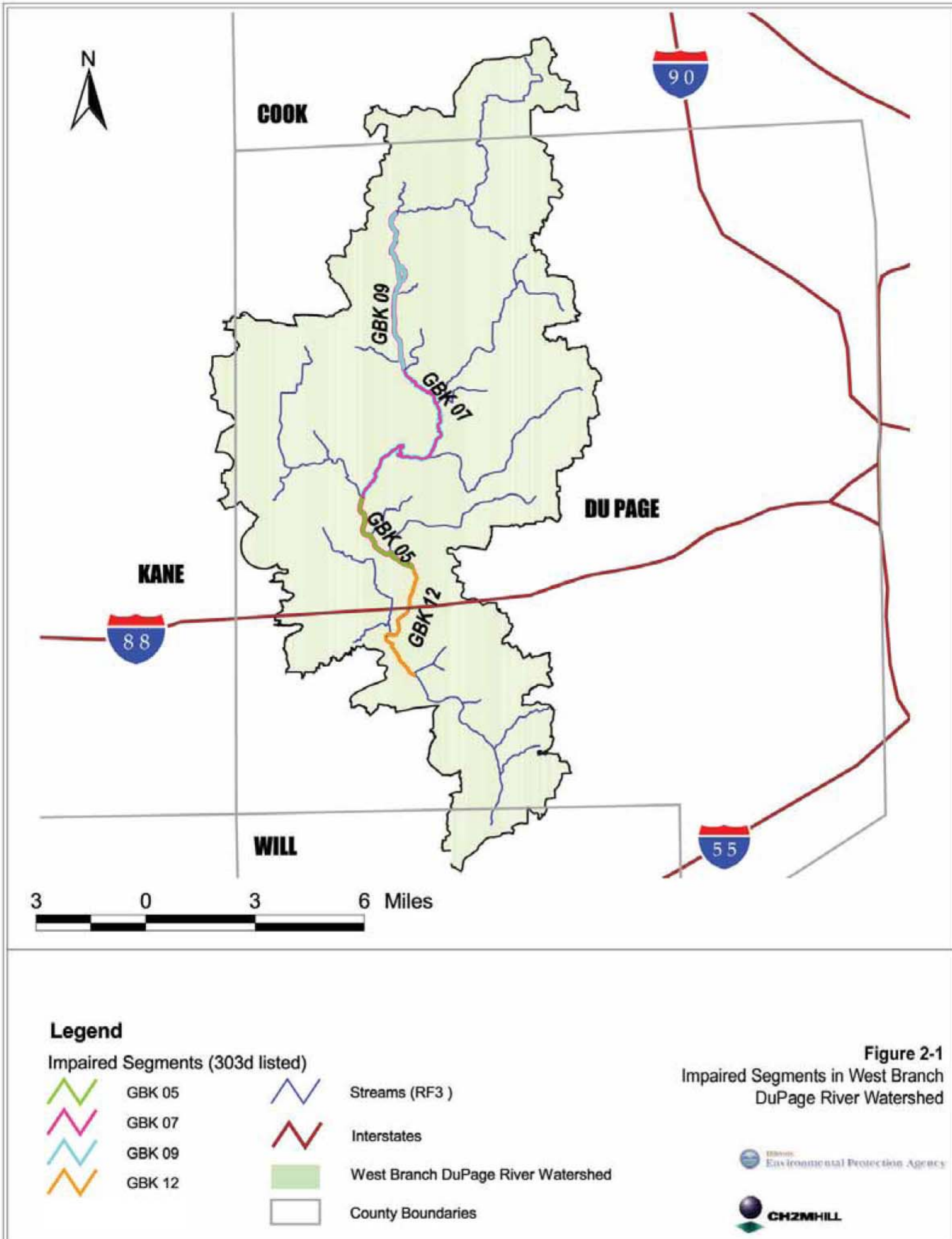


Figure 2-1
Impaired Segments in West Branch DuPage River Watershed

3. Watershed Characterization and Source Assessment

This section describes the data acquired and watershed characterization conducted to develop the West Branch DuPage River TMDLs. The historical data for each 303(d) listed pollutant are presented and discussed, followed by an assessment of available data for watershed modeling.

3.1 Watershed Description and Background Information

The West Branch DuPage River watershed encompasses about 127.2 square miles of northeastern Illinois, mainly in DuPage County with small segments in Kane, Cook, and Will counties. Digital Elevation Models (DEMs) from U.S. Geological Survey (USGS; http://edc.usgs.gov/geodata/) and watershed boundaries provided by the DuPage County Department of Environmental Concerns (DEC) Stormwater Division, and the most detailed Reach File Version 3 (RF3) provided with data from the Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) data set were used to verify watershed boundaries and create subbasins.

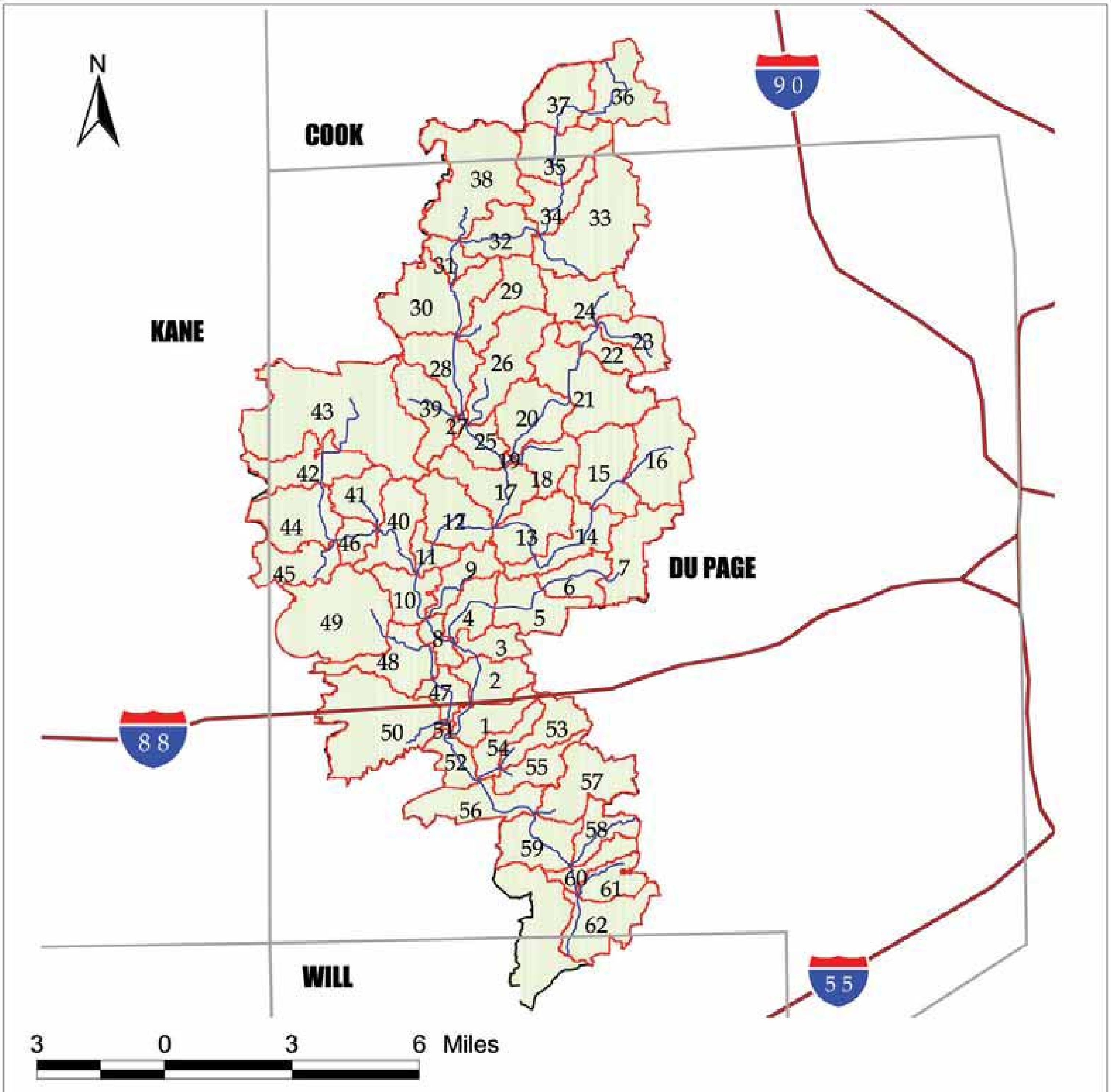
The watershed was divided into 62 subbasins. Figure 3-1 shows the subbasin delineation together with the 303(d) listed impaired segments. A draft delineation of the subbasins was made using the BASINS automatic delineation tool in ArcView, based on 30-meter DEM (USGS), watershed boundaries (DuPage County), and modified RF3 streams (USEPA). This draft delineation was then modified by combining the smallest subbasins and matching the edges of the subbasins to the watershed boundary provided by DuPage County. This iterative process produced 62 subbasins with an average area of 1.99 square miles.

Using this delineation, the drainage areas were checked versus the areas published by the USGS at each of three mainstem USGS gages. The delineated area is about 3 percent lower than the area published for the gage farthest upstream (at West Chicago) and within 0.5 percent at the other two gages. These differences are within a range deemed acceptable for modeling.

3.2 Land Use

Land use data were obtained from the Northeastern Illinois Planning Commission (NIPC) and BASINS. Current land usage within the watershed area, obtained from NIPC data (NIPC 1990), is shown in Figure 3-2. The category termed “open space” also contains forested areas. To distinguish forested areas from other land uses defined as open space, a coverage from the Illinois Department of Natural Resources (IDNR) was obtained with the forested areas located within the area of the watershed. By overlaying the NIPC and the IDNR coverage, a complete land use map of the watershed was obtained. The forested areas in the watershed equals about 47 percent of the open land category and 5.3 percent of the total watershed area.

Primary land use within the watershed includes 32.83 percent residential area and 17.44 percent agricultural area. Excluding wetland area, 16.91 percent of the land within the watershed area is vacant. Table 3-1 summarizes the land use distribution within the watershed.



Legend

- Streams (RF3)
- Interstates
- West Branch DuPage River Watershed
- County Boundaries
- Subwatersheds

Figure 3-1
Subwatersheds in West Branch DuPage River Watershed

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TABLE 3-1
Land Use Breakdown for West Branch DuPage River Watershed

Land Use	Area (acres)	Area (mi^2)	% of Total Area	% Impervious	Impervious (acres)
Agricultural	14,202	22.19	17.4	0	0.00
Cemeteries	157	0.25	0.2	0	0.00
Commercial	4,370	6.83	5.4	64	2,796.8
Expressways	189	0.30	0.2	60	113.4
Industrial	3,027	4.73	3.7	64	1,937.3
Institutional Excluding Cemeteries	4,379	6.84	5.4	64	2,802.6
Open Land **	9,132	14.27	11.2	0	0.00
Residential	26,730	41.77	32.8	10	2,673
Transportation Classification Units, Excluding Interstates*	937	1.46	1.2	60	562.2
Vacant Excluding Wetlands	13,766	21.51	16.9	0	0.00
Water	1,353	2.11	1.7	0	0.00
Wetlands	3,045	4.76	3.7	0	0.00
Unclassified	131	0.20	0.2	64	83.8
Total Area	**81,417**	**127.12**	**100**		**10,969.1**

Note:
All data were taken from NIPC, except areas classified as "Open Land," which were determined from IDNR land use data and NIPC data together.
*All transportation land use excluding interstates and expressways
** Forested areas covers about 47% of the open land category

Land use data were used to characterize nonpoint pollution sources in the watershed and to complete the load allocation portion of the TMDL. The West Branch DuPage River watershed was listed for two pollutants that are generated or transported by stormwater runoff, copper and chloride / total dissolved solids (TDS)/salinity. During modeling, these pollutants were linked to contributing types of land use (see Section 6).

3.3 Hydrographic Data

The DEC Stormwater Management Division (DCDS) provided hydrographic data that were compared with RF3 data in USEPA's BASINS 3.0. Both data sets had identical basic reach information. The DCDS data included smaller and isolated water bodies, but most of these smaller isolated water bodies showed very little stream network connectivity and consequently the RF3 data was used. The RF3 data included all the connected streams in the watersheds and additional attribute information that were required to set up the model. Appendix A includes a detailed summary of the reaches used for modeling.

3.4 Meteorological Data

Weather data were needed to calibrate hydrologic and water quality models and were used by the models to generate runoff volumes. The modeled runoff volumes were routed to determine stream flow values that were compared with data from several stream flow gage in the West Branch DuPage River watershed (see Section 3.6). Using this comparison of observed and modeled values, model input parameters were adjusted.

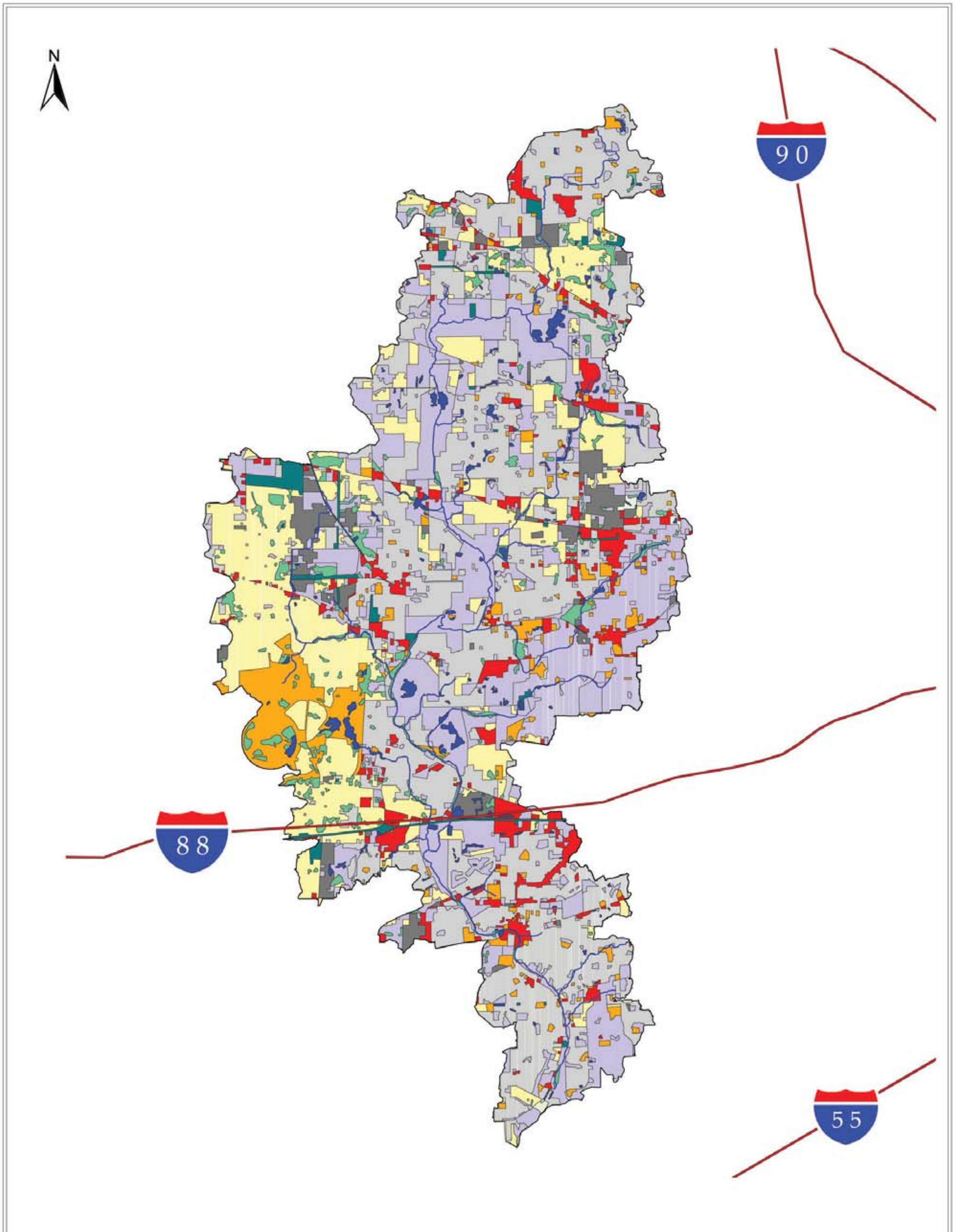

Figure 3-2
Land Use in West Branch DuPage River Watershed

A search was conducted, based on the location of National Climatic Data Center (NCDC) stations, to locate potential weather stations which could provide weather data such as precipitation, temperature, wind movement, dew point, and evapotransipiration. Only two weather stations, West Chicago and Naperville, were found to be located inside of the watershed boundaries. Figure 3-3 shows the locations of various weather stations with respect to the watershed. Data from several different stations was utilized in the construction of the Watershed Data Management file for modeling.

To create the Watershed Data Management file needed for HSPF modeling purposes available weather stations in the area were identified. In addition to the location of a particular weather station in proximity to the West Branch DuPage River watershed, record length and data quality are also important factors in determining which station(s) should be used to develop modeling input parameters. As listed in Table 3-2, certain USGS flow monitoring stations located in the area of the watershed regularly record precipitation as a component of their weather data. Table 3-2 also lists the length of available flow data records from USGS stations located in the West Branch DuPage River watershed.

NIPC provided NCDC and other weather data in a Watershed Data Management (WDM) file format. Table 3-2 shows the data included in the WDM files. NIPC obtained precipitation data primarily from the NCDC and from a gage at Argonne National Laboratory. Daily precipitation data were disaggregated using nearby hourly recording gages. Figure 3-3 shows the location of each station where precipitation data were collected for West Branch DuPage River. In addition to precipitation data, NIPC provided potential evapotranspiration, cloud cover, solar radiation, air temperature, dewpoint, temperature, and wind movement data in a WDM format. Most of these data come from the NCDC.

TABLE 3-2
Weather Data Provided in NIPC WDM Files

Start Date	End Date	Station ID	Data Type	Daily or Recording
01/01/1948	07/31/1996	Chicago O'Hare WSE ARP R	Hourly precipitation (0.01 inch)	Recording (hourly)
01/01/1948	09/30/1999	Chicago Midway AP 3 SW	Hourly precipitation (0.01 inch)	Recording (hourly)
06/30/1948	09/30/1988	McHenry WG Stratton L&D	Hourly precipitation (0.01 inch)	Recording (hourly)
09/30/1948	07/31/1996	Aurora	Daily data distributed to hourly (0.01 inch)	Daily (converted to hourly using Argonne data)
01/01/1948	12/31/1999	Wheaton 3 SE	Daily data distributed to hourly (0.01 inch)	Daily (converted to hourly using Argonne data)

Data source: NCDC

West Chicago was the only weather station with precipitation data located in the West Branch DuPage River watershed (Figure 3-3). This USGS flow gage station also records 5-minute precipitation data. However, it only contained values from 1996 to 2000, and occasionally there was missing data. A time series of precipitation data was created using O'Hare precipitation data (January 1, 1985 through December 3, 1996) and West Chicago precipitation data (December 4, 1996 through December 31, 1999). Missing West Chicago precipitation data were filled with O'Hare data. Precipitation data from Elgin were used for subwatersheds 36 and 37, the Wheaton precipitation data were applied to subwatersheds 6, 7, 14, 15, 16 and 53, Naperville precipitation data were applied to subwatershed 55 through 62 and West Chicago precipitation data were used for the remainder of the subwatershed in West Branch DuPage River watershed. Figure 3-4 shows a map of the precipitation gages used for each subbasin.

The spatial variability of rainfall throughout the study area was verified using annual rainfall data found at Oregon State University's software system web site (http://www.ocs.orst.edu/prism/). The parameter-elevation regressions on independent slopes model (PRISM) on the web site uses point data and a DEM to generate gridded estimates of climate parameters, including precipitation. The annual precipitation for Illinois was downloaded from this site. Review of the data shown in Figure 3-5 indicated that there were no significant spatial variations in rainfall patterns across the study area that would require special consideration. Over the 30-year period used in developing the PRISM data (1961-1990), the average annual precipitation values at O'Hare (35.8 inches) and Wheaton (36.5 inches) correspond to the average annual values from PRISM.

Hourly data from O'Hare were used for meteorological data such as solar radiation, wind speed, cloud cover, temperature, and dew point temperatures for the entire West Branch DuPage River watershed. O'Hare was chosen because it had the most long-term hourly data.

Pan evaporation data were obtained from the Midwestern Regional Climate Data Center (National Oceanographic and Atmospheric Administration [NOAA]) for the Urbana weather station in Champaign County. To adjust this to West Branch DuPage River watershed conditions, the NOAA pan evaporation charts were used to calculate a ratio of annual pan-evaporation from Urbana to West Branch DuPage River (Table 3-3). The data from Urbana were multiplied by this ratio to obtain a pan evaporation time series for the West Branch DuPage River watershed. The potential evapotranspiration (PET) was assumed equal to pan evaporation times the NOAA pan-coefficient (National Weather Service 1982c). Evapotranspiration data packaged with the USEPA's BASINS software were significantly higher than the values reported by NOAA.

3.5 Stream Flow Data

Stream flow data are needed to calibrate hydrologic and water quality models. As noted, the weather data first are used to generate the runoff volumes from the watershed. Modeled runoff volumes are routed to determine stream flow values that are compared with data from several stream flow gages located in the West Branch DuPage River watershed. The USGS gage station cover provided in BASINS 3.0 was used to determine the location of gages. Figure 3-6 shows the location of all USGS gage stations in the West Branch DuPage River.

From all the USGS flow gages in the West Branch DuPage River, only three contained long-term data needed for model calibration: West Branch DuPage River near West Chicago (USGS05539900)in the upper portion of the watershed, West Branch DuPage River near Warrenville (USGS05540095) in the middle portion, and the West Branch DuPage river near Naperville (USGS05540130) as the most downstream gage. Figure 3-7 shows the location of the three gages in the West Branch DuPage River watershed.

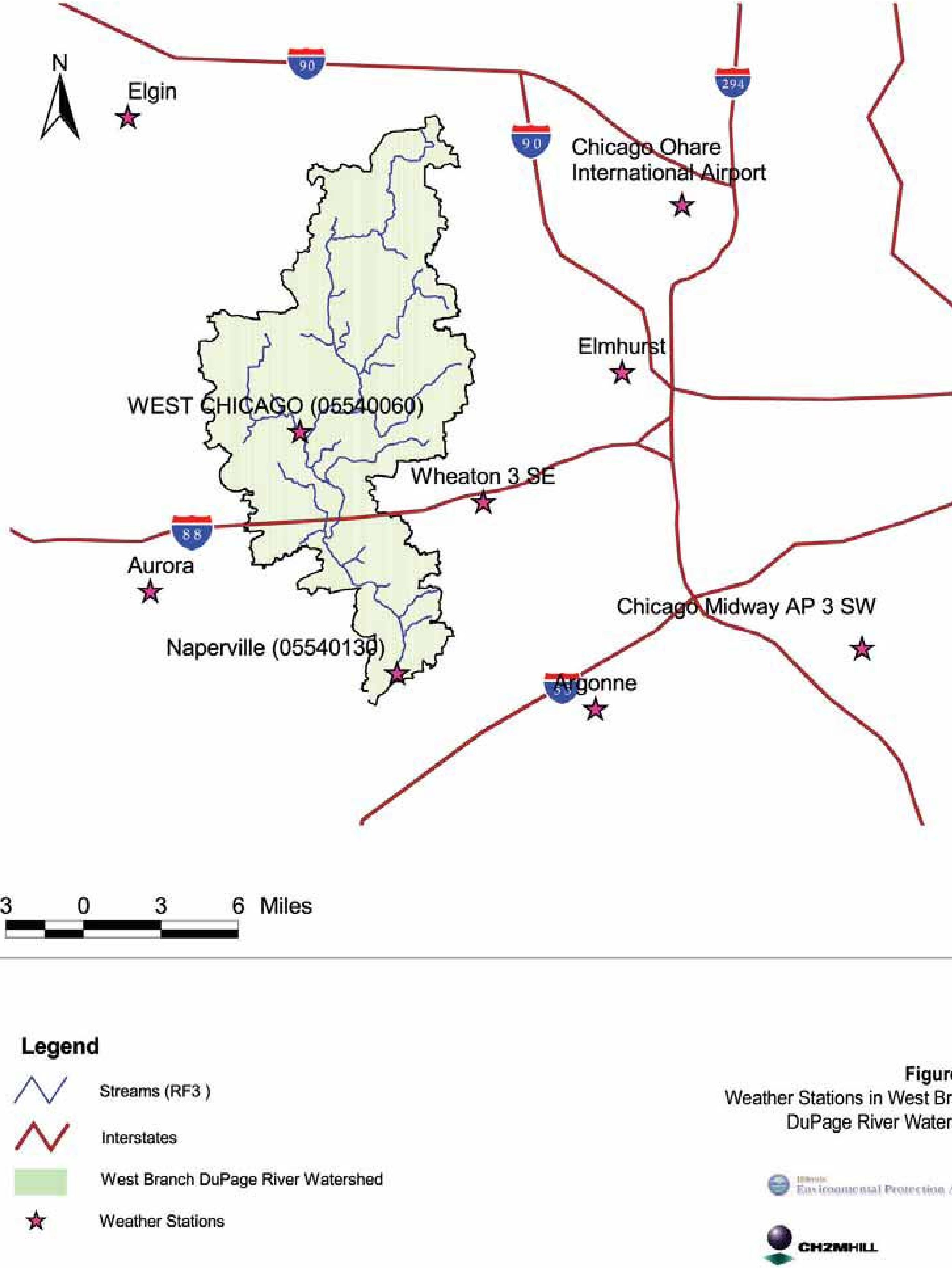

Figure 3-3
Weather Stations in West Branch DuPage River Watershed

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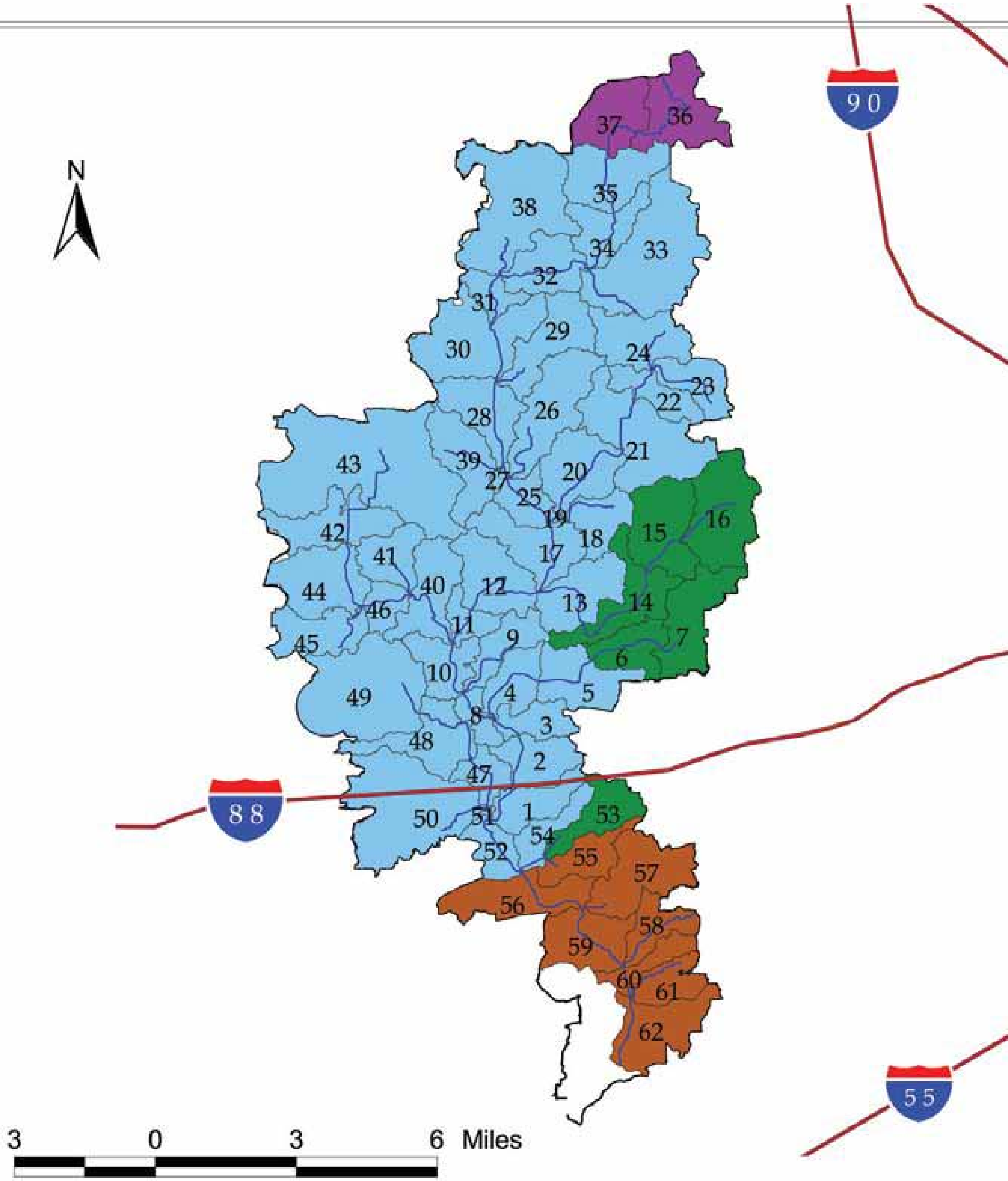

Legend

Streams (RF3)

Interstates

West Branch DuPage River Watershed

Elgin

Naperville

West Chicago

Wheaton

Figure 3-4
Subwatersheds Divided by
Weather Stations West Branch
DuPage River Watershed

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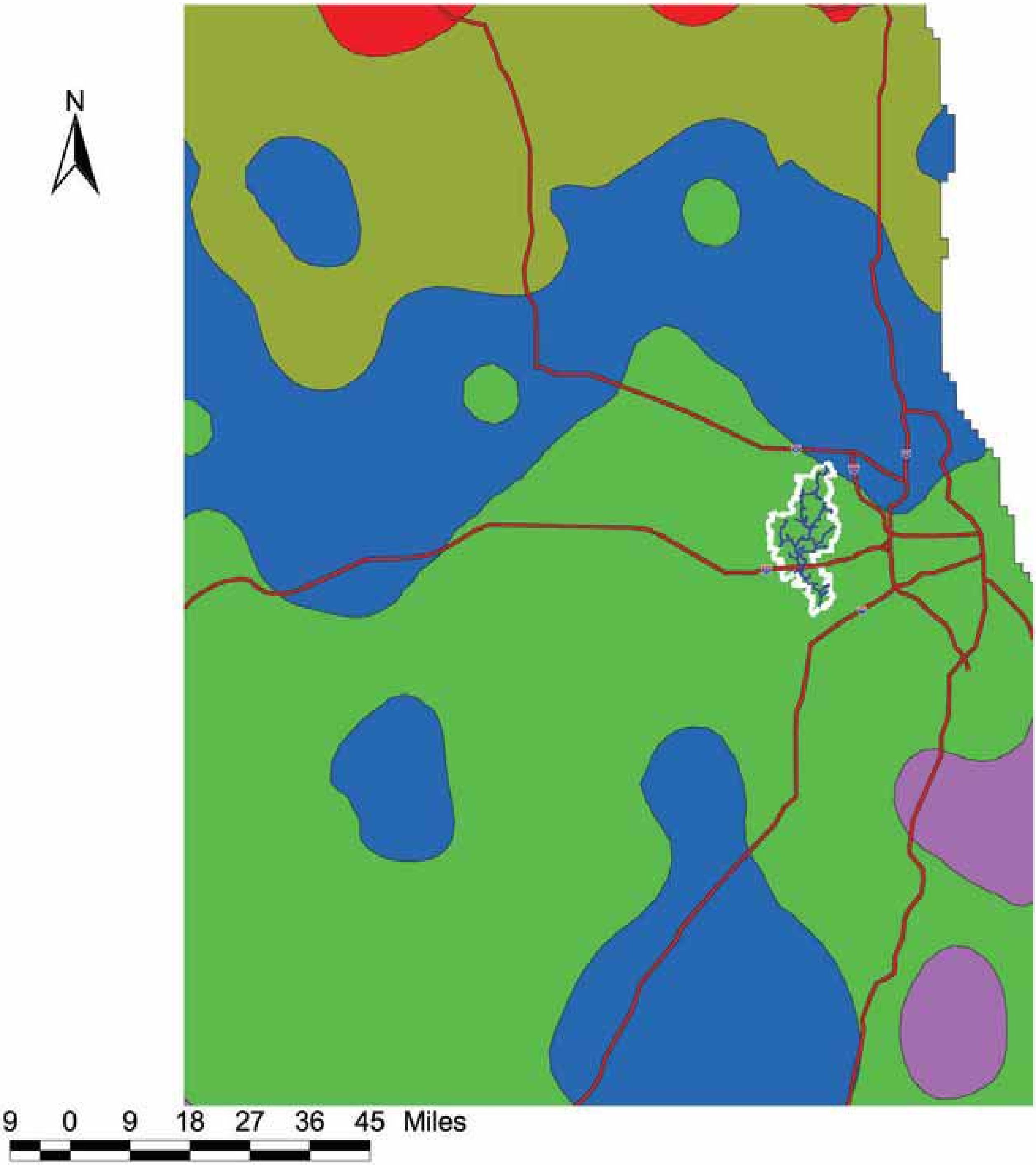

Legend

- 31 - 33 inches
- 33 - 35 inches
- 35 - 37 inches
- 37 - 39 inches
- 39 - 41 inches
- Streams (RF3)
- Interstates

Figure 3-5
Annual Precipitation
West Branch DuPage River Watershed

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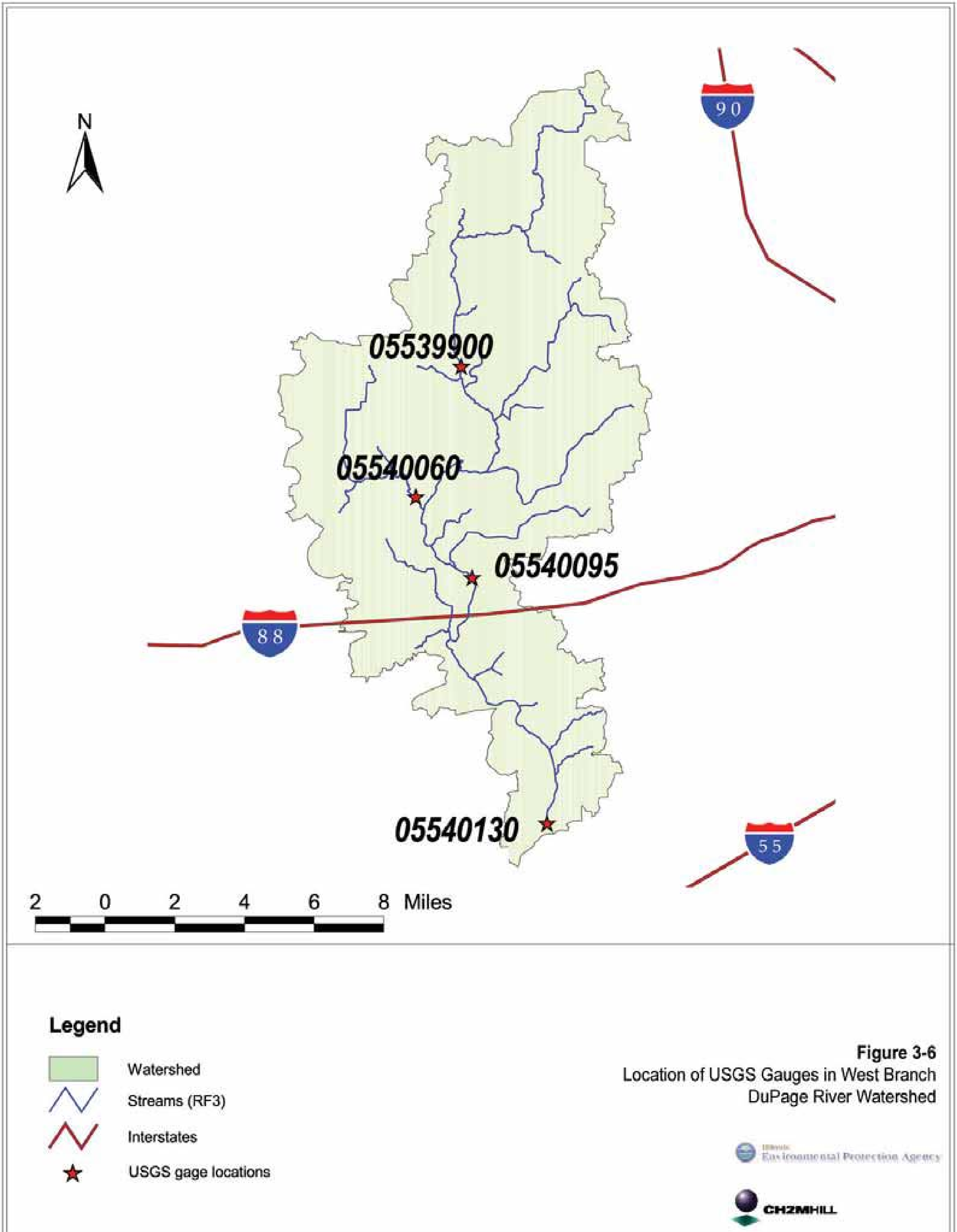

Figure 3-6
Location of USGS Gauges in West Branch DuPage River Watershed

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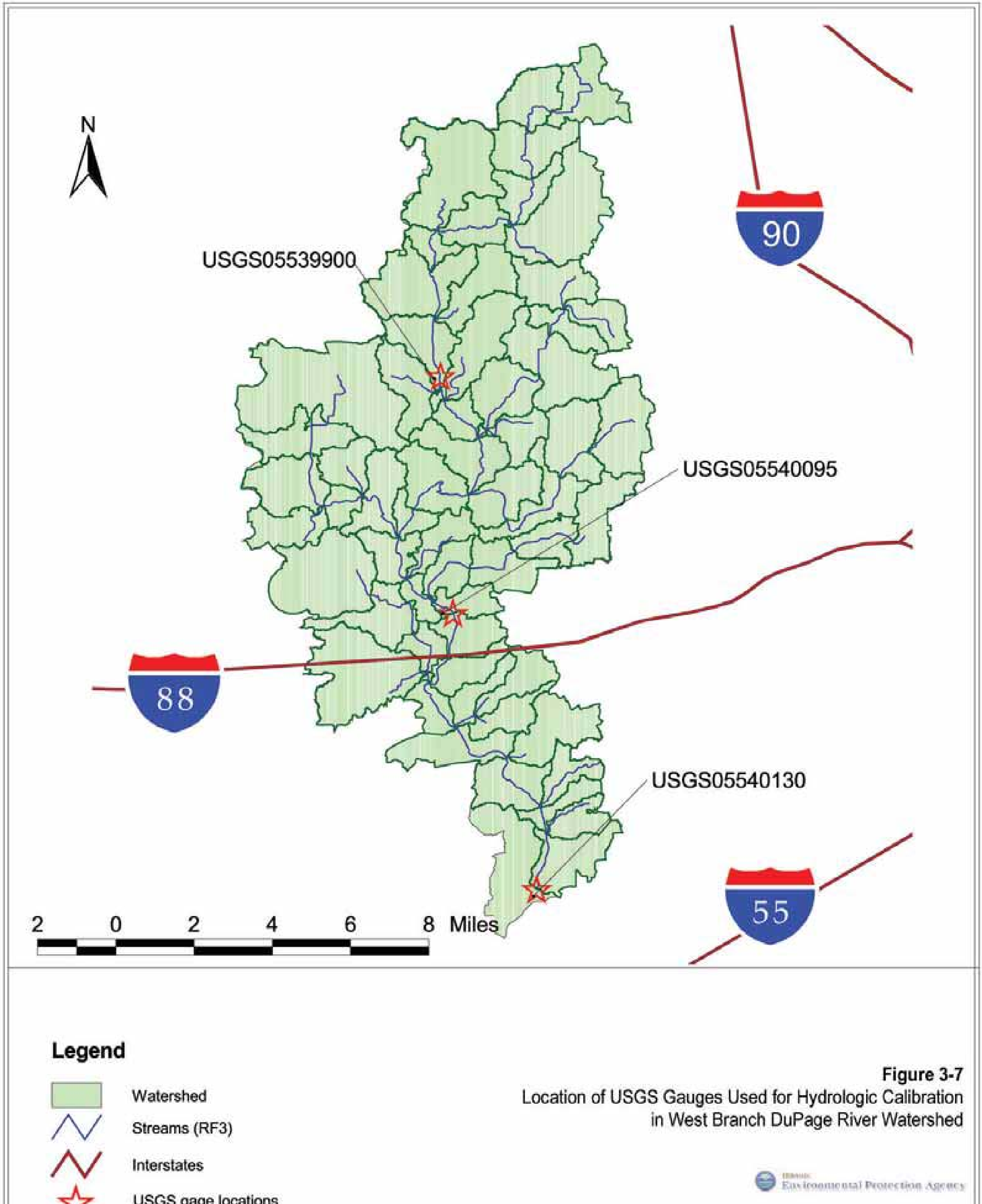

Figure 3-7
Location of USGS Gauges Used for Hydrologic Calibration
in West Branch DuPage River Watershed

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TABLE 3-3
National Climatic Data Center (NCDC / NOAA) Weather Stations in Vicinity of West Branch DuPage River Watershed

Name*	Hourly Precipitation Data	Daily Precipitation Data	Evaporation Data	Cloud Cover	Solar Radiation	Air Temperature	Dew Point Temperature	Wind Movement
Wheaton 3 SE	No	01 Jan 1948–Present	No	No	No	01 Jan 1948–Present	No	No
Chicago O'Hare International Airport	30 Oct 1958–Present	30 Oct 1958–Present	30 Oct 1958–Present	30 Oct 1958–Present	30 Oct 1958–Present	30 Oct 1958–Present	30 Oct 1958–Present	30 Oct 1958–Present
Chicago Midway AP 3 SW	01 Sep 1980–Present	01 Sep 1980–Present	No	No	No	01 Sep 1980–Present	No	No
McHenry WG Stratton L&D	01 Jan 1948–Present	01 Jan 1948–Present	No	No	No	01 Jan 1948–Present	No	No
Elgin	No	01 Jan 1948–Present	No	No	No	01 Jan 1948–Present	No	No
Aurora	No	01 Jan 1948 – 31 Mar 1983	No	No	No	01 Jan 1948 – 31 Mar 1983	No	No
Argonne	01 May 1969–01 Jan 1983	01 May 1969–01 Jan 1983	No	No	No	No	No	No
West Chicago	01 Nov 1961–Present	01 Nov 1961–Present	No	01 Nov 1961–Present	No	01 Nov 1961–Present	No	01 Nov 1961–Present

* Only West Chicago is located inside of the watershed boundaries. The remainder of the weather stations are located outside of the watershed boundaries.

3.6 Point Sources

Point source discharge data are needed to complete the WLA portion of the TMDL. Most of the necessary data were available from the Illinois Environmental Protection Agency (IEPA) and BASINS.

The IEPA provided two data sets, one from the discharge monitoring report system and an NPDES data set for NPDES permitted point sources. In addition, the BASINS 2.1 permit compliance system was used to locate point sources in the West Branch DuPage River watershed. Based on these three data sets, two of the point sources were relocated on the geographic information system (GIS) data set. Figure 3-8 shows the point source locations in the West Branch DuPage River. A list of the point source locations in the watershed and how they were used in the flow and chloride modeling is found in Table 3-4. Those point sources which were not used had very low or intermittent flows and expected low chloride levels. The point sources used in the model account for more than 95 percent of the total point source flows.

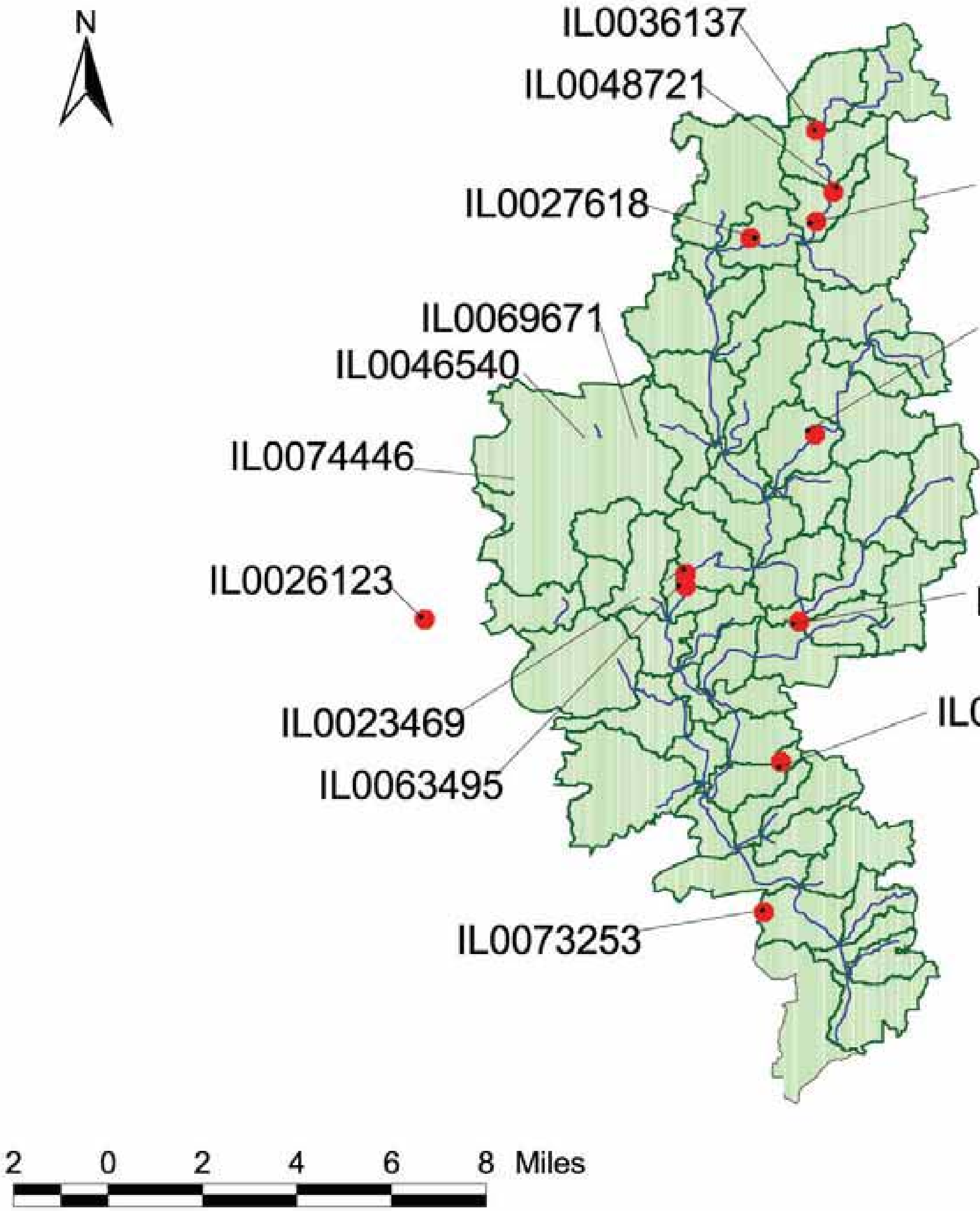
There are no Confined Animal Feeding Operations (CAFOs) in this watershed.

There are a number of operators of Municipal Separate Storm Sewer Systems (MS4s) in DuPage County and within the West Branch DuPage River Watershed (see Appendix F) that are covered by IEPA's MS4 general NPDES permit (see also Section 7.3.1.2).

TABLE 3-4
Major NPDES Permitted Discharges Located in the West Branch DuPage River

Name	NPDES	County	Subwatershed	Avg. Flow (cfs)	Flow Model	CHLORIDE MODEL
West Chicago STP	IL0023469	DuPage	12	6.79	Yes	Yes
U.S. Dept of Energy-Fermilab	IL0026123	Kane	45	5.30	Yes	
Carol Stream STP	IL0026352	DuPage	20	5.09	Yes	Yes
Bartlett WWTP	IL0027618	DuPage	32	3.38	Yes	Yes
Wheaton S.D.	IL0031739	DuPage	5	11.69	Yes	Yes
Hanover Park STP #1	IL0034479	DuPage	34	1.58	Yes	Yes
MWRDGC Hanover Park STP	IL0036137	Cook	35	14.2	Yes	Yes
BP Naperville Complex	IL0045241	DuPage	1	0.12	Yes	
Northwestern Flavors, Inc.	IL0046540	DuPage	43	0.10	Yes	
Roselle-Botterman WWTF	IL0048721	DuPage	34	1.23	Yes	Yes
Kerr-McGee-West Chicago	IL0063495	DuPage	11	0.25	Yes	
Reed Keppler Family Aquatic	IL0069671	DuPage	43	0.04	Yes	
Mapei Corporation-West Chicago	IL0074446	DuPage	42	1.43	Yes	
Naperville Park Dist-Sportsman	IL0073253	DuPage	59	0.01	Yes	

Note:
All permitted discharges are active.



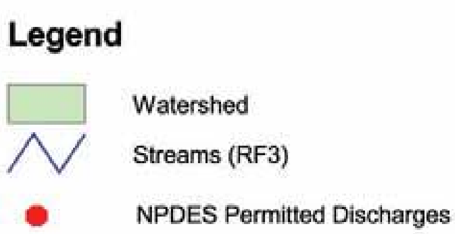


Figure 3-8
Major Point Source Dischargers in West Branch DuPage River Watershed

Illinois Environmental Protection Agency

CH2MHILL

3.7 Best Management Practices for Nonpoint Sources

Existing BMP data were requested from the DCDS and NIPC. Although no detailed information for these facilities was available from either agency, review of the DuPage County Countywide Stormwater and Floodplain Ordinance (September 1994) revealed that the ordinance promotes the application of BMPs to new development through riparian buffer zones, erosion control plans, detention basins, etc.

Grants are available through Section 319 of the Clean Water Act to fund nonpoint source pollution control projects. A total of $20 million has been granted for 132 such projects under Section 319 in Illinois since 1990. Previous section 319 grants for watershed improvements in the West Branch DuPage River watershed were primarily stream stabilization and debris removal projects. These particular projects are not of a type likely to have had an impact on chloride concentration levels.

3.8 Water Quality Data

Water quality data were obtained from two sources. Water quality data was available from STORET (http://www.epa.gov/storet) through October 2000 and the USGS instream water quality database. STORET is a national database maintained and operated by USEPA. Some duplicated records existed between the two sources. The data from both sources were carefully reviewed to verify the justification for listing on the 1998 303(d) list, to select appropriate modeling approaches, and to identify water quality stations most applicable for model calibration. Figure 3-9 shows the location of all water quality stations in the West Branch DuPage River watershed.

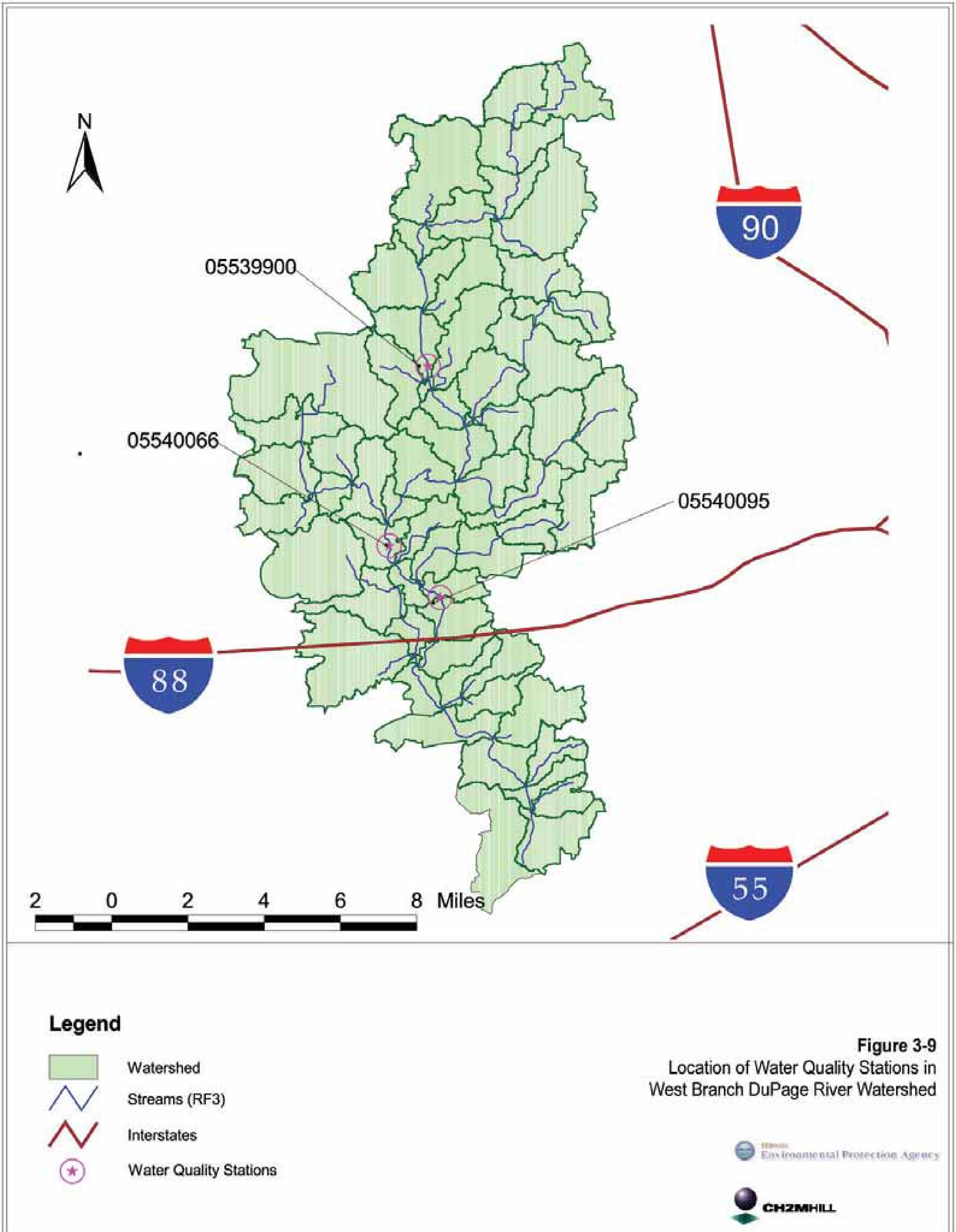


Figure 3-9
Location of Water Quality Stations in
West Branch DuPage River Watershed

4. Assessment of Water Quality Data and TMDL Approach

This section summarizes each pollutant on the West Branch DuPage River watershed list of impairments, and assesses the length of record and frequency of observations. The availability of data regarding frequency and amount of data varied for the different pollutants, which affected the selected modeling approaches. For each pollutant, a cause for listing has been provided, then an assessment of the potential sources, followed by a selected TMDL approach based on the findings of the first two sections for each pollutant. Details of the TMDL modeling are provided in Section 5.

4.1 Period of Assessment for Water Quality Data

Water quality impairments in a water body may be caused by pollutants from point and nonpoint sources. Generally dry weather periods are critical when direct discharge (e.g., point sources) is the primary source of the impairment. However, impairments during wet weather events may be caused by nonpoint sources or both point and nonpoint sources. Therefore, an analysis of long-term water quality is essential for a better understanding of the sources that cause the WQS violations and to help select a correct approach for developing a TMDL. IEPA uses monitoring data from the most recent 5 years to prepare the 303(d) list of impairments. Therefore, water quality data collected between 1990 and 1999 was used to develop the TMDLs for West Branch DuPage River and its tributaries.

CH2M HILL obtained data from various sources as described in the October 2001 West Branch DuPage River Watershed Data and Source Assessment memo. STORET and data provided by IEPA was reviewed for each impairment. Water quality data used for the modeling calibration and verification was selected from within the 1990 to 2000 timeframe.

Additional data was reviewed and incorporated into the analysis in special situations. During the assessment analysis, anticipated circumstances when data from other sources or from outside this timeframe was to be used in the analysis include:

- The cause of the impairment listing is not obvious within the 1990 to 2000 timeframe. In this case, earlier data would be reviewed.
- Wet-weather in-stream and discharger data collected during the fall of 2001 and spring of 2002 in support of the West Branch DuPage River TMDL development.
- Data obtained and currently under analysis that was collected under the Ambient Water Quality Monitoring Program of the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) from 1990 to 2000.

These data sources were referenced where needed during the data assessment and TMDL approach development process.

4.2 Copper: Historic Data/Causes for Listing

One segment of West Branch DuPage River (GBK 09) was listed as impaired based on one exceedance of the numeric chronic standard (CS) for total copper (STORET parameter code 01042) during the 1995–99 period. Water quality data collected at station 05539900, in the upper end of the watershed, was used to determine this exceedance. The numeric acute standards (AS) and CS for copper are hardness dependent and presented below.

Acute numeric standard for total copper (μg/L) = exp[- 1.464 + 0.9422 ln(H)]
Chronic numeric standard for total copper (μg/L) = exp[- 1.464 + 0.8545 ln(H)]

where ln(H) = natural logarithm of hardness (STORET 00900; mg/L as $CaCO_3$).

The GU WQS (Section 302.208) states:

a) The AS for the chemical constituents shall not be exceeded at any time except as provided in subsection (d).

b) The CS for the chemical constituents shall not be exceeded by **the arithmetic average of at least four consecutive samples collected over any period of at least 4 days**, except as provided in subsection (d). The samples used to demonstrate compliance or lack of compliance with a CS must be collected in a manner which assures an average representative of the sampling period.

The term "numeric chronic standard" refers to a value computed using the CS formula and an instantaneous hardness. The term "chronic standard" refers to the average of at least four consecutive samples collected over any period of at least 4 days.

The numeric AS and CS were calculated using the observed hardness data and plotted in Figure 4-1 along with observed total copper concentrations. All data are included in Appendix B. Table 4-1 summarizes data around the one exceedance occurrence. Total copper concentration exceeded the numeric CS on October 16, 1996. To assess if the WQS was violated, three samples immediately prior to and three samples immediately after each date were used to calculate the arithmetic average of four consecutive samples. Observed total copper concentrations and hardness, computed numeric AS and CS, 4-day averages of observed copper concentrations, and 4-day averages of the numeric CS are listed in Table 4-1.

An analysis of observed water quality data showed that one observed copper value on October 16, 1996, resulted in violations of the CS 4-day average over the next four observations. This data point is likely an outlier as it is more than one order of magnitude higher than any other observed value. Observed total copper concentration exceeded the numeric CS on one occasion but did not violate the chronic WQS for total copper as shown in Figure 4-2. The 4-day average of observed total copper concentrations and the 4-day average of calculated numeric CS were calculated and compared to determine if the chronic WQS was violated.

Generally, total copper does not pose a threat to the designated use of West Branch DuPage River. Fourteen percent of the observed values were below detection limits, all but one sample (10/16/1996) were below the numeric CS, and more than 90 percent of the observed concentrations were below 50 percent of the numeric CS. Metals are listed on the Illinois 305(b) report which is used in part to create the 303(d) list, when at least one AS or CS exceedance occurs within the most recent three years. Sampling data for the West Branch DuPage River watershed indicates only one exceedance in 10 years.

FIGURE 4-1
Copper Concentrations in Segment GBK_09 of West Branch DuPage River and Corresponding Acute Standard and Numeric Chronic Standard by Sample Date

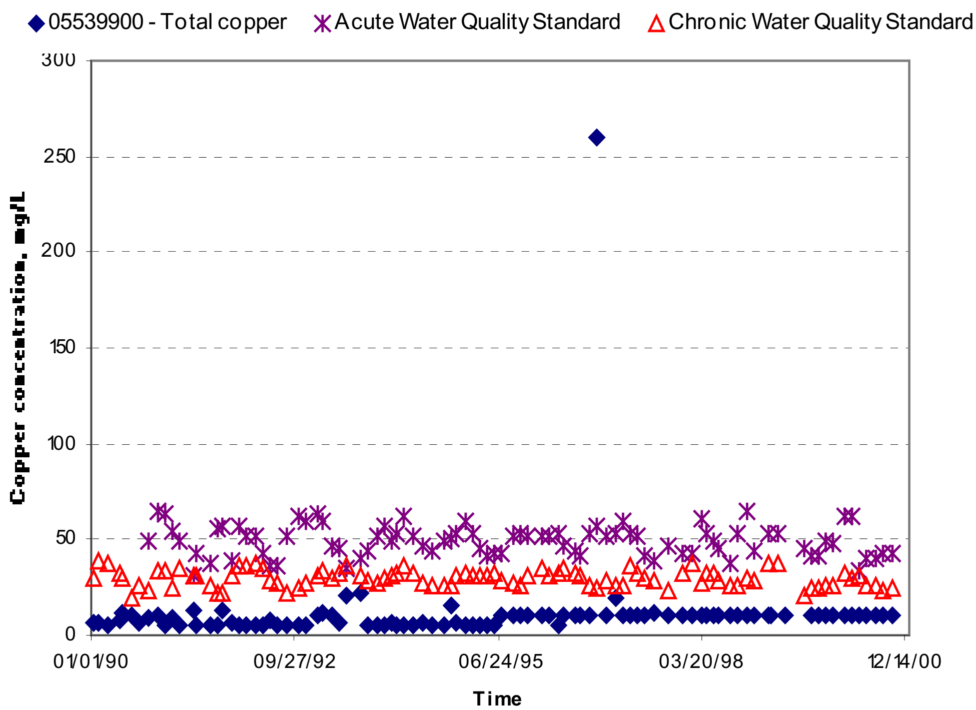


FIGURE 4-2
Four-day Average of Observed Total Copper Concentrations (Station 05539900) and Corresponding Chronic Standard by Sample Date

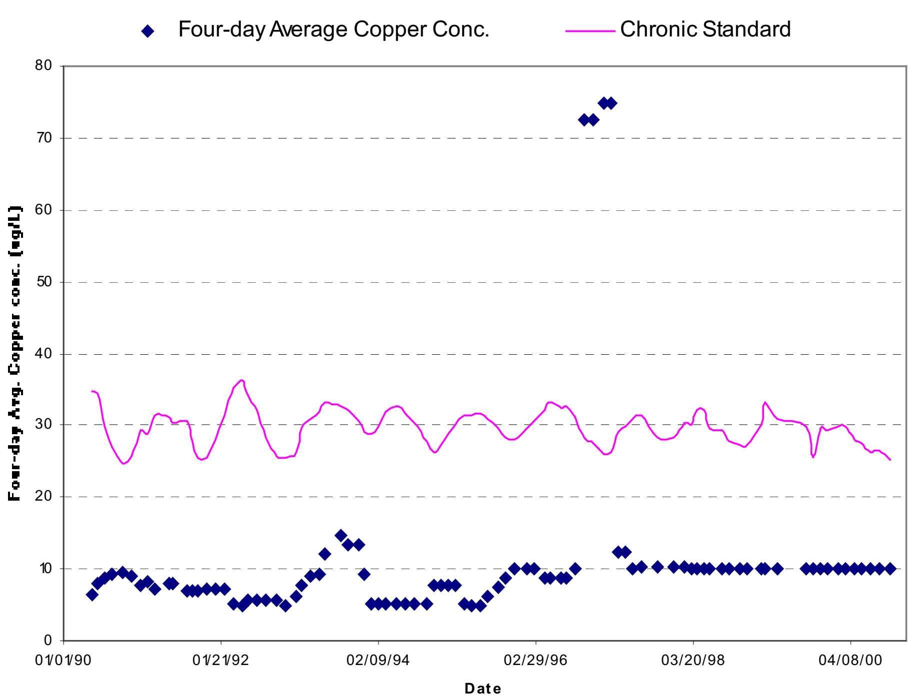


TABLE 4-1
Observed Copper Concentrations, Hardness, and Acute and Chronic Standards in West Branch DuPage River by Sample Date

Date	Time	Observed Copper Conc. (µg/L)	Hardness (mg/L as $CaCO_3$)	Acute Standard (µg/L)	Numeric Chronic Standard (µg/L)	4-day Average of Observed Copper Conc. (µg/L)*	4-day Average of the Numeric Chronic Standard (µg/L)*
07/03/1996	0919	10.0	319	52.9	31.9		
07/24/1996	1036	10.0	314	52.1	31.4		
9/10/1996	1011	10.0	247	41.6	25.6		
10/16/1996	**1500**	**260.0**	**233**	**39.3**	**24.4**	**72.5**	**28.33**
12/03/1996	1200	10.0	281	46.9	28.6	72.5	27.5
01/22/1997	0935	19.0	250	42.0	25.9	74.75	26.13
02/24/1997	1101	10	250	42.0	25.9	74.75	26.2

* This is the average computed with the exceedance and the three prior sampling dates

It is recommend that GBK09 be removed from the 303(d) list since the only copper exceedance is likely an outlier, and even if the data point is representative of actual conditions, there has only been one exceedance in the most recent 10 years of data collection.

4.3 Chloride, Total Dissolved Solids and Salinity: Historic Data and Cause for Listing

Chloride, total dissolved solids (TDS) and salinity (as measured through specific conductivity) are three related issues of water quality. TDS can be directly correlated to chloride and the specific conductivity of water is proportional to TDS. Hence by addressing the chloride impairments in the West Branch DuPage River the TDS and salinity problems will also be addressed. The stream segments listed as impaired for salinity, TDS, and chlorides are GBK 07, GBK 09, GBK 05, and GBK 12.

According to the Illinois GU WQS, TDS concentrations (STORET parameter code 70300) shall not exceed 1,000 mg/L. Conductance is directly proportional to the TDS concentration. Although there is no GU WQS for conductance, a conductance value of 1,667 µmho/cm corresponds to 1,000 mg/L of TDS (305[b] guideline). Therefore, an exceedance of 1,667 µmho/cm of conductance is considered indicative of potential exceedance of the 1,000 mg/L of the TDS standard.

Conductance exceedances occasionally and generally occur in colder months. Figures 4-3 and 4-4 show the conductance exceedances in winter for sampling stations 05539900 in the upper part of the watershed and 05540095 in the lower part. The exceedances only occur in the winter, as can be seen in Figures 4-5 and 4-6. The water quality data plot at station 05539900 near West Chicago and at station 05540095 near Warrenville clearly shows that that conductance occasionally exceeded 1,667 µmho/cm criteria during winter. These plots included data collected between 1995 and 1999.

FIGURE 4-3
Plot of West Branch DuPage River (Station 05539900) Conductance Data by Date

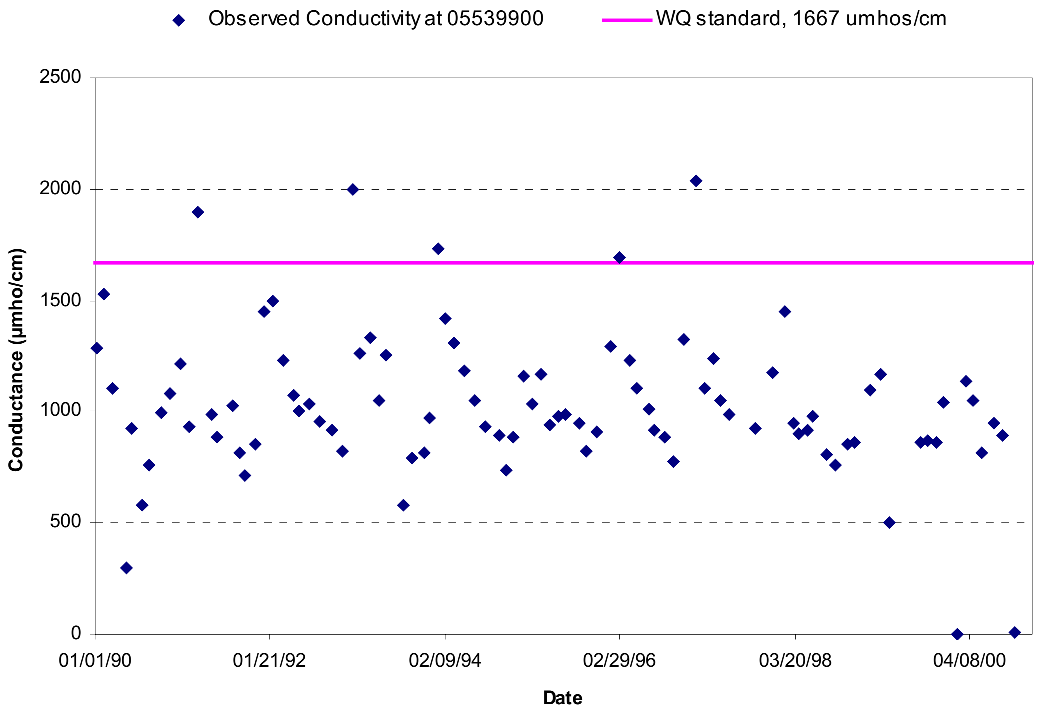


FIGURE 4-4
Plot of West Branch DuPage River (Station 05540095) Conductance Data by Date

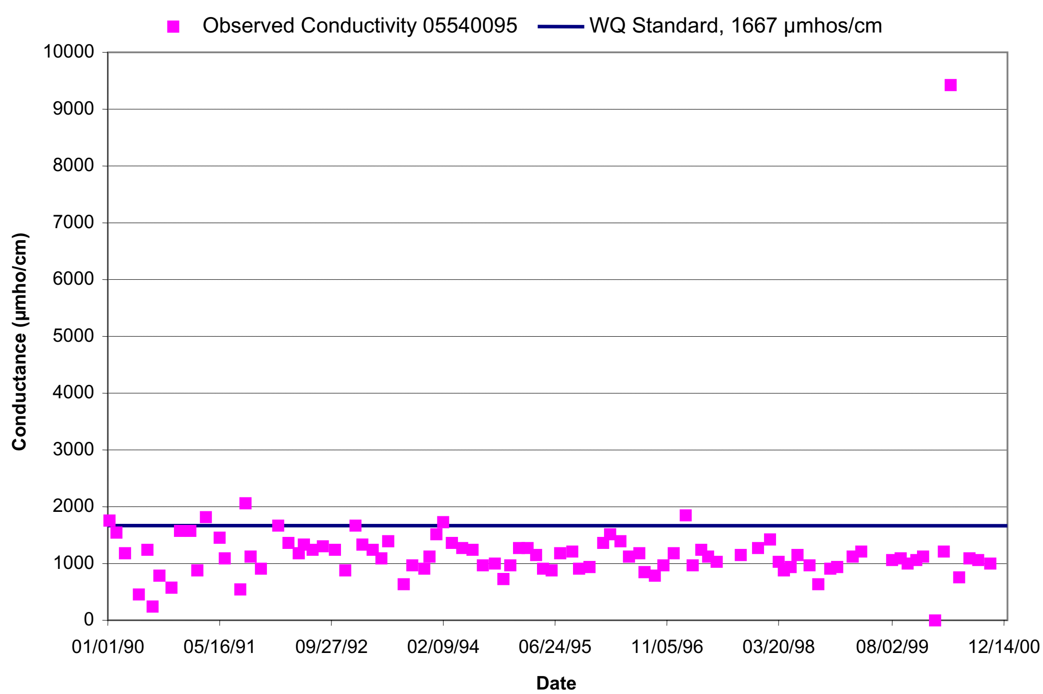


FIGURE 4-5
Observed Conductance at West Branch DuPage River (Station 05539900) by Month

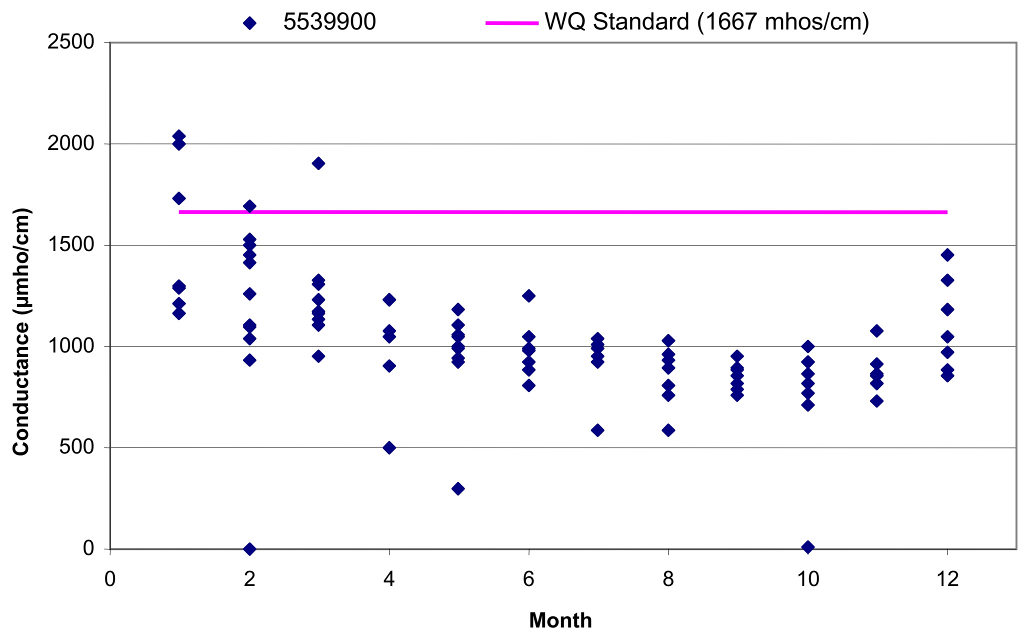
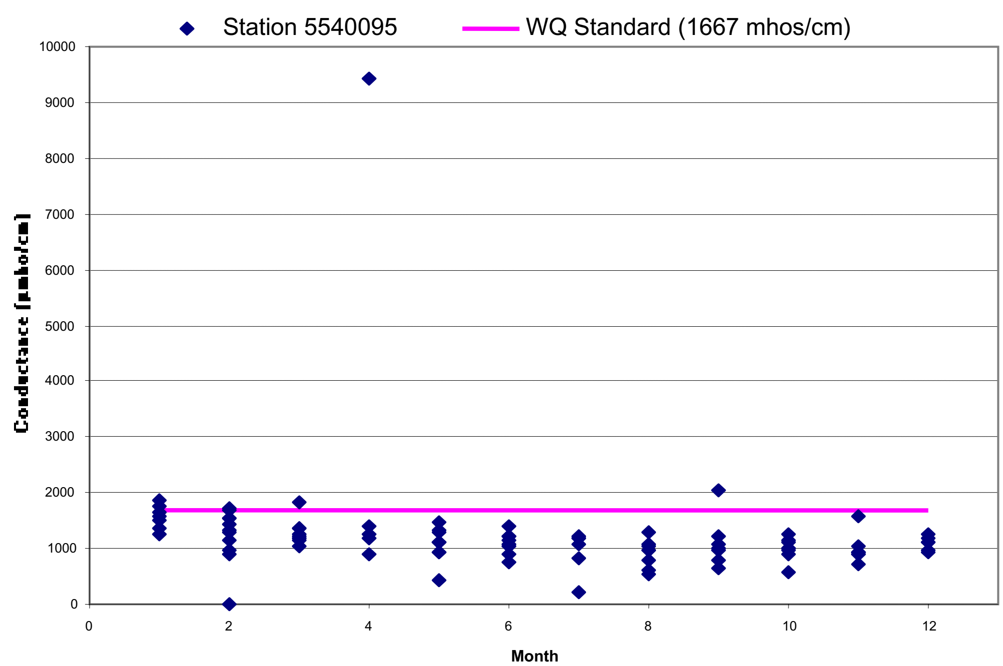


FIGURE 4-6
Observed Conductance at West Branch DuPage River (Station 05540095) by Month



Generally, many dissolved anions and cations constitute TDS/conductance in surface water. Most anions and cations are naturally occurring substances. Dissolution of minerals as water flows in contact with soil and precipitation containing atmospheric constituents contribute to naturally occurring TDS/conductance. Anthropogenic sources such as road salt application, fertilizer application, and point sources increase the concentration of TDS/conductance.

An investigation of seasonal pattern and correlation between chloride and conductance showed that high TDS/conductance is caused by road salt application in the winter months and is directly proportional to chloride concentration. Chloride is the major component of TDS in winter months, which is the time of year subject to conductance impairment. Snowmelt runoff includes chloride from roadway de-icing activities. Conductance generally is higher from December through April than from May through November (Figure 4-5 and 4-6). Conductance is closely correlated to observed chloride concentration in the West Branch DuPage River (Figure 4-7 and 4-8). To verify that chloride is a major component of TDS/conductance, a regression analysis of two constituents was performed.

Initial regression analyses showed that conductance values of 560 μmho in the upper portions of the watershed (station 05539900) and 540 μmho in the lower portions (station 05540095) of the watershed were contributed by background anions and cations (i.e., intercept of the regression equation) in West Branch DuPage River.

The relationship between conductance and chloride in West Branch DuPage River at station 05539900 is given by:

$$\text{Conductance } (\mu\text{mho}) = 2.95 \times \text{Chloride (mg/L)} + 560.4$$
$$r^2 = 0.83$$

The relationship between conductance and chloride in West Branch DuPage River at station 05540095 is given by:

$$\text{Conductance } (\mu\text{mho}) = 3.17 \times \text{Chloride (mg/L)} + 541.2$$
$$r^2 = 0.59$$

Figures 4-7 and 4-8 shows these relationships graphically. A strong correlation between chloride and conductance (i.e., high r^2 values) indicates that the variation in conductance levels can be explained by chloride concentrations. Also, chloride and conductance are high during winter months and concurrent with snowmelt runoff, strongly indicating that chloride from roadway deicing activities is the major component of TDS. The quantity of sodium in road salt is as significant as chloride and contributes equally to the TDS concentrations/conductance. Additionally, depending on the composition of road salt, there are other dissolved solids present in water.

High chloride concentrations in urban snowmelt and runoff is a problem for both infrastructure and the environment. Elevated chloride concentrations in urban runoff are a major cause of vehicular corrosion and deterioration of infrastructure (Novotny and Olem 1994). In addition high salt concentrations are damaging to the receiving water bodies and ecosystems. The general WQS set for chloride is based on toxicity studies for both aquatic plants and animals.

FIGURE 4-7
Relationship Between Conductance and Chloride (Station 05539900) in West Branch DuPage River

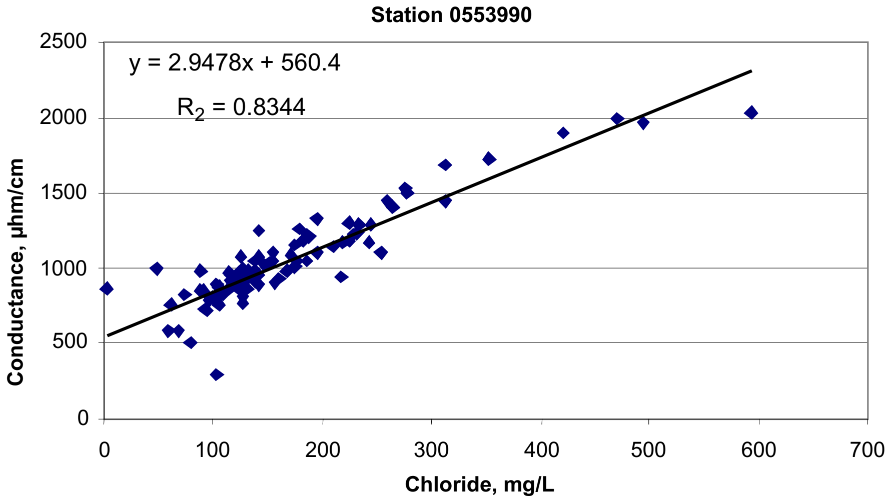
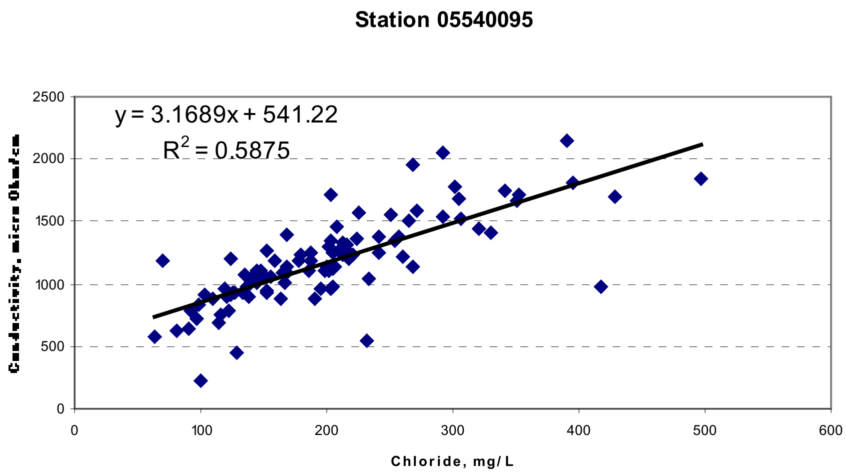


FIGURE 4-8
Relationship Between Conductance and Chloride (Station 05540095) in West Branch DuPage River



The stream segments listed as impaired for chloride are GBK 07, GBK 09, GBK 05 and GBK 12. According to the Illinois GU WQS, concentration of chloride (STORET parameter code 00940) shall not exceed 500 mg/L.

Chloride exceedances occasionally occur in the winter. Figures 4-9 and 4-10 show chloride exceedances in winter for sampling stations 05539900 in the upper part of the watershed, and 05540095 in the lower half of the watershed within the West Branch DuPage River.

FIGURE 4-9
West Branch DuPage River Chloride Concentrations by Sample Date and Water Quality Standard

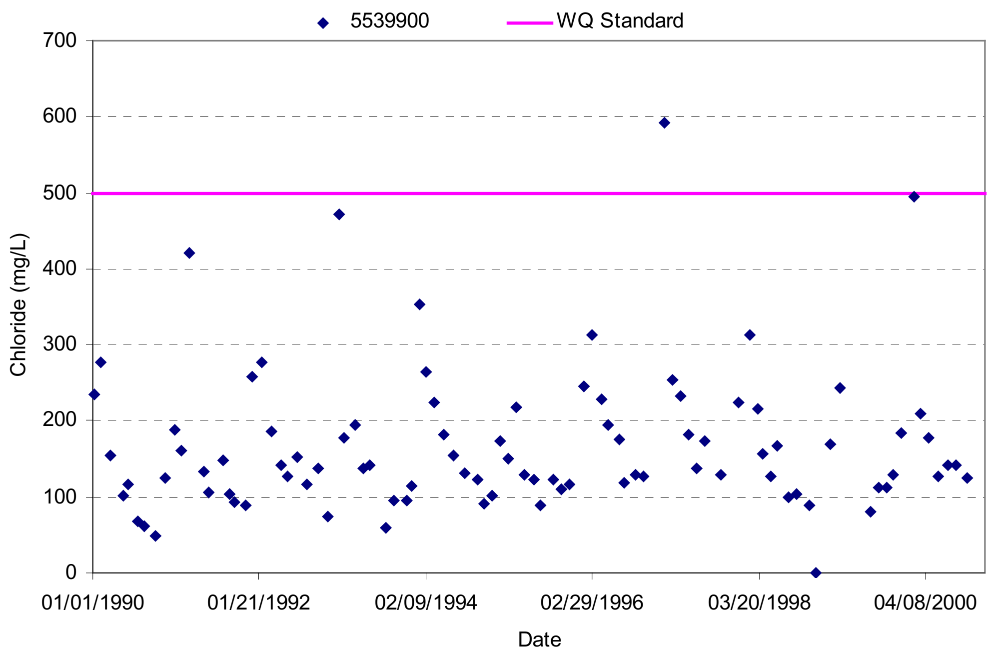
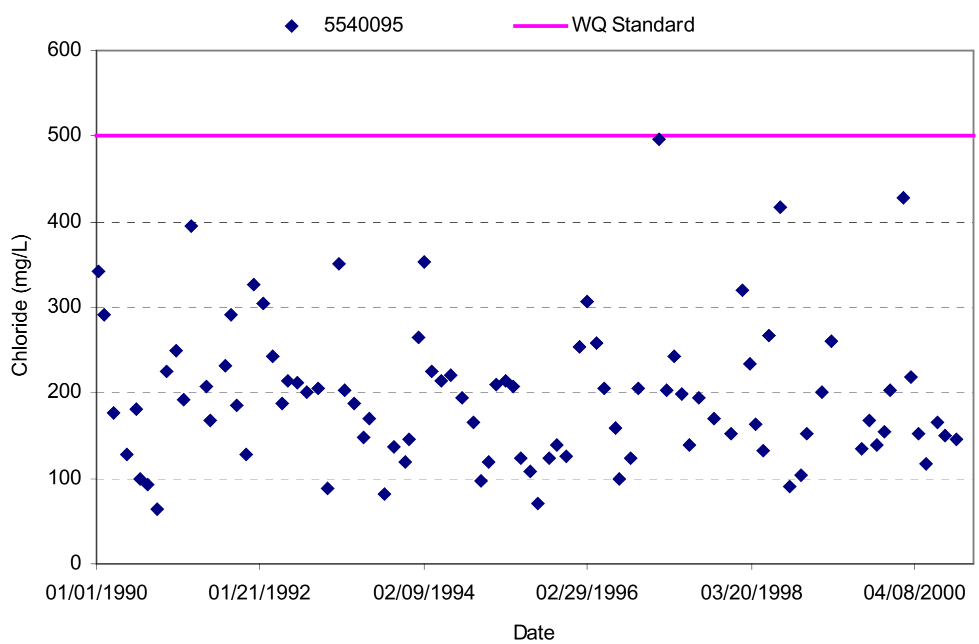


FIGURE 4-10
West Branch DuPage River Chloride Concentrations by Sample Date and Water Quality Standard



Water quality data collected between 1995 and 1999 show that there was one exceedance (Figure 4-9) of the chloride standard at the West Branch DuPage River station 05539900 on

January 22 1997. The observed data for this one violation is listed in Table 4-2. Figures 4-11 and 4-12 show chloride concentrations by month for station 05539900 and 05540095, respectively. Probabilities of exceedance of the chloride standard are 1 percent at station 05539900 and no violations occur at station 05540095 in the West Branch DuPage River Watershed based on observed data only. Section 5 contains a discussion of exceedance probability based on modeling results.

TABLE 4-2
Exceedances of the Chloride Standard in West Branch DuPage River

Date	Chloride (mg/L)	Station
01/22/1997	593	05539900

4.4 TMDL Approach

For the following reasons, chloride was selected as the TMDL target:

- There is a numeric WQS for chloride.
- There is a substantial amount of chloride data available for model calibration.
- TDS and salinity data are not available.
- Conductivity is only a surrogate for TDS and salinity—there is no numeric WQS for conductivity or salinity.
- Chloride data correlate well with conductivity data.
- By addressing the chloride impairments, the TDS and salinity problems will also be addressed.

Chloride was modeled for the West Branch DuPage River segments using HSPF. Road salt application information was incorporated in the model for calibration. Model calibration and validation was performed using chloride data collected at stations 05539900 and 05540095.

FIGURE 4-11
Chloride Concentrations in West Branch DuPage River (Station 05540095) by Sample Month and Water Quality Standard

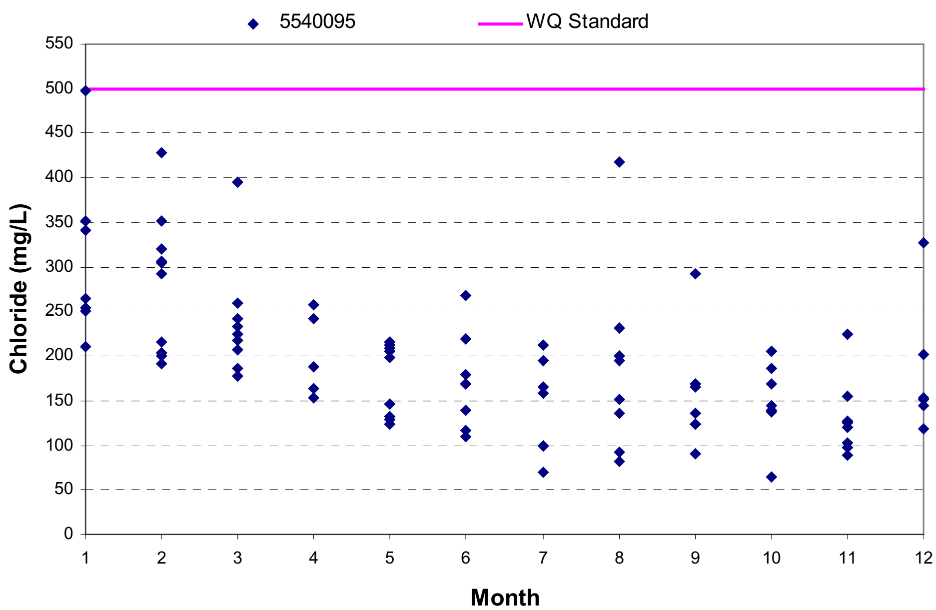
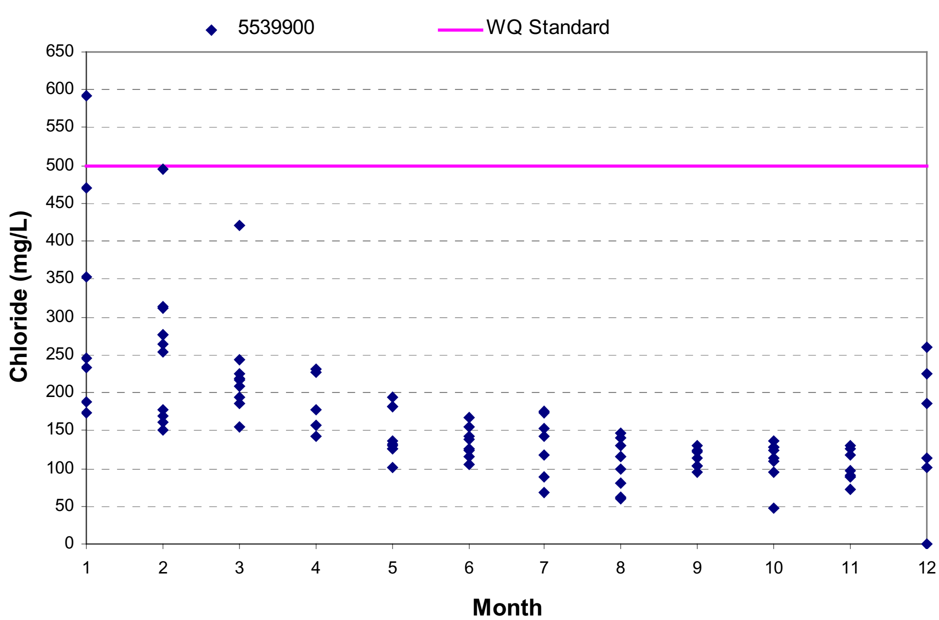


FIGURE 4-12
Chloride Concentrations in West Branch DuPage River (Station 05539900) by Sample Month and Water Quality Standard



5. Modeling Approach and Assumptions

This section describes the detailed approach and assumptions used to characterize the pollutant sources for modeling and to develop the model input for TMDL analysis in the West Branch DuPage River watershed. The first section outlines the procedure used to select the necessary models and tools to perform the TMDL analysis required. A section on the hydrologic calibration follows and the water quality calibrations for the pollutants of concern are presented.

5.1 Selection of Models and Tools

At the outset of this study it was envisioned that a larger set of parameters would require TMDL development based on the 1998 303(d) list (see Section 2). These parameters can be derived from a variety of sources, both point and nonpoint, with a strong hydrologic influence over a variety of seasonal conditions. The model selection process was thus governed by the need to simulate this complexity. The new prioritization approach for the 2002 list reduced the number of parameters subject to this study to copper and chloride, and data analyses justify delisting for copper. Thus, in the end modeling was needed only for a chloride TMDL. Nonetheless, the modeling approach needed for a rigorous chloride TMDL still involved complex hydrologic and pollutant source simulation (e.g., salt application/accumulation, snowmelt runoff, etc.). Consequently, the model selected (HSPF) remained a very appropriate tool for this TMDL.

HSPF (Hydrologic Simulation Program FORTRAN) is a continuous watershed model with stream modeling capabilities. It can model a wide variety of water quality constituents, sediment, and nutrients from various sources, including land uses. It also is a continuous simulation model that can handle the long-term simulations needed for nonpoint source load allocations during TMDL development.

5.2 Modeling Chloride Using HSPF

5.2.1 Hydrologic Calibration for HSPF General Background Information

Three long-term USGS stream flow gages—West Branch near West Chicago, West Branch near Warrenville, and West Branch near Naperville—were selected for model calibration as a result of the stream flow discussion detailed in Section 3.50. The gage farthest upstream is on the West Branch near West Chicago, with a drainage area of 28.5 square miles. The middle gage is at the West Branch near Warrenville, with a drainage area of 90.40 square miles, and that farthest downstream is at West Branch near Naperville, with a drainage area of 123 square miles.

The subbasins within the West Branch DuPage River, as described in Section 3.1, were used to calculate contributing areas for each flow gage. Using this delineation, the contributing area at the upstream gage was about 3.4 percent higher than that reported by the USGS. The area at the bottom gage was only 0.26 percent higher than that reported by the USGS. This discrepancy was considered within acceptable range for the model calibration.

The following sections detail the way various data were processed for use in the hydrologic HSPF calibration. Appendix C contains details on the calibration outputs and plots of simulated and observed flow.

5.2.2 Land Use Data

From the discussion of available land use data in Section 3.2, the classifications from Table 3-1 were used to determine the percentage of each land use category tributary to each of the three flow gages. Table 5-1 lists the land use breakdown for each flow gage. Table 5-2 lists the percentage of each land use category and corresponding effective impervious area.

TABLE 5-1
Reclassified NIPC Data for Hydrologic Calibration

Land Use	Acres	% of Total Land Use	Reclassified for HSPF
Agriculture	13,981	17.7	Agriculture
Commercial	4,322	5.5	Other Urban
Water	1,326	1.7	Water/Wetlands
Wetlands	3,025	3.8	Water/Wetlands
Industrial	3,020	3.8	Other Urban
Forest	5,199	6.6	Forest
Transportation	1,122	1.4	Transportation
Open land	17,339	22.0	Open Space
Institutional (excluding cemeteries)	4,315	5.5	Other Urban
Unclassified	163	0.2	Other Urban
Residential	25,125	31.8	Residential
Total	**78,937**	**100.0**	

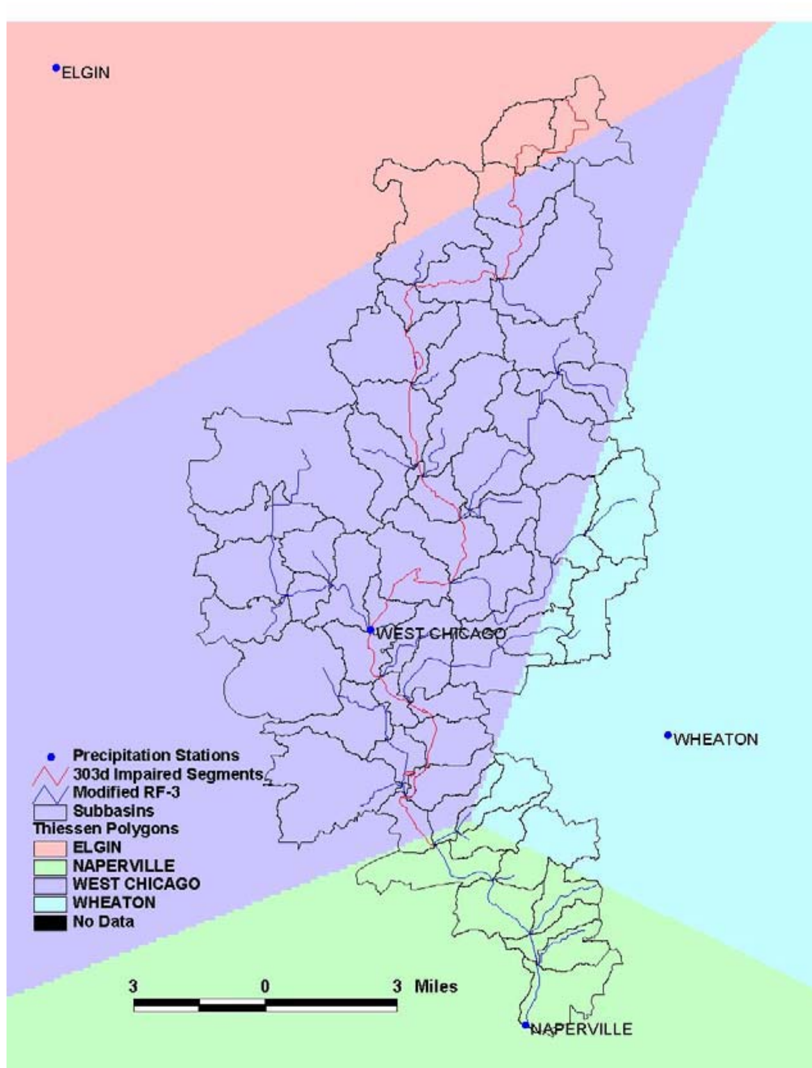
TABLE 5-2
Land Use Categories Modeled in HSPF and the Effective Impervious Area for Each Land Use

Land Use	Acres	% of Total Land Use	EIA %	Impervious Area per Land Use in Acres
Agricultural	13,981	17.7	0.0	0.0
Other Urban	11,820	15.0	64.0	7,565
Water/Wetlands	4,351	5.5	0.0	0.0
Forest	5,194	6.6	0.0	0.0
Residential	25,062	31.8	10.0	2,506
Transportation*	1,121	1.4	60.0	673
Open Space	17,285	21.9	0.0	0.0
Total	**78.814**	**100.0**		

* Included in the transportation category are all interstates, expressways and major divided highways.

The effective impervious area (EIA) values were extracted from the 1996 report entitled *Application Guide for Hydrologic Modeling In DuPage County Using Hydrologic Simulation Program – FORTRAN (HSPF)* (Price 1996). The EIA percentages reflect only the estimated runoff from impervious areas that are directly connected to storm water conveyance systems (e.g., stream channels, storm sewers) with no opportunity for infiltration. EIA values differ from total impervious area values because runoff from some impervious areas, such as rooftops, may flow onto pervious areas.

FIGURE 5-1
Theissen Polygon Proximity of Precipitation Stations to the West Branch DuPage Subbasins



5.2.3 Meteorological Data

There are no NCDC weather stations within the West Branch Watershed but there are two USGS gages with daily precipitation data, West Chicago (05540060) and West Branch near Naperville (05540130).

A Thiessen polygon approach was used to assign weather stations to the various subbasins. The precipitation for most of the watershed was taken from the West Chicago gage. Precipitation from Elgin, Wheaton, and Naperville was also used. Figure 5-1 shows the Thiessen polygon distribution.

Data from each of the four daily precipitation stations were disaggregated to an hourly timestep using the hourly precipitation data from O'Hare Airport and the program WDMUtil. Data from O'Hare Airport were used for the other meteorological constituents since that is the closest station to the watershed where these constituents are recorded and published.

5.2.4 Point Sources Data

According to the point source data provided by IEPA and BASINS, there are 28 point source discharges in the watershed. Data for these point sources were provided as monthly average discharges. Of these, only 14 have a maximum monthly discharge of at least 0.1 cubic foot per second (cfs), so these 14 were included in the model. This represents more than 95 percent of the total point source flow in the watershed.

Point source discharges from wastewater treatment plants make up a significant portion of the flow in the West Branch DuPage River during low flow periods. Point sources contribute heavily to flow at all three calibration gages. According to the data provided, the annual average point source discharge above the West Chicago gage is about 20.3 cfs, and the annual average point source discharge above the Warrenville gage is about 51.6 cfs.

Hydrologic Calibration of HSPF Model for DuPage County (Price 1994) suggests that there may be a large difference between the point source discharge data and the observed low flows at the USGS gages. The explanation for this discrepancy is related to storm water infiltrating the sanitary sewer system, where runoff enters the sanitary sewer system through manholes and through joints in the sewer pipe. Price concludes that 13.9 cfs is the average point source discharge into the West Branch at West Chicago, and 29.1 cfs at the USGS gage at Warrenville. These values were weighted among the point sources by average flow and input as a monthly value at each point source over the calibration period.

5.2.5 Hydrologic Calibration

The initial parameters for this calibration were taken from those used in the East Branch DuPage River and Salt Creek studies. Since these watersheds are immediately east of the West Branch DuPage River and in a very similar hydrologic regime, it was anticipated that these parameters would not need much adjusting for this watershed. Throughout the hydrologic calibration process only minor adjustments were made, refining the initial parameter set as is consistent with most applications.

Simulated snow pack depth was compared to the measured daily snow pack depth observations at O'Hare Airport. The snow simulations show a fair agreement with the snow depth observations (Figure C-1, Appendix C). The calibration shows some day-to-day differences between simulated and observed values, but this is a common occurrence in snow simulations. These differences can be attributed to the distance between the watershed and the O'Hare met station, and it is common to have significant variations in observed snow measurements within a watershed (AQUA TERRA 2000).

F-Tables containing rating curve (stage-discharge relationship) information for stream segments for the HSPF model were developed using cross sections from previous studies and rating curves at the three USGS gages. DuPage County has developed an HSPF model for overland flow and an FEQ model for flood management control. The FEQ model input files included cross sections at various points in the watershed. The F-Tables were developed at 0.2 ft increments up to a 10 ft depth and then extended using a larger increment up to 50 ft.

The hydrologic calibration process was greatly facilitated with the use of the HSPEXP, an expert system for hydrologic calibration, specifically designed for use with HSPF, developed under contract for the USGS (Lumb, McCammon, and Kittle 1994). This package gives calibration advice, such as which model parameters to adjust or input to check, based on predetermined rules, and allows the user to interactively modify the HSPF Users Control Input (UCI) files, make model runs, examine statistics, and generate a variety of plots. HSPEXP still has some limitations, such as 'how much' to change a parameter and relative differences among land uses, which required professional modeling experience and judgment.

The statistics computed by HSPEXP include error in total runoff volume, error in the 50 percent lowest flows, error in the 10 percent highest flows, error in the storm peaks, seasonal volume error, and summer storm volume error. The storms are chosen by the user, and up to 36 storms can be used in figuring the storm error term.

Whereas a usual hydrologic calibration process involves changing a few parameters based upon experience and advice from HSPEXP, this calibration was different since the parameters from the nearby studies were used. Initial changes to the model input during this calibration involved identifying errors or omissions in the model input and refining input accordingly. For example, during calibration the FTABLES were modified to allow for flood plain storage. Another example of this sort of change came about after close examination of the snow pack output indicated that some of the precipitation data was misaligned. An error in the import process was identified and the input time series was corrected. Once those errors were corrected, the hydrologic calibration process continued in the traditional manner, with further refinement of the parameter set from the nearby studies.

For a hydrology calibration the overall percent difference between simulated and observed flows is often used as a measure of the accuracy of the calibration. A difference of less than 10 percent is considered a very good calibration, while a difference of 10 to 15 percent is considered a good calibration. Differences between 15 and 25 percent are considered a fair calibration. (Donigian 2000) Typically the annual runoff errors vary from year to year due to inaccuracies in the precipitation data application, but over a span of several years these errors tend to even out to give an accurate representation of the quality of the calibration.

The total runoff volume errors at the three calibration locations are 10 percent or less, which indicates very good agreement. In fact, the runoff volume errors at Warrenville and Naperville, the two more downstream gages, are less than five percent. Table 5-3 shows a comparison between the observed and simulated annual runoff.

TABLE 5-3
Summary of Hydrologic Calibration – Comparison of Annual Simulated and Observed Runoff

	West Branch at West Chicago				West Branch at Warrenville				West Branch at Naperville			
Year	Precip (in)	Simulated Flow (in)	Observed Flow (in)	% Error	Precip (in)	Simulated Flow (in)	Observed Flow (in)	% Error	Precip (in)	Simulated Flow (in)	Observed Flow (in)	% Error
1990	46.8	24.3	24.5	-0.9%	46.8	22.4	20.3	10.3%	46.8	21.5	20.1	7.0%
1991	39.1	23.0	23.0	0.3%	39.1	20.9	18.9	10.8%	39.1	19.9	17.5	14.0%
1992	30.5	17.4	19.3	-9.5%	30.5	14.8	12.8	15.4%	30.5	13.7	11.7	16.2%
1993	36.6	23.8	26.5	-10.2%	36.6	20.8	22.2	-6.1%	36.6	19.6	20.3	-3.9%
1994	33.9	18.0	20.0	-10.2%	33.9	15.4	16.0	-3.3%	33.9	14.5	15.5	-6.8%
1995	38.9	22.3	24.9	-10.6%	38.9	19.5	19.2	1.5%	38.9	18.3	19.5	-6.0%
Total	**225.7**	**128.8**	**138.2**	**-6.8%**	**225.7**	**113.9**	**109.4**	**4.1%**	**225.7**	**107.3**	**104.6**	**2.6%**
Average	37.6	21.5	23.0	-6.8%	37.6	19.0	18.2	4.1%	37.6	17.9	17.4	2.6%

R-Squared, or the Coefficient of Determination, is sometimes used as a statistical measure of the quality of a calibration. When analyzing daily values, an R-Squared value of 0.8 to 0.9 is considered very good, 0.7 to 0.8 good, and 0.6 to 0.7 fair. When analyzing monthly values, an R-Squared value of 0.85 or higher is considered very good, 0.75 to 0.85 good, and 0.65 to 0.75 fair (Donigian 2001).

For the hydrology calibration, the daily R-Squared values at Warrenville and Naperville are in the fair range. The daily R-Squared value at West Chicago, however, falls below the fair range. This lower R-Squared value is likely influenced by the fact that the West Chicago gage captures the flows from the upper portions of the watershed, which are more influenced by the heavy point source discharges during low-flow periods. The monthly R-Squared values at Warrenville and Naperville are also in the good range, while the monthly R-Squared value at West Chicago is in the fair range.

Monthly average flows can indicate a seasonal error in the simulated flows. Table 5-4 shows the average simulated and observed runoff in inches for each month of the simulation at the three calibration locations. These statistics show a consistent under-simulation of flows in February and March at all three locations. These statistics also show an undersimulation in late summer at the most upstream gage, while showing an oversimulation at the lower gages in the fall. These differences may reflect the difficulties involved in snow simulation and snowmelt events in early spring where many of the meteorological time series used in the simulation were recorded some distance from the watershed. The over-simulation in the fall may be the result of inaccurate point source discharge data.

TABLE 5-4
Summary of Hydrologic Calibration—Monthly Average Runoff (inches) 1990 to 1995

	West Branch at West Chicago				West Branch at Warrenville				West Branch at Naperville			
Month	Avg. Simulated (in)	Avg. Observed (in)	Avg. Residual	% Error	Avg. Simulated (in)	Avg. Observed (in)	Avg. Residual	% Error	Avg. Simulated (in)	Avg. Observed (in)	Avg. Residual	% Error
Jan	2.1	1.9	0.2	9.8	1.8	1.5	0.4	25.4	1.7	1.4	0.3	19.9
Feb	1.4	2.0	-0.6	-27.6	1.2	1.4	-0.3	-17.6	1.0	1.4	-0.3	-23.9
Mar	2.2	2.7	-0.5	-19.0	1.9	2.2	-0.3	-13.0	1.8	2.0	-0.2	-8.7
Apr	3.0	3.0	0.0	-1.0	2.7	2.6	0.2	7.2	2.6	2.5	0.1	4.2
May	2.1	2.2	-0.1	-4.8	1.9	1.9	0.0	-0.1	1.9	2.1	-0.2	-10.4
Jun	1.7	1.8	-0.1	-4.5	1.5	1.6	-0.1	-5.1	1.4	1.4	0.0	1.5
Jul	1.2	1.4	-0.2	-16.1	0.9	0.9	0.0	-2.0	0.8	0.8	0.0	-2.2
Aug	1.3	1.6	-0.3	-21.4	1.1	1.1	0.0	1.7	1.0	1.1	0.0	-2.3
Sep	0.9	1.1	-0.2	-20.8	0.7	0.7	0.0	-3.8	0.7	0.8	-0.1	-9.5
Oct	1.3	1.4	0.0	-3.0	1.2	1.0	0.2	20.2	1.1	0.9	0.2	25.6
Nov	2.7	2.5	0.2	8.5	2.5	2.0	0.5	23.6	2.4	1.9	0.5	26.2
Dec	1.8	1.7	0.1	8.3	1.6	1.4	0.2	12.0	1.5	1.3	0.2	11.1
Totals	**21.5**	**23.1**	**0.1**	**-6.9**	**19.0**	**18.3**	**0.2**	**4.1**	**17.9**	**17.5**	**0.2**	**2.5**

The flow duration curves show extremely good agreement (see Figures C2, C3, and C4 in Appendix C). Scatter plots of observed versus simulated flow at the three calibration locations show correlation coefficients of 0.65 for West Chicago (USGS05539900), 0.83 for Warrenville (USGS05540095) and 0.84 for Naperville (USGS05540130) (see Figures C5, C6, and C7 in Appendix C).

5.2.6 West Branch DuPage River Hydrologic Validation Summary

To validate the results of the hydrology calibration, HSPF was run for the West Branch DuPage watershed for the period January 1996 through December 1999. Table 5-5 lists statistical summaries of the annual simulated and observed runoff. The runoff volume errors at the three calibration locations are less than 10 percent, indicating very good agreement.

TABLE 5-5
Summary of Hydrologic Validation—Comparison of Annual Simulated and Observed Runoff

	West Branch at West Chicago				West Branch at Warrenville				West Branch at Naperville			
Year	Precip (in)	Simulated Flow (in)	Observed Flow (in)	% Error	Precip (in)	Simulated Flow (in)	Observed Flow (in)	% Error	Precip (in)	Simulated Flow (in)	Observed Flow (in)	% Error
1996	41.0	22.8	21.8	4.8	41.0	20.3	18.2	11.5	41.0	19.2	19	1.4
1997	32.6	19.4	19.9	-2.4	32.6	17.1	16.4	3.9	32.6	15.7	16.2	-2.7
1998	39.4	21.2	24.5	-13.3	39.4	19	21.1	-10.0	39.4	18.7	20.6	-9.2
1999	30.9	18.3	22	-16.9	30.9	15.5	20.3	-23.4	30.9	14.5	19.4	-25.1
Total	**143.9**	**81.7**	**88.1**	**-7.3**	**143.9**	**71.9**	**76**	**-5.4**	**143.9**	**68.2**	**75.1**	**-9.2**
Average	36.0	20.4	22	-7.3	36.0	18	19	-5.4	36.0	17	18.8	-9.2

For the validation, the daily R-Squared values at Warrenville and Naperville are in the 'fair' range. The monthly R-Squared value at Naperville is in the 'good' range, while the monthly R-Squared value at Warrenville is in the 'fair' range. The daily and monthly R-Squared values at West Chicago, however, fall below the 'fair' range.

5.2.7 Water Quality Calibration for Chloride

From the water quality data discussion in Section 3.9, stations 05539900 and 05540095 were selected as good sources of long-term water quality data (Figure 3-10). Figure 5-2 shows the water quality calibration of chloride for station 05539900 and Figure 5-3 shows the water quality calibration for chloride at station 05540095.

The primary source of chloride is the road salt applications during winter months. HSPF was selected as the model for simulating snow accumulation, snowmelt, and chloride concentrations in runoff. The hydrologic calibration phase included the calibration of the model for snow. The chloride simulation option was added to the hydrologically calibrated model using the general quality modules. The general quality modules simulate surface runoff of chloride using build-up (or accumulation) and washoff functions. An analysis was performed to estimate the chloride build-up rates on pervious an impervious land segments in different watersheds.

The chloride modeling results showed an overall good fit compared to the observed data points. One measure of how good the simulated value fit the observed value is the ratio between them. A ratio of 1.0 would indicate that observed and simulated values were identical. A value greater than 1.0 indicates a simulated value above observed value and a value less than 1.0 indicates a simulated value below the observed value. The average ratio of simulated to observed values were 1.9 for station 05539900 and 2.9 for 05540095. Station 05539900 showed a better fit than station 05540095. The median ratios were 1.4 for station 05539900 and 2.2 for 05540095.

TABLE 5-6
Statistical Summary for Chloride Modeling at Stations 05539900 and 05540095

	Simulated		Observed	
	5539900	**5540095**	**5539900**	**5540095**
Max, mg/L	677.8	810.7	593	497
Min, mg/L	6.6	1.1	1.0	64.0
Avg, mg/L	115.5	93.2	167.8	196.4
Std. Dev, mg/L	62.3	70.2	94.5	82.9
Variance	3878.3	4926.6	8925.8	6875.6

Station 05539900 shows better correlation with observed data than does station 05540095. There are several possible reasons for this. Station 05540095 is at the downstream end of the watershed with more potential influxes and variations that make it more difficult to model.

TABLE 5-7
Distribution of Snowfall Events per Month in West Branch DuPage River Watershed

Month	Average Snowfall Events
January	3.87
February	3.27
March	2.07
April	0.53
May	0.07
June	0.0
July	0.0
August	0.0
September	0.0
October	0.07
November	1.33
December	2.87

A GIS coverage of road data was obtained from Environmental Systems Research Institute, Inc. (http://www.esri.com/data/download/census2000_tigerline/index.html) The data, which originated with the U.S. Bureau of the Census TIGER/Line® 2000 Data, provided a detailed road network in all the subwatersheds. Miles of roads in each subwatershed were calculated and classified according to number of lanes. This was used as a basis for estimating the amount of road salt applied to each subwatershed. The average number of snowfalls and the monthly distribution were estimated using historic precipitation and air temperature data. On average, 14 snowfall events occurred in the area (consecutive days of snowfall were treated as one event). Table 5-7 lists the distribution of snowfall events by month. It was assumed that 18.23 tons of salt were applied to every mile of road (9.11 tons of salt per lane-mile per year). This rate is consistent with road salt application rates for several DuPage County communities in the late 1990s (Table 5-8). Daily accumulation rates were calculated based on the acres of pervious and impervious areas for residential, commercial, transportation, and other urban land use in each subwatershed and the average number of snowfall events per month.

TABLE 5-8
Seasonal Salt Application Rates in Four West Branch DuPage River Watershed Communities in the 1990s

Year	Average Salt Use per Mile (ton/mile)	Average Salt Use per Lane per Mile (tons/lane-mile)
90/91	16.66	8.33
91/92	13.10	6.55
92/93	17.91	8.95
93/94	17.58	8.79
94/95	13.72	6.86
95/96	21.43	10.72
96/97	23.78	11.89
97/98	14.94	7.47
98/99	17.14	8.57
99/00	20.00	10.00
00/01	25.35	12.67
01/02	12.99	6.50
Average Applications		
90/91–01/02	18.23	9.11
1990s	18.00	9.00

Source: Bartlett, Village of Carol Stream, Wheaton, and West Chicago

Model calibration results are shown in Figures 5-2 and 5-3 at the two stations on the West Branch DuPage River (water quality stations 0553990 and 05540095). The model successfully simulated chloride concentrations over a long period (1990 to 1999) and captured the variability of chloride concentrations in different seasons of the year. The model is considered adequately calibrated for developing TMDL allocation for chloride.

FIGURE 5-2
Water Quality Calibration of Chloride at West Branch DuPage River (Station 0553990)

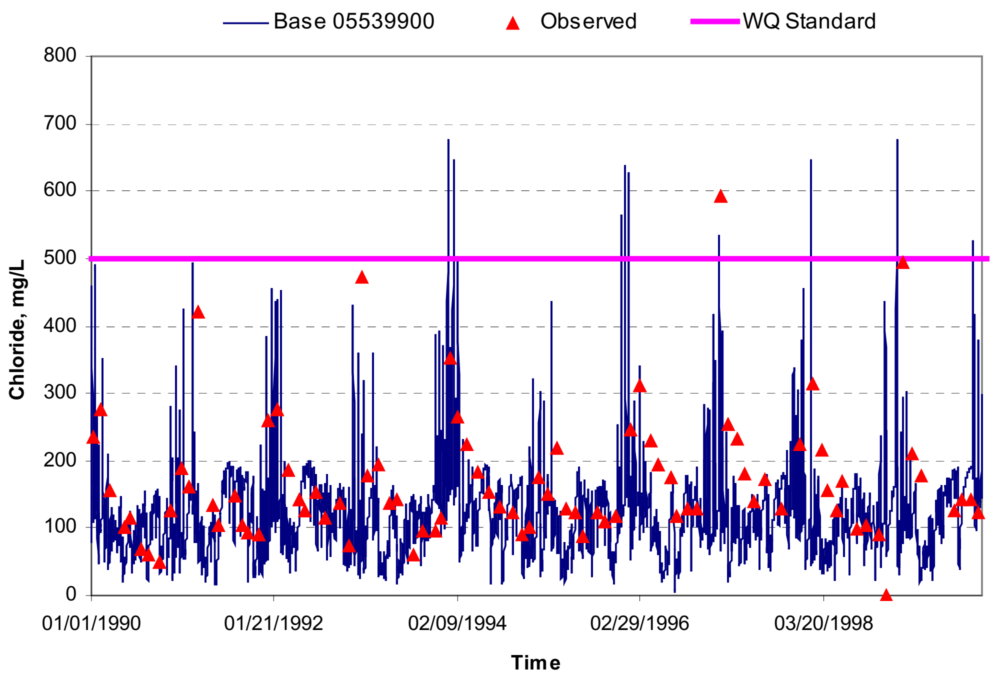
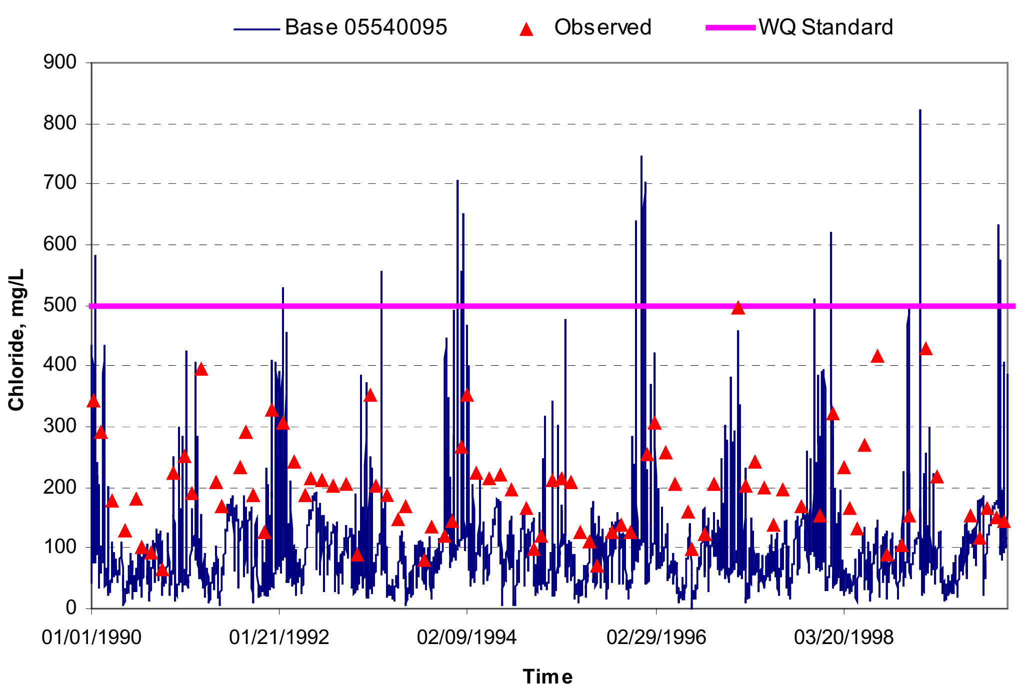


FIGURE 5-3
Water Quality Calibration of Chloride at West Branch DuPage River (Station 05540095)



6. TMDL Allocation

6.1 Approach and Methodology

TMDLs are the sum of the individual WLAs for point sources, LAs for both nonpoint sources and natural background, and an MOS. This definition is denoted by the equation

$$TMDL = \Sigma\ WLAs + \Sigma\ LAs + MOS$$

Development of a TMDL is an iterative process that involves modeling and generation of allocation scenarios that meet water quality targets. The West Branch DuPage River TMDLs were developed using the calibrated models presented in Section 5. Each scenario was carefully evaluated and the TMDLs are presented in the following sections. Seasonal variability of pollutant concentrations and flow were considered explicitly in the model through continuous simulation and time varying input variables or through determination of critical conditions, as discussed in Section 5. Separate TMDLs were developed using approaches appropriate for the listed pollutants. The following sections present the TMDLs for each cause of impairment.

Section 303(d) of the Clean Water Act (CWA) requires TMDLs to include "a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality." There are two methods for incorporating the MOS (USEPA 1991):

- Implicitly incorporate the MOS using conservative model assumptions to develop allocations
- Explicitly specify a portion of the total TMDL as the MOS; use the remainder for allocations

Implicit MOS was used in the development of the TMDLs presented in this report.

6.2 Future Growth

The West Branch DuPage River watershed is a quickly urbanizing area in DuPage, Cook, Will, and Kane counties, Illinois. Much of the watershed is already developed, however, there is the potential for future development primarily in the Kress Creek portion of the watershed. 1990 land use data indicates 17 percent of the watershed is agricultural land. The potential for additional chloride application exists primarily through development of agricultural lands. A more detailed discussion about how the future growth potential was incorporated can be found in section 6.5 below. Future growth implications for chloride reduction are also considered in the implementation plan.

6.3 Critical Condition

Section 303(d) of the CWA and the USEPA's regulations in 40 CFR 130.7 both require the consideration of seasonal variation in the conditions affecting the constituent of concern and the inclusion of a MOS in the development of a TMDL. For the West Branch DuPage River TMDL, long-term monitoring data and continuous modeling results were used to determine seasonal variation of chloride concentration. The TMDL was developed based on the critical conditions in the winter months. Runoff and interflow generated from precipitation and snowmelt are the primary modes of chloride transport from land surface to water bodies.

A reasonable approach for TMDL allocation calculations requires using a representative year (not a dry or wet year) for modeling. Annual stream flow data between 1991 and 1998 were compared to determine a representative flow year to avoid using an extreme wet or dry year. Stream flows in 1996 and 1997 produced representative weather conditions. A 3-year period between January 1, 1996 and December 31, 1998, which included representative weather conditions, was selected for TMDL scenario development. In finding a representative year the winter month conditions were critical as this is when the chloride exceedances occurred.

6.4 Margin of Safety

An implicit MOS was incorporated in data analysis, modeling, and calculation of the TMDL allocations. Conservative assumptions were made with respect to chloride road salt application rates, point source discharge concentrations, and TMDL calculation. A conservative road salt application rate was assumed in modeling by using a value representative of an 83rd percentile application rate (greater than 10 out of 12 years based on available data). Point source discharge concentrations were conservatively assumed by using a value higher than the highest measured concentration in the discharges. The TMDL was also conservative because the salt application rate that the percent reduction was applied to in order to calculate the load allocation for MS4s was lower than that used in the model (greater than 8 out of 12 years based on available data). These conservative assumptions in approach made the MOS implicit in the TMDL development.

In addition, a rigorous modeling approach was used. Continuous modeling of hydrology and water quality provided in-stream chloride concentrations that allowed direct comparison of model results with observed data and seasonal variation of chloride concentrations. Direct comparison of model results with observed data show the ability of the model to simulate seasonal variability and the extent of violation of the chloride standard under different scenarios. Hydrologic modeling included continuous snow simulation providing runoff from snowmelt. The snow simulation capability was critical in determining the chloride load generated from road salt application for deicing. Ten years of observed chloride data were used to calibrate and validate the HSPF model, then three representative years with respect to weather were used in TMDL allocation development. Because of this modeling rigor, an explicit MOS is unnecessary.

Finally, the allocation approach (i.e., reducing loads such that there were only two exceedances over the 3-year representative period of the WQS) was very conservative.

6.5 Conductance/Total Dissolved Solids and Chloride

The chloride TMDL addresses issues involving the conductance/TDS and the chloride exceedances in the West Branch DuPage River watershed. A strong correlation was found between conductance and chloride (Section 4.3). Road salt application for deicing contributes chloride loads to surface waters. The HSPF model was used to simulate the chloride load from the watershed and to develop TMDL allocation scenarios. The model setup and calibration procedures are described in Section 5.2.7. Historical chloride application rates were used to estimate the annual chloride load under existing conditions. The model was run to determine the percent reduction of chloride application needed to minimize the number of exceedances.

6.5.1 Chloride Exceedances

Modeling was done to determine a percentage reduction in nonpoint source chloride contribution. A 35 percent nonpoint source chloride reduction was chosen based upon the modeling of existing land use conditions and a range of point source discharge concentrations was determined. The number of exceedances over the 3-year period used for TMDL development was determined for what was simulated as existing land use conditions. Table 6-1 summarizes this information for various point source discharge concentrations.

TABLE 6-1
Chloride Exceedance Summary by Point Source Discharge Concentration 1996–1998 for 35 Percent Nonpoint Source Reduction

Point Source Discharge Concentration	0 mg/L	300 mg/L	400 mg/L	500 mg/L
Number of Model Predicted Exceedances 1996–1998 gage 5539900 (West Chicago) (seg28)	0	2	2	3
Number of Model Predicted Exceedances 1996–1998 gage 5540095 (Warrenville) (seg3)	0	2	2	4
Exceedance Percentage of Time gage 5539900 (West Chicago) (seg28)	0	0.18%	0.18%	0.27%
Exceedance Percentage of Time gage 5540095 (Warrenville) (seg3)	0	0.18%	0.18%	0.36%

The table illustrates that there is no difference in the number of chloride exceedances between 300 mg/L and 400 mg/L point source chloride discharge concentration. A model run was also made in which the chloride concentration for point source discharges was set to zero. The results show that zero exceedances under existing land use nonpoint source conditions is theoretically possible, but that there is very little difference (less than a 0.4 percent change in amount of time) in the number of exceedances over the range of zero to 500 mg/L point source discharge concentrations.

A discharge of 500 mg/L produces additional exceedances, however the percentage of time exceedances occur for all discharge levels is small.

6.5.2 Load Allocations

A review of the available data and modeling results indicates that the chloride exceedances of 500 mg/L or more occur during the deicing season. The primary contributor to the exceedances is application of road salt for snow and ice control purposes. However, due to the sporadic nature of deicing activities, on a yearly basis, the chloride mass contributed to the West Branch DuPage River watershed is larger from point sources than nonpoint sources. Table 6-1 illustrates that the primary cause of exceedances is from nonpoint contributions.

Load allocation provides the maximum allowable nonpoint source and background contributions of chloride that will meet the WQS. The WQS is expressed as a concentration of chloride (500 mg/L). The HSPF model was set up to output total annual load and daily average chloride concentration. The model was run iteratively reducing the overall winter season chloride load from salt application until daily average concentrations met the WQS at nearly all times. Because of the complexity of the relationships among different variables that define concentrations and flow, an iterative approach was necessary to determine the final allocation scenario. Figures 6-1 and 6-2 respectively show the allocation model results for stations 05539900 and 05540095 in the West Branch DuPage River watershed. The chloride standard is included in the plots to compare the modeled chloride concentrations with the standard. Since salt application for deicing is the major source of chloride leading to standard exceedance, the chloride TMDL indicates the need for salt application chloride reduction. This allocation approach was very conservative (i.e., protective of WQS) because a single criterion exceedance does not necessarily lead to impairment of a designated use, as discussed below.

6.5.2.1 Nonpoint Source Load

The chloride TMDL describes load allocations (LAs; i.e., NPS allocations) as being applicable to stormwater sources of chloride, such as road salting activities. However, due to regulatory approaches, stormwater in municipal separate storm sewer systems (MS4s) is regulated as a point source instead of a non-point source. Consequently, the MS4 chloride load will be handled as a WLA and not as a LA. Additional discussion on MS4s and LA versus WLA is contained in Section 7 *Implementation Plan*.

Because Phase II of the NPDES stormwater program will apply to most or all of the municipalities in the watershed (see Appendix F for the list of stormwater permittees), as well as to the roads owned and operated by the state and the Tollway Authority, it is anticipated that stormwater-related allocations will actually be implemented as point source controls, as described in recent USEPA guidance and as governed by the Illinois Environmental Protection Agency (IEPA) General Permit for Stormwater Discharges. Consequently, chloride from road deicing materials is not included as a nonpoint source load allocation (LA). Instead, the load from road salt is listed as a waste load allocation (WLA) for MS4s and there is no nonpoint source load for this TMDL.

6.5.2.2 MS4 Load

The chloride WLA from deicing materials was determined by taking the average road salt application in tons applied per lane-mile as determined from an analysis of communities within the watershed from 1990 to 2002. A 35 percent reduction in chloride application was found to result in an application of 22,637,000 pounds of chloride, or 37,316,000 pounds of deicing salt (sodium chloride or equivalent) per year.

The MS4 waste load allocation was based upon an analysis of road lane-miles within the watershed and represented as a reduction in salt applied for deicing purposes since that is the most direct measurement of chloride applied to the watershed. A combination of measuring chloride applied and in-stream chloride concentrations should provide a strong gauge for meeting chloride water quality standards.

Part of the watershed still is considered agricultural land, but it is facing heavy development pressures. Consequently, it was assumed that the watershed will continue developing such that the agricultural land use will be changed to a land use distribution similar to that found throughout the rest of the watershed. Taking this into account, a future MS4 WLA was found to be equal to 27,421,000 pounds of chloride, or 45,202,000 pounds of sodium chloride (or equivalent) deicing salt per year.

FIGURE 6-1
Modeled Chloride Concentrations West Branch DuPage River Segment GBK 09 (Station 05539900) for the TMDL Allocation Scenario

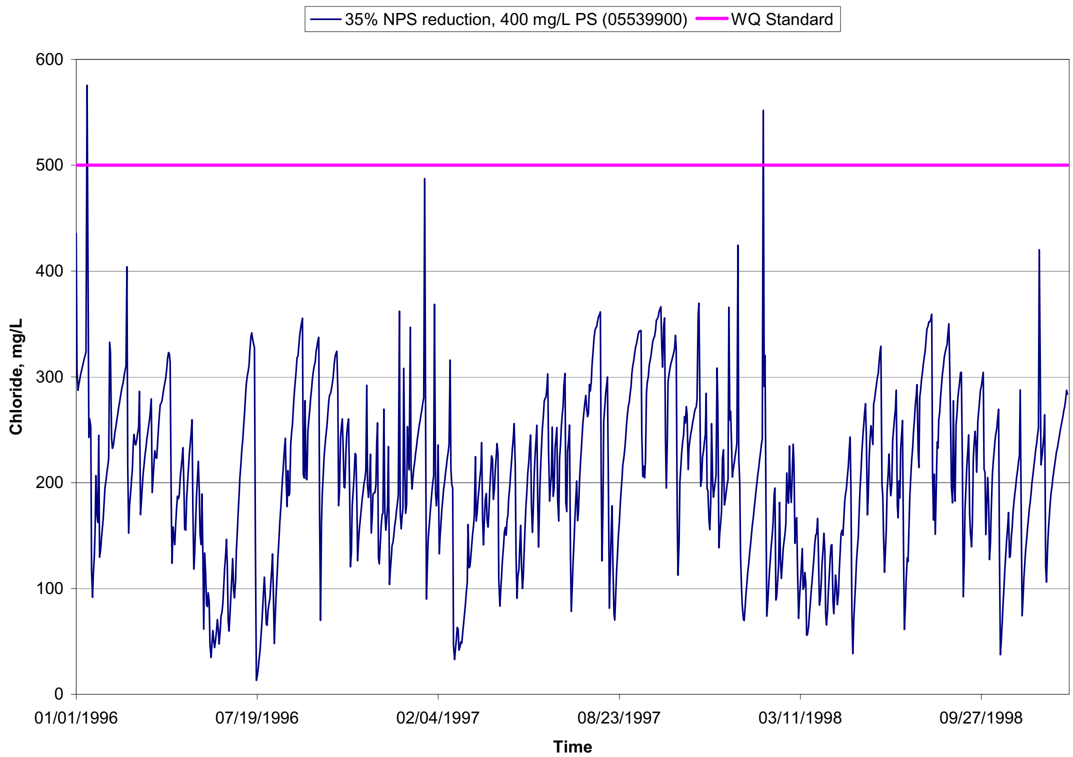
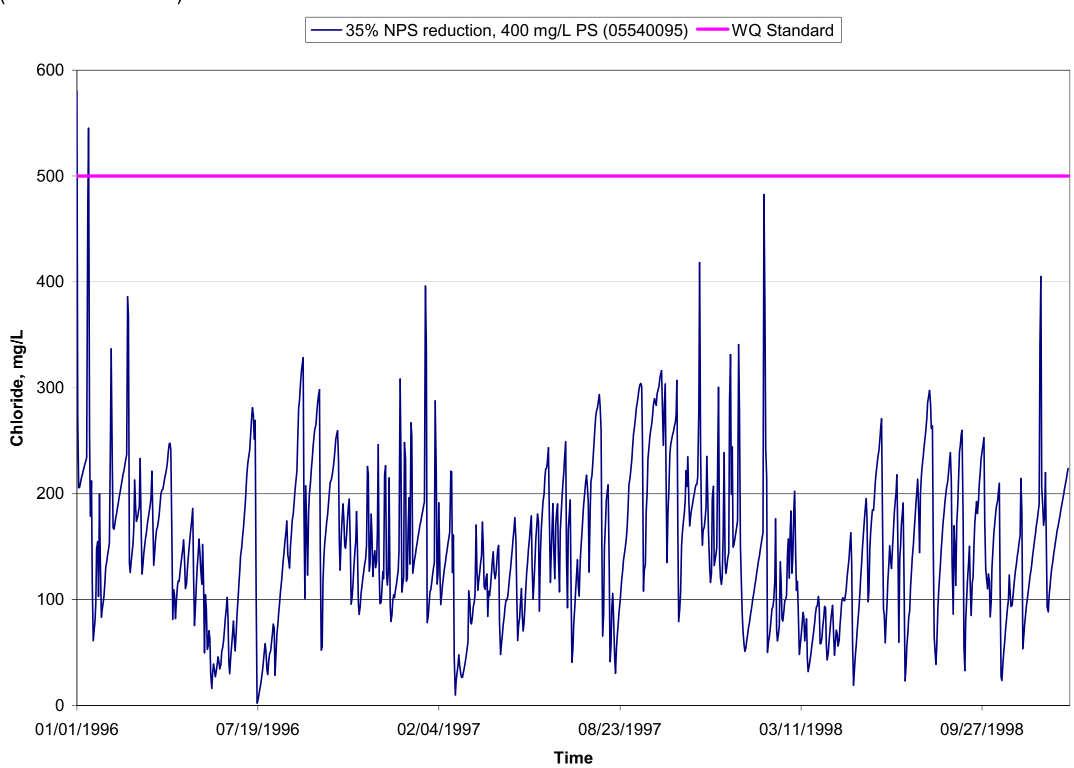


FIGURE 6-2
Modeled Chloride Concentrations West Branch DuPage River Segment GBK 05 (Station 05540095) for the TMDL Allocation Scenario



To account for the potential for future growth in the watershed a HSPF model run was setup where all agricultural land use was converted to urban, residential, other urban, and commercial land use categories. First the model was run with chloride application rates equal to the current rates and then the model was run with the 35 percent reduction required to meet the WQS. The model results showed that the frequency of exceedances would increase significantly but the average magnitude of the exceedances would only increase between 10 to 16 percent at the two calibration gages with application rates equal to existing rates. The results for the model run with a 35 percent reduced application rate showed that in about 99 percent of the simulated observations the chloride concentrations would be below the WQS as station 05539900. In the few cases that an exceedance was recorded the reduction required to be in compliance with the WQS would not be a feasible measure. This analysis is shown in Figures 6-3 and 6-4.

6.5.2.3 Point Source Load

The point source discharge monitoring reports (DMR) flows were reviewed from the late 1990s along with the discharge concentrations for chloride collected as part of The Conservation Foundation data collection program. The highest concentration observed was 312 mg/L chloride at point sources. The average from three point sources ranged from 178 to 268 mg/L.

A review of where land is still developable within the watershed indicated that property still available for development primarily lies within the West Chicago area. Consequently, an increase in flow of 20 percent above the average DMR flow was assumed for West Chicago, while an increase of 10 percent above the average DMR flow was assumed for other point sources. These flow values are shown in Table 6-2. The chloride discharge mass associated with varying chloride discharge concentrations was then determined based upon the increased flow rates. This information was used to calculate a non-MS4 WLA in pounds per year for point source discharge. The point source discharge concentration should be combined with the MS4 deicing material reduction strategy during implementation to balance water quality objectives with public safety concerns.

TABLE 6-2
Point Source Flow Rates Used in TMDL WLA

Point Source	Number	Average DMR Flow (mgd)	Estimated Future Flow (mgd)
MWRDGC Hanover Park STP	IL0036137	9.18	10.10
Roselle-Botterman WWTF	IL0048721	0.81	0.89
Hanover Park STP #1	IL0034479	1.00	1.10
Bartlett WWTP	IL0027618	2.12	2.33
Carol Stream STP	IL0026352	3.28	3.61
West Chicago STP	IL0023469	4.38	5.26
Wheaton S.D.	IL0031739	7.56	8.31
Total		28.34	31.61

FIGURE 6-3
Future Land Use Analysis in the West Branch DuPage River Watershed Without Reductions

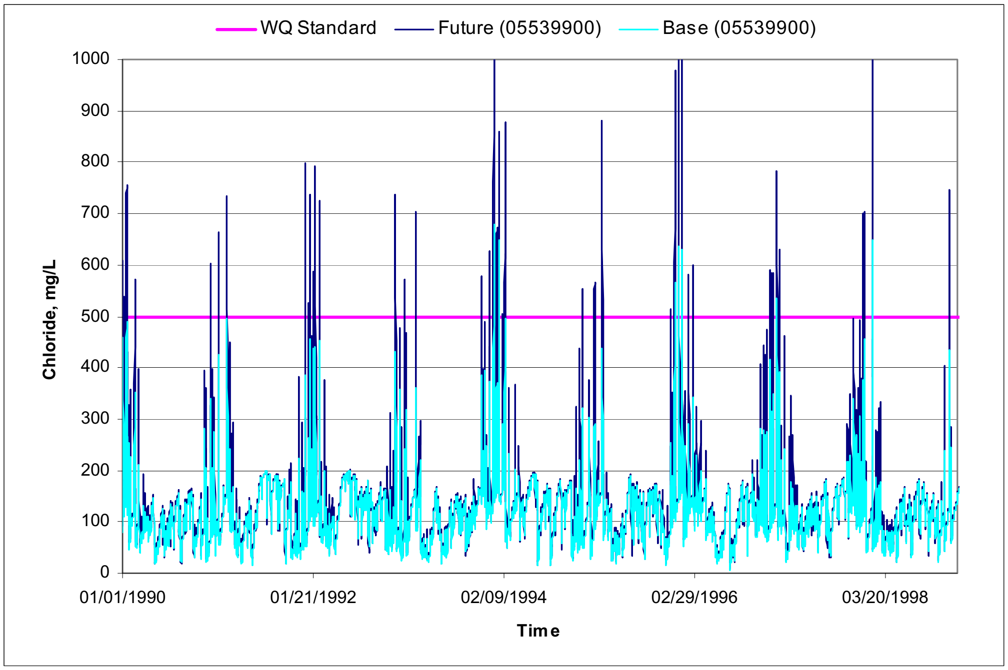
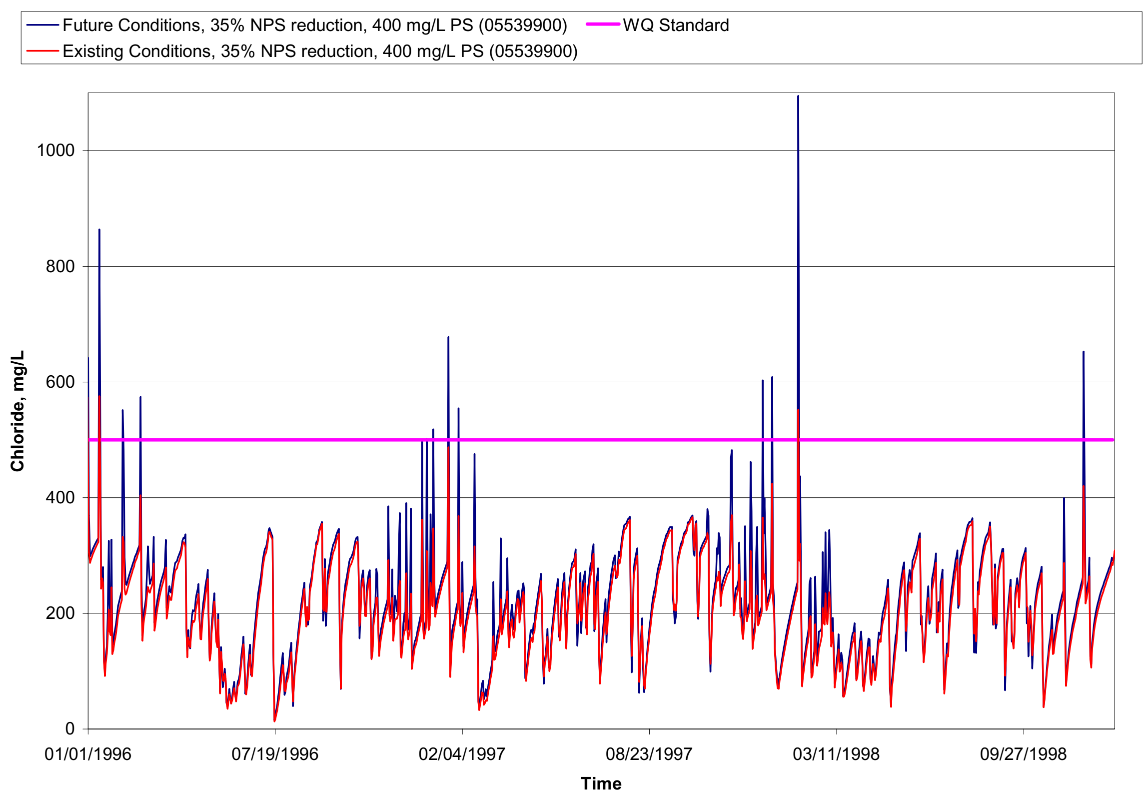


FIGURE 6-4
Future Land Use Analysis in the West Branch DuPage River Watershed



While the future growth produces additional exceedances, the percentage of exceedances remains small. Based upon this information, a point source discharge concentration of 400 mg/L was chosen. This estimate was conservatively made based on observed data from three wastewater treatment plants in the watershed (Table 6-3). The data from these plants were obtained as part of the additional data collected in 2001 as part of The Conservation Foundation's sampling program. Other plants were assumed to have similar values. See Table 3-4 for the list of point sources used in the model and the rationale for their inclusion.

TABLE 6-3
Effluent Discharge Data from Three WWTPs in West Branch DuPage River Watershed

Wastewater Treatment Plant	Chloride Concentration (mg/L)		
	Minimum	Maximum	Average
Bartlett	210	300	254
West Chicago	240	312	268
Wheaton	144	225	178

Note: Data are from November 7, 2001, through March 13, 2002.

6.5.2.4 TMDL

The WLA value in Table 6-4 has been divided to amounts from each discharger based upon the flow rates in Table 6-2. The MS4 WLA value represents a lumped WLA for all MS4 permittees. At this time, Illinois EPA intends to implement the MS4 WLA as a lumped value.

MS4 permittees and other nonpoint sources are addressed with the MS4 WLA in Table 6-4. Further discussion regarding implementation of this is provided in Section 7.

The TMDL allocations for West Branch DuPage River watershed required an overall reduction of road salt application of 35 percent to meet water quality standards in all impaired segments. Table 6-4 summarizes the proposed TMDL allocation for an across the board reduction in chloride usage from deicing activities equal to 35 percent. The allocations reflect future development.

TABLE 6-4
TMDL Based Upon 400 mg/L Point Source Discharge

TMDL Component	Value (lb/year)
The WLA is made up of the following components:	
MWRDGC Hanover Park STP IL0036137	12,303,000
Roselle-Botterman WWTF IL0048721	1,084,000
Hanover Park STP #1 IL0034479	1,339,000
Bartlett WWTP IL0027618	2,843,000
Carol Stream STP IL0026352	4,401,000
West Chicago STP IL0023469	6,410,000
Wheaton S.D. IL0031739	10,127,000
Subtotal WLA	38,507,000
Waste Load Allocation (lb/yr)	38,507,000
MS4 Waste Load Allocation (lb/yr)	27,421,000
Load Allocation (lb/yr)	0
Margin of Safety	Implicit
TMDL (lb/yr)	65,928,000
Nonpoint Source Reduction	35 percent

7. West Branch DuPage River Watershed Implementation Plan

7.1 Scope of this Implementation Plan

Each total maximum daily load (TMDL) described in this report should have a reasonable assurance of implementation in the watershed and should be consistent with all applicable federal regulations and guidance provided by the U. S. Environmental Protection Agency (USEPA). This plan includes the management practices to be implemented and the associated costs and institutional arrangements necessary for implementation, and it addresses the following TMDLs:

- Chloride TMDL for West Branch DuPage River
  - Applicable to road salting activities

7.2 General Description of Applicable Pollution Control Programs

7.2.1 Point Sources—Stormwater

The chloride TMDL describes load allocations (LAs; i.e., NPS allocations) applicable to stormwater sources of chloride, such as road salting activities. The LAs will also be applicable to stormwater discharges. Because Phase II of the NPDES stormwater program will apply to most or all of the municipalities in the watershed (see Appendix F for the list of stormwater permittees), as well as to the roads owned and operated by the state and the Tollway Authority, it is anticipated that stormwater-related allocations will actually be implemented as point source controls, as described in recent USEPA guidance and as governed by the Illinois Environmental Protection Agency (IEPA) General Permit for Stormwater Discharges.

7.2.1.1 USEPA Regulations and Guidance

USEPA has recently issued guidance directing how stormwater sources are to be addressed in TMDLs (source: USEPA. *Establishing Total Maximum Daily Load [TMDL] Wasteload Allocations [WLAs] for Stormwater Sources and NPDES Permit Requirements Based on Those WLAs*. Memorandum from Robert Wayland and James Hanlon to Water Division Directors, November 22, 2002). Relevant key points presented in this guidance include:

- NPDES-regulated stormwater discharges must be addressed by the WLA component of the TMDL [40 CFR 130.2(h)].
- NPDES-regulated stormwater discharges may not be addressed by the LA component of the TMDL [40 CFR 130.2(g)&(h)].
- Stormwater discharges from sources that are not currently subject to NPDES regulation may be addressed by the LA component of the TMDL [40 CFR 130.2(g)].

- It may be reasonable to express allocations for NPDES-regulated stormwater discharges from multiple point sources as a single categorical WLA when data and information are insufficient to assign each source or outfall to individual WLAs [40 CFR 130.2(i)]. In such cases where WLAs have been developed for categories of discharges, these categories should be defined as narrowly as available information allows.
- The WLAs and LAs are to be expressed in numeric form in the TMDL [40 CFR 130.2(h)&(i)]. USEPA expects TMDL authorities to make separate allocations to NPDES-regulated stormwater discharges (in the form of WLAs) and unregulated stormwater (in the form of LAs). USEPA recognizes that these allocations might be rudimentary due to data limitations and variability in the system.
- Water Quality Based Effluent Limits (WQBELs) for NPDES-regulated stormwater discharges that implement WLAs in TMDLs may be expressed in the form of best management practices (BMPs) under specific circumstances [40 CFR 122.44(k)(2)&(3)]. If BMPs alone adequately implement the WLAs, then additional controls are not necessary.
- USEPA expects that most WQBELs for NPDES-regulated municipal and small construction stormwater discharges will be in the form of BMPs, and that numeric limits will be used only in rare instances.

According to this guidance, all of the chloride-related allocations for the West Branch DuPage River TMDLs should be characterized as WLAs for point sources. In all other respects, the West Branch DuPage River TMDLs are consistent with this guidance.

7.2.1.2 IEPA General Stormwater NPDES Permit

IEPA has recently issued General Permit No. ILR40, *General NPDES Permit for Discharges from Small Municipal Separate Storm Sewer Systems*. The effective date of this permit is March 1, 2003 through February 29, 2008. Applicable Municipal Separate Storm Sewer Systems (MS4s) are expected to file a notice of intent to be covered by the permit, and then comply with all applicable permit requirements. The two sections of the permit most relevant to this plan are Part III C (Special Conditions for TMDL Watersheds) and Part IV (Stormwater Management Programs). Each of these sections is reproduced below, describing the conditions and requirements for covered permittees:

Part III. Special Conditions for TMDL Watersheds

C. If a TMDL allocation or watershed management plan is approved for any waterbody into which you discharge, you must review your stormwater management program to determine whether the TMDL or watershed management plan includes requirements for control of stormwater discharges. If you are not meeting the TMDL allocations, you must modify your stormwater management program to implement the TMDL or watershed management plan within 18 months of notification by the Agency of the TMDL's approval. Where a TMDL or watershed management plan is approved, you must:

   1. Determine whether the approved TMDL is for a pollutant likely to be found in stormwater discharges from your MS4.
   2. Determine whether the TMDL includes a pollutant WLA or other performance requirements specifically for stormwater discharges from your MS4.

3. Determine whether the TMDL addresses a flow regime likely to occur during periods of stormwater discharge.

4. After the determinations above have been made and if it is found that your MS4 must implement specific WLA provisions of the TMDL, assess whether the WLAs are being met through implementation of existing stormwater control measures or if additional control measures are necessary.

5. Document all control measures which are currently being implemented or are planned to be implemented. Also include a schedule of implementation for all planned controls. Document the calculations or other evidence that shows that the WLA will be met.

6. Describe and implement a monitoring program to determine whether the stormwater controls are adequate to meet the WLA.

7. If the evaluation shows that additional or modified controls are necessary, describe the type and schedule for the control additions/revisions. Continue steps four through seven above until two continuous monitoring cycles show that the WLAs are being met or that WQ standards are being met.

Part IV. Stormwater Management Programs

A. Requirements

You must develop, implement, and enforce a stormwater management program designed to reduce the discharge of pollutants from your small municipal separate storm sewer system to the maximum extent practicable (MEP) to protect water quality and to satisfy the appropriate water quality requirements of the Illinois Pollution Control Board Rules and Regulations (35 Ill. Adm. Code, Subtitle C, Chapter 1) and the Clean Water Act. Your stormwater management program must include the minimum control measures described in section B of this Part. You must develop and implement your program by 5 years from your coverage date under this permit.

B. Minimum Control Measures

The six minimum control measures to be included in your stormwater management program are:

1. Public education and outreach on stormwater impacts.

   You must:

   a. implement a public education program to distribute educational materials to the community or conduct equivalent outreach activities about the impacts of stormwater discharges on water bodies and the steps that the public can take to reduce pollutants in stormwater runoff; and

   b. define appropriate BMPs for this minimum control measure and measurable goals for each BMP. These measurable goals must ensure the reduction of all of the pollutants of concern in your stormwater discharges to the maximum extent practicable.

2. Public involvement/participation.

   You must:

   a. at a minimum, comply with state and local public notice requirements when implementing a public involvement/ participation program; and

   b. define appropriate BMPs for this minimum control measure and measurable goals for each BMP These measurable goals must ensure the reduction of all of the pollutants of concern in your stormwater discharges to the maximum extent practicable.

3. Illicit discharge detection and elimination.

   You must:

   a. develop, implement, and enforce a program to detect and eliminate illicit discharges into your small MS4;

   b. develop, if not already completed, a storm sewer system map showing the location of all outfalls and the names and locations of all waters that receive discharges from those outfalls;

   c. to the extent allowable under state or local law, effectively prohibit, through ordinance or other regulatory mechanism, non-stormwater discharges into your storm sewer system and implement appropriate enforcement procedures and actions;

   d. develop, implement, and adequately fund a plan to detect and address non-stormwater discharges, including illegal dumping, to your system;

   e. inform public employees, businesses, and the general public of the hazards associated with illegal discharges and the improper disposal of waste;

   f. address the categories of non-stormwater discharges listed in Section I.B.2 only if you identify them as a significant contributor of pollutants to your small MS4 (discharges or flows from firefighting activities are excluded from the effective prohibition against non-stormwater and only need to be addressed where they are identified as significant sources of pollutants to waters of the United States); and

   g. define appropriate BMPs for this minimum control measure and measurable goals for each BMP. These measurable goals must ensure the reduction of all pollutants of concern in your stormwater discharges to the maximum extent practicable.

4. Construction site stormwater runoff control.

   You must:

   a. develop, implement, and enforce a program to reduce pollutants in any stormwater runoff to your small MS4 from construction activities that result in a land disturbance of greater than or equal to 1 acre. Reduction of stormwater discharges from construction activities disturbing less than 1 acre must be included in your program if that construction activity is part of a larger common plan of development or sale that would disturb 1 acre or more, or it has been designated by the permitting authority.

Your program must include the development and implementation of, at a minimum:

i. an ordinance or other regulatory mechanism to require erosion and sediment controls, as well as sanctions to ensure compliance, to the extent allowable under state or local law;

ii. requirements for construction site operators to implement appropriate erosion and sediment control best management practices;

iii. requirements for construction site operators to control waste, such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste, at the construction site that may cause adverse impacts to water quality;

iv. require all regulated construction sites to have a stormwater pollution prevention plan that meets the requirements of Part IV of NPDES permit No. ILR10, including management practices, controls, and other provisions at least as protective as the requirements contained in the Illinois Urban Manual, 2002;

v. procedures for site plan review which incorporate consideration of potential water quality impacts and review of individual pre-construction site plans to ensure consistency with local sediment and erosion control requirements;

vi. procedures for receipt and consideration of information submitted by the public; and

vii. procedures for site inspections and enforcement of control measures.

b. define appropriate BMPs for this minimum control measure and measurable goals for each BMP. These measurable goals must ensure the reduction of all of the pollutants of concern in your stormwater discharges to the maximum extent practicable.

5. Post-construction stormwater management in new development and redevelopment.

You must:

a. develop, implement, and enforce a program to address stormwater runoff from new development and redevelopment projects that that result in a land disturbance of greater than or equal to 1 acre, including projects which are less than 1 acre that are part of a larger common plan of development or sale or that have been designated to protect water quality, that discharge into your small MS4. Your program must ensure that controls are in place which would protect water quality and reduce the discharge of pollutants to the maximum extent practicable;

b. develop and implement strategies which include a combination of structural and/or non-structural BMPs appropriate for your community that will reduce the discharge of pollutants to the maximum extent practicable;

c. use an ordinance or other regulatory mechanism to address post-construction runoff from new development and redevelopment projects to the extent allowable under state or local law;

d. require all regulated construction sites to have post-construction management that meets or exceeds the requirements of Section IV (D)(2)(b) of NPDES permit No. ILR10, including management practices, controls, and other provisions that are at least as protective as the requirements contained in the Illinois Urban Manual, 2002;

e. ensure adequate long-term operation and maintenance of BMPs; and

f. define appropriate BMPs for this minimum control measure and measurable goals for each BMP. These measurable goals must ensure the reduction of all of the pollutants of concern in your stormwater discharges to the maximum extent practicable.

6. Pollution prevention/good housekeeping for municipal operations.

   You must:

   a. develop and implement an operation and maintenance program that includes a training component and is designed to prevent and reduce the discharge of pollutants to the maximum extent practicable;

   b. using training materials that are available from USEPA, the state of Illinois, or other organizations. Your program must include employee training designed to prevent and reduce stormwater pollution from activities, such as park and open space maintenance, fleet and building maintenance, operation of storage yards, snow disposal, new construction and land disturbances, and stormwater system maintenance procedures for proper disposal of street cleaning debris and catch basin material; it must address ways that flood management projects impact water quality, NPS pollution control, and aquatic habitat; and

   c. define appropriate BMPs for this minimum control measure and measurable goals for each BMP. These measurable goals must ensure the reduction of all of the pollutants of concern in your stormwater discharges to the maximum extent practicable.

7.2.2 Point Sources—WWTPs

The WWTPs already have individual NPDES permits for their discharges. However, WWTP effluent chloride concentrations are not a significant contribution to the chloride exceedances. No permit change for chloride is expected for WWTP point sources.

7.2.3 Nonpoint Sources

Section 319 of the Clean Water Act (CWA) authorizes states to address NPS pollution through the development of assessment reports and the adoption and implementation of NPS management programs. USEPA awards grants to states to assist in implementing these programs. Section 319 programs are largely voluntary, and promote practices on a watershed scale. IEPA is the designated state agency in Illinois for the 319 program. IEPA provides technical assistance, and informational and educational programs and funding to various units of local government and other organizations to implement projects that utilize cost-effective BMPs (source: IEPA. *Illinois EPA and Section 319*. IEPA/BOW/98-010. August 1998).

Previous Section 319 grants for watershed improvements in the West Branch DuPage River watershed primarily used to fund stream stabilization and debris removal projects. These particular projects are not likely to have an impact on chloride concentration levels. Other types of projects that would help implement the chloride TMDL, however, could be funded through the 319 program, including the general BMPs identified above, provided that they are already not being utilized in the watershed. A total of $20 million in Section 319 grant money has been awarded since 1990 to fund a total of 132 watershed improvement projects (source: IEPA. *Illinois EPA and Section 319*. IEPA/BOW/98-010. August 1998).

7.2.4 Reasonable Assurance

For watersheds that have a combination of point sources and NPS, where reduction goals can only be achieved by including some NPS reduction, the TMDL must incorporate reasonable assurances that implemented NPS reductions will be effective in achieving the load allocation (source: USEPA. *Guidance for Water Quality-Based Decisions: The TMDL Process*. EPA 440/4-91-001, 1991).

Although the West Branch DuPage River watershed is mostly urban , a small percentage of land use is agricultural (approximately 17 percent). As the chloride TMDL largely focuses on the use of road salt for deicing, agricultural activities are not relevant to this TMDL.

The assurance of achievement of TMDL goals will be provided by stormwater permit programs.

7.3 Specific Implementation Considerations for West Branch DuPage River Chloride TMDL

7.3.1 Chloride TMDL

The allocation scenario for chloride assumes that the WQS must be met at nearly all times and that a reduction in overall annual road salt application mass would be used to achieve that end. This is a conservative approach, because a reduction in an overall annual load may not be feasible or necessary to meet the designated uses. Thus, as described below, this approach should be further evaluated in the context of an adaptive or iterative implementation plan.

7.3.1.1 General BMPs for Road Deicing

The following BMPs are generally considered practicable for road deicing activities (source: FHWA. *Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring*. FHWQ-EP-00-002. May 2000).

- Optimization of use:

  Storage:

  - Salt storage piles need to be completely covered (i.e., use of salt domes)
  - Storage and handling operations should be performed on impervious surfaces
  - Stormwater runoff from areas where salt is stored should be contained in a suitable area

Application:

- Use of calibrated spreaders; trucks can be equipped with ground speed sensors that can accurately control the rate of spreading
- Training programs for drivers and handlers should be implemented to improve the efficiency of application and to reduce losses
- Snow plow operators need to avoid piling snow on or near frozen ponds, lakes, streams, or wetlands

- Other:
  - Identify ecosystems that are sensitive to salts
  - Use of alternatives such as calcium chloride and calcium magnesium acetate may be less environmentally harmful to sensitive ecosystems; these alternatives are more expensive than regular salt, but they are less corrosive to bridges and overpasses (see Tables 7-1 and 7-2 for information on these alternatives)
  - In some instances, sand may be used in place of salt to improve traction, but that may not be appropriate where sedimentation presents adverse environmental impacts

TABLE 7-1
Alternative Road Deicers—Temperature, Cost, and Environmental Considerations

Check the Label For	Works Down to:	Cost is:	Environmental Impacts
Calcium Magnesium Acetate (CMA)	22°F–25°F	20× more than rock salt	(+) Less toxic
Calcium Chloride (CaCl)	-25°F	3× more than rock salt	(+) Can use lower doses (+) No cyanide (-) Chloride impact
Urea	20°F–25°F	5× more than rock salt	(+) Less corrosion (-) Adds needless nutrients
Sand	No melting effect	~$3 for a 50 lb bag	(-) Accumulates in streets and streams
Sodium Chloride (NaCl; rock salt)	15°F	~$5 for a 50 lb bag	(-) Contains cyanide (-) Chloride impact

Source: Envirocast Newsletter. Volume 1, No. 3. http://www.stormcenter.com/envirocast/2003-01-01. January 2003.

TABLE 7-2
Alternative Road Deicers—Temperature and Cost Considerations

Deicer	Minimum Operating Temperature	Cost ($/lane mile/season)
Sodium chloride	12°F	$6,371–6,909
Calcium chloride	-20°F	$6,977–7,529
CG-90 Surface Saver[a]	1°F	$5,931–6,148
Calcium Magnesium Acetate	23°F	$12,958–16,319

[a]CG-90 is a combination of sodium and magnesium chloride with additives. Source: Center for Watershed Protection. *Stormwater BMP Design Supplement for Cold Climates*. Prepared for USEPA. December 1997.

7.3.1.2 Specific Road Salting BMPs–West Branch DuPage River Watershed

Local communities, IDOT, and the Illinois Tollway Authority are the primary parties responsible for the removal of snow and the application of road salt within the West Branch DuPage River watershed. While specific practices may vary from community to community, the following typical general description is applicable. This information is based on responses given during telephone interviews of officials from several of the communities located in the watershed, IDOT, and the Illinois Tollway Authority.

IDOT is responsible for the maintenance of state highways and roads, including snow removal and road salt application operations. These roadways typically have a U. S. or Illinois state highway route number assigned to them. While IDOT has agreements with some municipalities in the state under which the local municipality conducts the maintenance operations in place of IDOT, these agreements are rare in DuPage County.

The Illinois Tollway Authority is responsible for the maintenance of tollways, including snow removal and road salt application operations. The I-88 Tollway is located within the West Branch DuPage River watershed. The Tollway Authority typically dispatches snow removal and road salt application crews during or immediately after a snow event. Snow that is cleared is deposited in the Tollway right-of-way off the road shoulder or within the Tollway median. The Tollway Authority uses digitally-calibrated spreader trucks at an application rate of either 200, 300, or 500 lb/road-mile for its salting operations. The application rate used depends on several factors, including the severity of the storm and present road conditions. The spreader trucks are automated to spread salt at the selected rate regardless of vehicle speed. Operators are required to participate in a yearly training program.

DuPage County and local communities and townships located within the watershed are responsible for maintaining all county roadways and local streets, including local collector and arterial streets. Municipal Public Works Departments typically dispatch snow removal and road salt application crews during or immediately after a snow event. In most cases, snow that is cleared is deposited on the side of the road. In certain locations, such as downtown areas, the snow that is cleared may be hauled away and stored at a central location. With the possible exception of snow storage sites located upstream of a local stormwater detention basin, such sites typically do not have erosion and sediment control practices or structural or non-structural water quality BMPs in place. Some communities are in the process of phasing in new salt spreader trucks which tend to have automated salt spreader controls that are connected to the vehicle’s speedometer and which automatically apply salt at a standard rate regardless of vehicle speed. Newer salt spreader trucks are digitally calibrated and do not need to be calibrated yearly, as is generally required for older salt spreader trucks. Those communities which use older salt spreader trucks typically instruct drivers to stop spreading salt when the truck is stationary at a stoplight or in traffic. Training procedures vary by municipality, but all drivers are trained upon hiring, and most communities have some type of annual meeting or annual training requirements.

The following agencies or communities within the West Branch DuPage River watershed were contacted to provide information about their snow removal and salt application activities: DuPage County, Illinois Tollway Authority, Illinois Department of Transportation, Wheaton, Carol Stream, Bartlett, West Chicago, and Milton Township.

Information on whether the agency/community has a written snow plan, conducts yearly training, and/or owns digitally-calibrated salt spreading equipment is presented below.

TABLE 7-3
Summary of Snow Removal and Salt Application Information Collected from Selected Agencies and Municipalities

Agency/Community	Written Plan	Yearly Training	Digital Spreaders
IDOT	Yes	No	"Vast Majority"
Tollway	Yes	Yes	Yes
DuPage County	No	No	8 of 40
Bartlett	No	Yes	Yes
Carol Stream	Yes	No	No
West Chicago	Yes	No	No
Wheaton	Yes	Yes	No
Milton Township	No	No	No

The following is a list of municipal, government, and other entities which are likely to conduct snow removal and salt application operations within the West Branch DuPage River watershed (see Appendix F for the list of MS4 permittees):

Aurora
Bartlett
Batavia
Bloomingdale
Bolingbrook
Carol Stream
Geneva
Glen Ellyn
Glendale Heights
Hanover Park
Hoffman Estates
Lisle
Naperville
Roselle
Schaumburg
St. Charles
Streamwood
Warrenville
Wayne
West Chicago
Wheaton
Winfield
Bloomingdale Township
Lisle Township
Milton Township
Schaumburg Township
Wayne Township
Winfield Township
Cook County
DuPage County
Fermilab
Illinois Department of Transportation
Illinois Tollway Authority

7.3.1.3 Recommended Management Actions and Institutional Arrangements

It is recognized that road deicing is necessary for public safety. Thus, the implementation of the chloride TMDL by MS4s should be based on prudent and practicable road salting BMPs to the extent that public safety is not compromised.

Section III C. of IEPA General Permit No. ILR40, *General NPDES Permit for Discharges from Small Municipal Separate Storm Sewer Systems,* identifies the specific actions and schedule that each permittee will be required to follow to comply with TMDLs. If it is determined that a permittee will need to implement additional BMPs beyond those already in place, then the general road salting BMPs identified should be evaluated for their applicability and effectiveness as a part of that permittee's plan to comply with TMDLs.

The General Permit requires each permittee to notify IEPA if it does not currently meet the WLA for a TMDL. For the chloride TMDL, separate WLAs were not identified according to each individual jurisdiction that conducts road deicing activities. Instead, a single allocation was made for a category of discharges, namely deicing-related discharges. Thus, permittees should have the option of either: 1) demonstrating to IEPA that their activities do not cause or contribute to chloride exceedances, 2) using prudent and practicable BMPs already in place, or 3) proceeding to implement the remaining TMDL provisions of the General Permit.

7.3.1.4 Cost Considerations

It is anticipated that many of the general BMPs identified above for road salting, if not already in place, can be implemented over time by the appropriate jurisdictions. For example, the controlled application of salt is a reasonable and prudent step that is commonly used to avoid over-salting. However, the use of alternative deicing agents will have to be carefully considered by each permittee in relation to cost, applicability, practicability, and public safety. As shown above, costs for alternatives to sodium chloride-based rock salt are substantially higher, and these alternatives cannot be used in all conditions or locations. In addition, each of the alternatives poses its own adverse water quality impacts which must be taken into consideration.

7.4 Adaptive Management

7.4.1 Chloride TMDL

The chloride criteria exceedances for the West Branch DuPage River, both monitored and modeled, are infrequent (less than 0.5 percent of the time). For example, USEPA guidance recommends that water bodies should only be considered impaired if exceedances occur more than a given percent of time, depending on such factors as pollutant type and data distribution (see USEPA July 2002 Consolidated Assessment and Listing Methodology guidance). For acute and chronic chemical criteria for conventional pollutants, USEPA guidance identifies a greater than 10 percent exceedance threshold for non-attainment of standards and 305(b) and 303(d) listings. In addition, it may be possible to identify which specific hydrologic and salt application conditions lead to elevated instream chloride concentrations through further discussion with permittees, or through additional monitoring and/or modeling activities. It may be possible to target control actions specific to these conditions. If successful, it would not be necessary to achieve an overall annual salt application reduction of the magnitude indicated in the TMDL.

7.4.2 Recommended Elements of Adaptive TMDL Implementation

The following discussion summarizes adaptive management language included in the Tualatin River TMDL, as approved by USEPA (source: Oregon DEQ. August 2001).

As a goal of the CWA and associated administrative rules for Illinois, water quality standards shall be met or all feasible steps should be taken toward achieving the highest quality water attainable. This is a long-term goal in many watersheds. The TMDLs developed for the West Branch DuPage River watershed are based on mathematical models and other analytical methods that are designed to simulate complicated physical, chemical, and biological processes. They are, to a certain extent, simplifications of the actual processes, and thus do not produce an exact prediction of a particular system response to pollutants. These uncertainties have been recognized and conservative assumptions have been used to address them, as acknowledged in the margin of safety considerations. Subject to available resources, IEPA should review, and, if necessary, modify the TMDLs if IEPA determines that new scientific information is available that indicates significant changes are warranted.

This watershed plan is designed to reduce pollutant loads to meet TMDL targets. However, it should be recognized that it may take some period of time from full implementation before management practices identified become fully effective in reducing and controlling certain pollutants. In addition, technology for controlling some pollutant sources such as NPS and stormwater, are still in the development stages and will take one or more iterations to develop effective techniques. Finally, it is possible that after application of all reasonable BMPs, some of these TMDLs cannot be achieved as originally established.

When developing WQBELs for NPDES permits, IEPA should ensure that the limits are consistent with the assumptions of the WLA (40 CFR 122.44(d)(1)(vii)(B)) and work with stormwater permittees in developing management plans that are consistent with the TMDLs.

IEPA should regularly review progress towards achievement of the TMDLs. If and when IEPA determines that the plan has been fully implemented, that all feasible practices have reached maximum effectiveness, and that a TMDL or its target have not been achieved, the TMDL should be reopened to adjust the targets and associated water quality standards as necessary. The determination that all feasible steps have been taken should be based on site-specific balancing of (1) protection of designated uses, (2) appropriateness to local conditions, (3) use of best treatment technologies or BMPs, and (4) cost of compliance.

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Appendix A
RF3 Summary Table

TABLE A-1
Reaches Used in Hydrologic Modeling in the West Branch DuPage River Watershed

REACHID	PNAME	REACHTYPE	LENGTH_FT
1	DuPage River, West Branch	R	5124.7
2	DuPage River, West Branch	R	6745.8
3	DuPage River, West Branch	R	3054.2
4	Spring Brook	R	9886.9
5	Spring Brook	R	7745.4
6	Spring Brook	R	11334.6
7	Spring Brook	S	2481.1
8	DuPage River, West Branch	R	5396.3
9	Tributary to DuPage River, West Branch	S	10061.9
10	DuPage River, West Branch	R	6762.4
11	DuPage River, West Branch	R	4438.3
12	DuPage River, West Branch	R	12452.5
13	Tributary to DuPage River, West Branch	R	8594.2
14	Tributary to DuPage River, West Branch	R	12998.8
15	Tributary to DuPage River, West Branch	R	8378.3
16	Tributary to DuPage River, West Branch	S	10261.9
17	DuPage River, West Branch	R	8981.0
18	Tributary to DuPage River, West Branch	S	8379.3
19	Tributary to DuPage River, West Branch	R	1581.8
20	Tributary to DuPage River, West Branch	R	11919.9
21	Tributary to DuPage River, West Branch	R	6715.4
22	Tributary to DuPage River, West Branch	R	4925.3
23	Tributary to DuPage River, West Branch	S	10072.6
24	Tributary to DuPage River, West Branch	S	5662.5
25	DuPage River, West Branch	R	7643.0
26	Tributary to DuPage River, West Branch	S	9196.3
27	DuPage River, West Branch	R	1707.7
28	DuPage River, West Branch	R	9984.0
29	Tributary to DuPage River, West Branch	S	5780.2
30	DuPage River, West Branch	R	14272.6
31	DuPage River, West Branch	R	6758.9

TABLE A-1
Reaches Used in Hydrologic Modeling in the West Branch DuPage River Watershed

REACHID	PNAME	REACHTYPE	LENGTH_FT
32	DuPage River, West Branch	R	12278.9
33	Tributary to DuPage River, West Branch	S	8761.2
34	DuPage River, West Branch	R	7889.0
35	DuPage River, West Branch	R	8132.8
36	DuPage River, West Branch	S	12932.2
37	DuPage River, West Branch	R	6508.8
38	Tributary to DuPage River, West Branch	S	5679.2
39	Tributary to DuPage River, West Branch	S	4573.6
40	Kress Creek	R	9783.2
41	Kress Creek	S	5121.6
42	Kress Creek	R	6150.5
43	Kress Creek	S	8543.1
44	Kress Creek	R	8324.8
45	Kress Creek	S	6654.3
46	Kress Creek	R	5798.4
47	Tributary to DuPage River, West Branch	R	6919.7
48	Tributary to DuPage River, West Branch	R	12831.3
49	Tributary to DuPage River, West Branch	S	4101.0
50	Tributary to DuPage River, West Branch	S	6774.1
51	Tributary to DuPage River, West Branch	R	1363.3
52	DuPage River, West Branch	R	8449.8
53	Tributary to DuPage River, West Branch	S	3047.9
54	Tributary to DuPage River, West Branch	R	3471.1
55	Tributary to DuPage River, West Branch	S	1935.7
56	DuPage River, West Branch	R	9639.1
57	Tributary to DuPage River, West Branch	S	2910.1
58	Tributary to DuPage River, West Branch	S	11656.7
59	DuPage River, West Branch	R	9471.8
60	DuPage River, West Branch	R	3873.5
61	Tributary to DuPage River, West Branch	S	8271.2
62	DuPage River, West Branch	R	7942.1

Appendix B
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05539900	01/09/1990	CHLORIDE	TOTAL	MG/L	00940	234
05539900	02/06/1990	CHLORIDE	TOTAL	MG/L	00940	276
05539900	03/20/1990	CHLORIDE	TOTAL	MG/L	00940	155
05539900	05/18/1990	CHLORIDE	TOTAL	MG/L	00940	102
05539900	06/08/1990	CHLORIDE	TOTAL	MG/L	00940	116
05539900	07/20/1990	CHLORIDE	TOTAL	MG/L	00940	68
05539900	08/23/1990	CHLORIDE	TOTAL	MG/L	00940	61
05539900	10/10/1990	CHLORIDE	TOTAL	MG/L	00940	48
05539900	11/20/1990	CHLORIDE	TOTAL	MG/L	00940	125
05539900	01/03/1991	CHLORIDE	TOTAL	MG/L	00940	188
05539900	02/05/1991	CHLORIDE	TOTAL	MG/L	00940	160
05539900	03/15/1991	CHLORIDE	TOTAL	MG/L	00940	420
05539900	05/16/1991	CHLORIDE	TOTAL	MG/L	00940	133
05539900	06/05/1991	CHLORIDE	TOTAL	MG/L	00940	105
05539900	08/15/1991	CHLORIDE	TOTAL	MG/L	00940	147
05539900	09/10/1991	CHLORIDE	TOTAL	MG/L	00940	103
05539900	10/04/1991	CHLORIDE	TOTAL	MG/L	00940	94
05539900	11/18/1991	CHLORIDE	TOTAL	MG/L	00940	89
05539900	12/23/1991	CHLORIDE	TOTAL	MG/L	00940	259
05539900	02/04/1992	CHLORIDE	TOTAL	MG/L	00940	277
05539900	03/19/1992	CHLORIDE	TOTAL	MG/L	00940	186
05539900	04/29/1992	CHLORIDE	TOTAL	MG/L	00940	142
05539900	05/26/1992	CHLORIDE	TOTAL	MG/L	00940	126
05539900	07/07/1992	CHLORIDE	TOTAL	MG/L	00940	152
05539900	08/19/1992	CHLORIDE	TOTAL	MG/L	00940	116
05539900	10/13/1992	CHLORIDE	TOTAL	MG/L	00940	137
05539900	11/23/1992	CHLORIDE	TOTAL	MG/L	00940	73
05539900	01/13/1993	CHLORIDE	TOTAL	MG/L	00940	471
05539900	02/08/1993	CHLORIDE	TOTAL	MG/L	00940	178
05539900	03/26/1993	CHLORIDE	TOTAL	MG/L	00940	194
05539900	05/06/1993	CHLORIDE	TOTAL	MG/L	00940	137
05539900	06/03/1993	CHLORIDE	TOTAL	MG/L	00940	142
05539900	08/16/1993	CHLORIDE	TOTAL	MG/L	00940	59
05539900	09/21/1993	CHLORIDE	TOTAL	MG/L	00940	95
05539900	11/12/1993	CHLORIDE	TOTAL	MG/L	00940	96
05539900	12/06/1993	CHLORIDE	TOTAL	MG/L	00940	114
05539900	01/11/1994	CHLORIDE	TOTAL	MG/L	00940	353
05539900	02/08/1994	CHLORIDE	TOTAL	MG/L	00940	264
05539900	03/17/1994	CHLORIDE	TOTAL	MG/L	00940	224
05539900	05/03/1994	CHLORIDE	TOTAL	MG/L	00940	182
05539900	06/16/1994	CHLORIDE	TOTAL	MG/L	00940	154
05539900	08/02/1994	CHLORIDE	TOTAL	MG/L	00940	131
05539900	09/28/1994	CHLORIDE	TOTAL	MG/L	00940	123
05539900	11/01/1994	CHLORIDE	TOTAL	MG/L	00940	91
05539900	12/02/1994	CHLORIDE	TOTAL	MG/L	00940	102
05539900	01/10/1995	CHLORIDE	TOTAL	MG/L	00940	174
05539900	02/15/1995	CHLORIDE	TOTAL	MG/L	00940	151
05539900	03/27/1995	CHLORIDE	TOTAL	MG/L	00940	218
05539900	05/02/1995	CHLORIDE	TOTAL	MG/L	00940	129
05539900	06/09/1995	CHLORIDE	TOTAL	MG/L	00940	123

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05539900	07/12/1995	CHLORIDE	TOTAL	MG/L	00940	88.19
05539900	09/05/1995	CHLORIDE	TOTAL	MG/L	00940	122
05539900	10/10/1995	CHLORIDE	TOTAL	MG/L	00940	109
05539900	11/20/1995	CHLORIDE	TOTAL	MG/L	00940	117
05539900	01/23/1996	CHLORIDE	TOTAL	MG/L	00940	245
05539900	02/26/1996	CHLORIDE	TOTAL	MG/L	00940	312
05539900	04/10/1996	CHLORIDE	TOTAL	MG/L	00940	228
05539900	05/13/1996	CHLORIDE	TOTAL	MG/L	00940	194
05539900	07/03/1996	CHLORIDE	TOTAL	MG/L	00940	175
05539900	07/24/1996	CHLORIDE	TOTAL	MG/L	00940	118
05539900	09/10/1996	CHLORIDE	TOTAL	MG/L	00940	129
05539900	10/16/1996	CHLORIDE	TOTAL	MG/L	00940	127
05539900	01/22/1997	CHLORIDE	TOTAL	MG/L	00940	593
05539900	02/24/1997	CHLORIDE	TOTAL	MG/L	00940	254
05539900	04/02/1997	CHLORIDE	TOTAL	MG/L	00940	232
05539900	05/05/1997	CHLORIDE	TOTAL	MG/L	00940	181
05539900	06/10/1997	CHLORIDE	TOTAL	MG/L	00940	138
05539900	07/22/1997	CHLORIDE	TOTAL	MG/L	00940	173
05539900	10/02/1997	CHLORIDE	TOTAL	MG/L	00940	128
05539900	12/16/1997	CHLORIDE	TOTAL	MG/L	00940	224
05539900	02/05/1998	CHLORIDE	TOTAL	MG/L	00940	313
05539900	03/18/1998	CHLORIDE	TOTAL	MG/L	00940	216
05539900	04/09/1998	CHLORIDE	TOTAL	MG/L	00940	156
05539900	05/12/1998	CHLORIDE	TOTAL	MG/L	00940	126
05539900	06/08/1998	CHLORIDE	TOTAL	MG/L	00940	168
05539900	08/03/1998	CHLORIDE	TOTAL	MG/L	00940	99.59
05539900	09/09/1998	CHLORIDE	TOTAL	MG/L	00940	104
05539900	11/02/1998	CHLORIDE	TOTAL	MG/L	00940	89.69
05539900	12/02/1998	CHLORIDE	TOTAL	MG/L	00940	1
05539900	02/08/1999	CHLORIDE	TOTAL	MG/L	00940	170
05539900	03/23/1999	CHLORIDE	TOTAL	MG/L	00940	243
05539900	08/04/1999	CHLORIDE	TOTAL	MG/L	00940	79.6
05539900	09/09/1999	CHLORIDE	TOTAL	MG/L	00940	113
05539900	10/13/1999	CHLORIDE	TOTAL	MG/L	00940	113
05539900	11/17/1999	CHLORIDE	TOTAL	MG/L	00940	130
05539900	12/20/1999	CHLORIDE	TOTAL	MG/L	00940	185
05539900	02/14/2000	CHLORIDE	TOTAL	MG/L	00940	495
05539900	03/20/2000	CHLORIDE	TOTAL	MG/L	00940	209
05539900	04/25/2000	CHLORIDE	TOTAL	MG/L	00940	177
05539900	06/02/2000	CHLORIDE	TOTAL	MG/L	00940	126
05539900	07/18/2000	CHLORIDE	TOTAL	MG/L	00940	142
05539900	08/24/2000	CHLORIDE	TOTAL	MG/L	00940	141
05539900	10/16/2000	CHLORIDE	TOTAL	MG/L	00940	124
05540066	07/23/1990	CHLORIDE	TOTAL	MG/L	00940	160
05540095	01/09/1990	CHLORIDE	TOTAL	MG/L	00940	342
05540095	02/06/1990	CHLORIDE	TOTAL	MG/L	00940	292
05540095	03/20/1990	CHLORIDE	TOTAL	MG/L	00940	177
05540095	05/18/1990	CHLORIDE	TOTAL	MG/L	00940	128
05540095	06/28/1990	CHLORIDE	TOTAL	MG/L	00940	180
05540095	07/20/1990	CHLORIDE	TOTAL	MG/L	00940	100

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05540095	08/23/1990	CHLORIDE	TOTAL	MG/L	00940	92
05540095	10/10/1990	CHLORIDE	TOTAL	MG/L	00940	64
05540095	11/20/1990	CHLORIDE	TOTAL	MG/L	00940	225
05540095	01/03/1991	CHLORIDE	TOTAL	MG/L	00940	250
05540095	02/05/1991	CHLORIDE	TOTAL	MG/L	00940	191
05540095	03/15/1991	CHLORIDE	TOTAL	MG/L	00940	395
05540095	05/16/1991	CHLORIDE	TOTAL	MG/L	00940	208
05540095	06/05/1991	CHLORIDE	TOTAL	MG/L	00940	168
05540095	08/15/1991	CHLORIDE	TOTAL	MG/L	00940	232
05540095	09/10/1991	CHLORIDE	TOTAL	MG/L	00940	292
05540095	10/04/1991	CHLORIDE	TOTAL	MG/L	00940	186
05540095	11/18/1991	CHLORIDE	TOTAL	MG/L	00940	127
05540095	12/23/1991	CHLORIDE	TOTAL	MG/L	00940	327
05540095	02/04/1992	CHLORIDE	TOTAL	MG/L	00940	305
05540095	03/19/1992	CHLORIDE	TOTAL	MG/L	00940	242
05540095	04/29/1992	CHLORIDE	TOTAL	MG/L	00940	188
05540095	05/26/1992	CHLORIDE	TOTAL	MG/L	00940	213
05540095	07/07/1992	CHLORIDE	TOTAL	MG/L	00940	212
05540095	08/19/1992	CHLORIDE	TOTAL	MG/L	00940	201
05540095	10/13/1992	CHLORIDE	TOTAL	MG/L	00940	205
05540095	11/23/1992	CHLORIDE	TOTAL	MG/L	00940	88
05540095	01/13/1993	CHLORIDE	TOTAL	MG/L	00940	351
05540095	02/08/1993	CHLORIDE	TOTAL	MG/L	00940	203
05540095	03/26/1993	CHLORIDE	TOTAL	MG/L	00940	187
05540095	05/06/1993	CHLORIDE	TOTAL	MG/L	00940	147
05540095	06/03/1993	CHLORIDE	TOTAL	MG/L	00940	169
05540095	08/16/1993	CHLORIDE	TOTAL	MG/L	00940	81
05540095	09/21/1993	CHLORIDE	TOTAL	MG/L	00940	136
05540095	11/12/1993	CHLORIDE	TOTAL	MG/L	00940	120
05540095	12/06/1993	CHLORIDE	TOTAL	MG/L	00940	145
05540095	01/11/1994	CHLORIDE	TOTAL	MG/L	00940	265
05540095	02/08/1994	CHLORIDE	TOTAL	MG/L	00940	352
05540095	03/17/1994	CHLORIDE	TOTAL	MG/L	00940	224
05540095	05/03/1994	CHLORIDE	TOTAL	MG/L	00940	215
05540095	06/16/1994	CHLORIDE	TOTAL	MG/L	00940	220
05540095	08/02/1994	CHLORIDE	TOTAL	MG/L	00940	195
05540095	09/28/1994	CHLORIDE	TOTAL	MG/L	00940	166
05540095	11/01/1994	CHLORIDE	TOTAL	MG/L	00940	97
05540095	12/02/1994	CHLORIDE	TOTAL	MG/L	00940	119
05540095	01/10/1995	CHLORIDE	TOTAL	MG/L	00940	210
05540095	02/15/1995	CHLORIDE	TOTAL	MG/L	00940	215
05540095	03/27/1995	CHLORIDE	TOTAL	MG/L	00940	207
05540095	05/02/1995	CHLORIDE	TOTAL	MG/L	00940	124
05540095	06/09/1995	CHLORIDE	TOTAL	MG/L	00940	109
05540095	07/12/1995	CHLORIDE	TOTAL	MG/L	00940	70
05540095	09/05/1995	CHLORIDE	TOTAL	MG/L	00940	124
05540095	10/10/1995	CHLORIDE	TOTAL	MG/L	00940	138
05540095	11/20/1995	CHLORIDE	TOTAL	MG/L	00940	126
05540095	01/23/1996	CHLORIDE	TOTAL	MG/L	00940	254
05540095	02/26/1996	CHLORIDE	TOTAL	MG/L	00940	306

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05540095	04/10/1996	CHLORIDE	TOTAL	MG/L	00940	257
05540095	05/13/1996	CHLORIDE	TOTAL	MG/L	00940	205
05540095	07/03/1996	CHLORIDE	TOTAL	MG/L	00940	158
05540095	07/24/1996	CHLORIDE	TOTAL	MG/L	00940	99.19
05540095	09/10/1996	CHLORIDE	TOTAL	MG/L	00940	123
05540095	10/16/1996	CHLORIDE	TOTAL	MG/L	00940	205
05540095	01/22/1997	CHLORIDE	TOTAL	MG/L	00940	497
05540095	02/24/1997	CHLORIDE	TOTAL	MG/L	00940	203
05540095	04/02/1997	CHLORIDE	TOTAL	MG/L	00940	242
05540095	05/05/1997	CHLORIDE	TOTAL	MG/L	00940	199
05540095	06/10/1997	CHLORIDE	TOTAL	MG/L	00940	139
05540095	07/22/1997	CHLORIDE	TOTAL	MG/L	00940	195
05540095	10/02/1997	CHLORIDE	TOTAL	MG/L	00940	169
05540095	12/16/1997	CHLORIDE	TOTAL	MG/L	00940	153
05540095	02/05/1998	CHLORIDE	TOTAL	MG/L	00940	320
05540095	03/18/1998	CHLORIDE	TOTAL	MG/L	00940	233
05540095	04/09/1998	CHLORIDE	TOTAL	MG/L	00940	164
05540095	05/12/1998	CHLORIDE	TOTAL	MG/L	00940	133
05540095	06/08/1998	CHLORIDE	TOTAL	MG/L	00940	268
05540095	08/03/1998	CHLORIDE	TOTAL	MG/L	00940	417
05540095	09/09/1998	CHLORIDE	TOTAL	MG/L	00940	89.89
05540095	11/02/1998	CHLORIDE	TOTAL	MG/L	00940	103
05540095	12/02/1998	CHLORIDE	TOTAL	MG/L	00940	152
05540095	02/08/1999	CHLORIDE	TOTAL	MG/L	00940	200
05540095	03/23/1999	CHLORIDE	TOTAL	MG/L	00940	260
05540095	08/04/1999	CHLORIDE	TOTAL	MG/L	00940	135
05540095	09/09/1999	CHLORIDE	TOTAL	MG/L	00940	168
05540095	10/13/1999	CHLORIDE	TOTAL	MG/L	00940	139
05540095	11/17/1999	CHLORIDE	TOTAL	MG/L	00940	155
05540095	12/20/1999	CHLORIDE	TOTAL	MG/L	00940	202
05540095	02/14/2000	CHLORIDE	TOTAL	MG/L	00940	428
05540095	03/20/2000	CHLORIDE	TOTAL	MG/L	00940	218
05540095	04/25/2000	CHLORIDE	TOTAL	MG/L	00940	153
05540095	06/02/2000	CHLORIDE	TOTAL	MG/L	00940	116
05540095	07/18/2000	CHLORIDE	TOTAL	MG/L	00940	165
05540095	08/24/2000	CHLORIDE	TOTAL	MG/L	00940	151
05540095	10/16/2000	CHLORIDE	TOTAL	MG/L	00940	145
STATION	DATE	PARMHD1	PARMHD2	PARMHD3	PARMN0	NUMVAL
05539900	01/09/90	CNDUCTVY	FIELD	MICROMHO	00094	1285
05539900	02/06/90	CNDUCTVY	FIELD	MICROMHO	00094	1526
05539900	03/20/90	CNDUCTVY	FIELD	MICROMHO	00094	1104
05539900	05/18/90	CNDUCTVY	FIELD	MICROMHO	00094	294
05539900	06/08/90	CNDUCTVY	FIELD	MICROMHO	00094	924
05539900	07/20/90	CNDUCTVY	FIELD	MICROMHO	00094	583
05539900	08/23/90	CNDUCTVY	FIELD	MICROMHO	00094	761
05539900	10/10/90	CNDUCTVY	FIELD	MICROMHO	00094	998
05539900	11/20/90	CNDUCTVY	FIELD	MICROMHO	00094	1080
05539900	01/03/91	CNDUCTVY	FIELD	MICROMHO	00094	1216
05539900	02/05/91	CNDUCTVY	FIELD	MICROMHO	00094	936
05539900	03/15/91	CNDUCTVY	FIELD	MICROMHO	00094	1900

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05539900	05/16/91	CNDUCTVY	FIELD	MICROMHO	00094	990
05539900	06/05/91	CNDUCTVY	FIELD	MICROMHO	00094	883
05539900	08/15/91	CNDUCTVY	FIELD	MICROMHO	00094	1026
05539900	09/10/91	CNDUCTVY	FIELD	MICROMHO	00094	816
05539900	10/04/91	CNDUCTVY	FIELD	MICROMHO	00094	715
05539900	11/18/91	CNDUCTVY	FIELD	MICROMHO	00094	853
05539900	12/23/91	CNDUCTVY	FIELD	MICROMHO	00094	1448
05539900	02/04/92	CNDUCTVY	FIELD	MICROMHO	00094	1500
05539900	03/19/92	CNDUCTVY	FIELD	MICROMHO	00094	1229
05539900	04/29/92	CNDUCTVY	FIELD	MICROMHO	00094	1076
05539900	05/26/92	CNDUCTVY	FIELD	MICROMHO	00094	1001
05539900	07/07/92	CNDUCTVY	FIELD	MICROMHO	00094	1034
05539900	08/19/92	CNDUCTVY	FIELD	MICROMHO	00094	957
05539900	10/13/92	CNDUCTVY	FIELD	MICROMHO	00094	920
05539900	11/23/92	CNDUCTVY	FIELD	MICROMHO	00094	822
05539900	01/13/93	CNDUCTVY	FIELD	MICROMHO	00094	2000
05539900	02/08/93	CNDUCTVY	FIELD	MICROMHO	00094	1260
05539900	03/26/93	CNDUCTVY	FIELD	MICROMHO	00094	1331
05539900	05/06/93	CNDUCTVY	FIELD	MICROMHO	00094	1050
05539900	06/03/93	CNDUCTVY	FIELD	MICROMHO	00094	1254
05539900	08/16/93	CNDUCTVY	FIELD	MICROMHO	00094	582
05539900	09/21/93	CNDUCTVY	FIELD	MICROMHO	00094	789
05539900	11/12/93	CNDUCTVY	FIELD	MICROMHO	00094	816
05539900	12/06/93	CNDUCTVY	FIELD	MICROMHO	00094	971
05539900	01/11/94	CNDUCTVY	FIELD	MICROMHO	00094	1730
05539900	02/08/94	CNDUCTVY	FIELD	MICROMHO	00094	1416
05539900	03/17/94	CNDUCTVY	FIELD	MICROMHO	00094	1306
05539900	05/03/94	CNDUCTVY	FIELD	MICROMHO	00094	1185
05539900	06/16/94	CNDUCTVY	FIELD	MICROMHO	00094	1047
05539900	08/02/94	CNDUCTVY	FIELD	MICROMHO	00094	935
05539900	09/28/94	CNDUCTVY	FIELD	MICROMHO	00094	893
05539900	11/01/94	CNDUCTVY	FIELD	MICROMHO	00094	735
05539900	12/02/94	CNDUCTVY	FIELD	MICROMHO	00094	887
05539900	01/10/95	CNDUCTVY	FIELD	MICROMHO	00094	1159
05539900	02/15/95	CNDUCTVY	FIELD	MICROMHO	00094	1035
05539900	03/27/95	CNDUCTVY	FIELD	MICROMHO	00094	1167
05539900	05/02/95	CNDUCTVY	FIELD	MICROMHO	00094	942
05539900	06/09/95	CNDUCTVY	FIELD	MICROMHO	00094	977
05539900	07/12/95	CNDUCTVY	FIELD	MICROMHO	00094	989
05539900	09/05/95	CNDUCTVY	FIELD	MICROMHO	00094	948
05539900	10/10/95	CNDUCTVY	FIELD	MICROMHO	00094	820
05539900	11/20/95	CNDUCTVY	FIELD	MICROMHO	00094	913
05539900	01/23/96	CNDUCTVY	FIELD	MICROMHO	00094	1295
05539900	02/26/96	CNDUCTVY	FIELD	MICROMHO	00094	1690
05539900	04/10/96	CNDUCTVY	FIELD	MICROMHO	00094	1229
05539900	05/13/96	CNDUCTVY	FIELD	MICROMHO	00094	1104
05539900	07/03/96	CNDUCTVY	FIELD	MICROMHO	00094	1009
05539900	07/24/96	CNDUCTVY	FIELD	MICROMHO	00094	919
05539900	09/10/96	CNDUCTVY	FIELD	MICROMHO	00094	883
05539900	10/16/96	CNDUCTVY	FIELD	MICROMHO	00094	774

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05539900	12/03/96	CNDUCTVY	FIELD	MICROMHO	00094	1326
05539900	01/22/97	CNDUCTVY	FIELD	MICROMHO	00094	2040
05539900	02/24/97	CNDUCTVY	FIELD	MICROMHO	00094	1107
05539900	04/02/97	CNDUCTVY	FIELD	MICROMHO	00094	1235
05539900	05/05/97	CNDUCTVY	FIELD	MICROMHO	00094	1053
05539900	06/10/97	CNDUCTVY	FIELD	MICROMHO	00094	987
05539900	10/02/97	CNDUCTVY	FIELD	MICROMHO	00094	921
05539900	12/16/97	CNDUCTVY	FIELD	MICROMHO	00094	1179
05539900	02/05/98	CNDUCTVY	FIELD	MICROMHO	00094	1448
05539900	03/18/98	CNDUCTVY	FIELD	MICROMHO	00094	948
05539900	04/09/98	CNDUCTVY	FIELD	MICROMHO	00094	905
05539900	05/12/98	CNDUCTVY	FIELD	MICROMHO	00094	920
05539900	06/08/98	CNDUCTVY	FIELD	MICROMHO	00094	979
05539900	08/03/98	CNDUCTVY	FIELD	MICROMHO	00094	809
05539900	09/09/98	CNDUCTVY	FIELD	MICROMHO	00094	762
05539900	11/02/98	CNDUCTVY	FIELD	MICROMHO	00094	851
05539900	12/02/98	CNDUCTVY	FIELD	MICROMHO	00094	860
05539900	02/08/99	CNDUCTVY	FIELD	MICROMHO	00094	1096
05539900	03/23/99	CNDUCTVY	FIELD	MICROMHO	00094	1171
05539900	04/28/99	CNDUCTVY	FIELD	MICROMHO	00094	501
05539900	09/09/99	CNDUCTVY	FIELD	MICROMHO	00094	859
05539900	10/13/99	CNDUCTVY	FIELD	MICROMHO	00094	868
05539900	11/17/99	CNDUCTVY	FIELD	MICROMHO	00094	862
05539900	12/20/99	CNDUCTVY	FIELD	MICROMHO	00094	1045
05539900	02/14/00	CNDUCTVY	FIELD	MICROMHO	00094	1.97
05539900	03/20/00	CNDUCTVY	FIELD	MICROMHO	00094	1139
05539900	04/25/00	CNDUCTVY	FIELD	MICROMHO	00094	1050
05539900	06/02/00	CNDUCTVY	FIELD	MICROMHO	00094	812
05539900	07/18/00	CNDUCTVY	FIELD	MICROMHO	00094	951
05539900	08/24/00	CNDUCTVY	FIELD	MICROMHO	00094	895
05539900	10/16/00	CNDUCTVY	FIELD	MICROMHO	00094	8.67
05540095	01/09/90	CNDUCTVY	FIELD	MICROMHO	00094	1749
05540095	02/06/90	CNDUCTVY	FIELD	MICROMHO	00094	1541
05540095	03/20/90	CNDUCTVY	FIELD	MICROMHO	00094	1186
05540095	05/18/90	CNDUCTVY	FIELD	MICROMHO	00094	444
05540095	06/28/90	CNDUCTVY	FIELD	MICROMHO	00094	1229
05540095	07/20/90	CNDUCTVY	FIELD	MICROMHO	00094	230
05540095	08/23/90	CNDUCTVY	FIELD	MICROMHO	00094	790
05540095	10/10/90	CNDUCTVY	FIELD	MICROMHO	00094	576
05540095	11/20/90	CNDUCTVY	FIELD	MICROMHO	00094	1563
05540095	01/03/91	CNDUCTVY	FIELD	MICROMHO	00094	1561
05540095	02/05/91	CNDUCTVY	FIELD	MICROMHO	00094	885
05540095	03/15/91	CNDUCTVY	FIELD	MICROMHO	00094	1811
05540095	05/16/91	CNDUCTVY	FIELD	MICROMHO	00094	1457
05540095	06/05/91	CNDUCTVY	FIELD	MICROMHO	00094	1082
05540095	08/15/91	CNDUCTVY	FIELD	MICROMHO	00094	539
05540095	09/10/91	CNDUCTVY	FIELD	MICROMHO	00094	2050
05540095	10/04/91	CNDUCTVY	FIELD	MICROMHO	00094	1112
05540095	11/18/91	CNDUCTVY	FIELD	MICROMHO	00094	924
05540095	02/04/92	CNDUCTVY	FIELD	MICROMHO	00094	1680

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05540095	03/19/92	CNDUCTVY	FIELD	MICROMHO	00094	1378
05540095	04/29/92	CNDUCTVY	FIELD	MICROMHO	00094	1182
05540095	05/26/92	CNDUCTVY	FIELD	MICROMHO	00094	1331
05540095	07/07/92	CNDUCTVY	FIELD	MICROMHO	00094	1231
05540095	08/19/92	CNDUCTVY	FIELD	MICROMHO	00094	1306
05540095	10/13/92	CNDUCTVY	FIELD	MICROMHO	00094	1257
05540095	11/23/92	CNDUCTVY	FIELD	MICROMHO	00094	890
05540095	01/13/93	CNDUCTVY	FIELD	MICROMHO	00094	1660
05540095	02/08/93	CNDUCTVY	FIELD	MICROMHO	00094	1341
05540095	03/26/93	CNDUCTVY	FIELD	MICROMHO	00094	1253
05540095	05/06/93	CNDUCTVY	FIELD	MICROMHO	00094	1100
05540095	06/03/93	CNDUCTVY	FIELD	MICROMHO	00094	1392
05540095	08/16/93	CNDUCTVY	FIELD	MICROMHO	00094	625
05540095	09/21/93	CNDUCTVY	FIELD	MICROMHO	00094	975
05540095	11/12/93	CNDUCTVY	FIELD	MICROMHO	00094	894
05540095	12/06/93	CNDUCTVY	FIELD	MICROMHO	00094	1109
05540095	01/11/94	CNDUCTVY	FIELD	MICROMHO	00094	1510
05540095	02/08/94	CNDUCTVY	FIELD	MICROMHO	00094	1720
05540095	03/17/94	CNDUCTVY	FIELD	MICROMHO	00094	1356
05540095	05/03/94	CNDUCTVY	FIELD	MICROMHO	00094	1287
05540095	06/16/94	CNDUCTVY	FIELD	MICROMHO	00094	1230
05540095	08/02/94	CNDUCTVY	FIELD	MICROMHO	00094	955
05540095	09/28/94	CNDUCTVY	FIELD	MICROMHO	00094	1015
05540095	11/01/94	CNDUCTVY	FIELD	MICROMHO	00094	729
05540095	12/02/94	CNDUCTVY	FIELD	MICROMHO	00094	956
05540095	01/10/95	CNDUCTVY	FIELD	MICROMHO	00094	1265
05540095	02/15/95	CNDUCTVY	FIELD	MICROMHO	00094	1281
05540095	03/27/95	CNDUCTVY	FIELD	MICROMHO	00094	1138
05540095	05/02/95	CNDUCTVY	FIELD	MICROMHO	00094	916
05540095	06/09/95	CNDUCTVY	FIELD	MICROMHO	00094	887
05540095	07/12/95	CNDUCTVY	FIELD	MICROMHO	00094	1187
05540095	09/05/95	CNDUCTVY	FIELD	MICROMHO	00094	1201
05540095	10/10/95	CNDUCTVY	FIELD	MICROMHO	00094	895
05540095	11/20/95	CNDUCTVY	FIELD	MICROMHO	00094	927
05540095	01/23/96	CNDUCTVY	FIELD	MICROMHO	00094	1350
05540095	02/26/96	CNDUCTVY	FIELD	MICROMHO	00094	1530
05540095	04/10/96	CNDUCTVY	FIELD	MICROMHO	00094	1386
05540095	05/13/96	CNDUCTVY	FIELD	MICROMHO	00094	1129
05540095	07/03/96	CNDUCTVY	FIELD	MICROMHO	00094	1191
05540095	07/24/96	CNDUCTVY	FIELD	MICROMHO	00094	841
05540095	09/10/96	CNDUCTVY	FIELD	MICROMHO	00094	793
05540095	10/16/96	CNDUCTVY	FIELD	MICROMHO	00094	974
05540095	12/03/96	CNDUCTVY	FIELD	MICROMHO	00094	1170
05540095	01/22/97	CNDUCTVY	FIELD	MICROMHO	00094	1850
05540095	02/24/97	CNDUCTVY	FIELD	MICROMHO	00094	964
05540095	04/02/97	CNDUCTVY	FIELD	MICROMHO	00094	1257
05540095	05/05/97	CNDUCTVY	FIELD	MICROMHO	00094	1111
05540095	06/10/97	CNDUCTVY	FIELD	MICROMHO	00094	1038
05540095	10/02/97	CNDUCTVY	FIELD	MICROMHO	00094	1140
05540095	12/16/97	CNDUCTVY	FIELD	MICROMHO	00094	1261

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05540095	02/05/98	CNDUCTVY	FIELD	MICROMHO	00094	1437
05540095	03/18/98	CNDUCTVY	FIELD	MICROMHO	00094	1042
05540095	04/09/98	CNDUCTVY	FIELD	MICROMHO	00094	881
05540095	05/12/98	CNDUCTVY	FIELD	MICROMHO	00094	927
05540095	06/08/98	CNDUCTVY	FIELD	MICROMHO	00094	1141
05540095	08/03/98	CNDUCTVY	FIELD	MICROMHO	00094	971
05540095	09/09/98	CNDUCTVY	FIELD	MICROMHO	00094	648
05540095	11/02/98	CNDUCTVY	FIELD	MICROMHO	00094	918
05540095	12/02/98	CNDUCTVY	FIELD	MICROMHO	00094	935
05540095	02/08/99	CNDUCTVY	FIELD	MICROMHO	00094	1134
05540095	03/23/99	CNDUCTVY	FIELD	MICROMHO	00094	1217
05540095	08/04/99	CNDUCTVY	FIELD	MICROMHO	00094	1067
05540095	09/09/99	CNDUCTVY	FIELD	MICROMHO	00094	1084
05540095	10/13/99	CNDUCTVY	FIELD	MICROMHO	00094	1011
05540095	11/17/99	CNDUCTVY	FIELD	MICROMHO	00094	1057
05540095	12/20/99	CNDUCTVY	FIELD	MICROMHO	00094	1113
05540095	02/14/00	CNDUCTVY	FIELD	MICROMHO	00094	1.7
05540095	03/20/00	CNDUCTVY	FIELD	MICROMHO	00094	1197
05540095	04/25/00	CNDUCTVY	FIELD	MICROMHO	00094	9426
05540095	06/02/00	CNDUCTVY	FIELD	MICROMHO	00094	751
05540095	07/18/00	CNDUCTVY	FIELD	MICROMHO	00094	1082
05540095	08/24/00	CNDUCTVY	FIELD	MICROMHO	00094	1050
05540095	10/16/00	CNDUCTVY	FIELD	MICROMHO	00094	1009
05540095	01/09/1990	TOT HARD	CACO3	MG/L	00900	369
05540095	02/06/1990	TOT HARD	CACO3	MG/L	00900	405
05540095	03/20/1990	TOT HARD	CACO3	MG/L	00900	402
05540095	05/18/1990	TOT HARD	CACO3	MG/L	00900	346
05540095	06/28/1990	TOT HARD	CACO3	MG/L	00900	345
05540095	07/20/1990	TOT HARD	CACO3	MG/L	00900	196
05540095	08/23/1990	TOT HARD	CACO3	MG/L	00900	247
05540095	10/10/1990	TOT HARD	CACO3	MG/L	00900	232
05540095	11/20/1990	TOT HARD	CACO3	MG/L	00900	413
05540095	01/03/1991	TOT HARD	CACO3	MG/L	00900	412
05540095	02/05/1991	TOT HARD	CACO3	MG/L	00900	219
05540095	03/15/1991	TOT HARD	CACO3	MG/L	00900	386
05540095	05/16/1991	TOT HARD	CACO3	MG/L	00900	378
05540095	06/05/1991	TOT HARD	CACO3	MG/L	00900	369
05540095	08/15/1991	TOT HARD	CACO3	MG/L	00900	335
05540095	09/10/1991	TOT HARD	CACO3	MG/L	00900	354
05540095	10/04/1991	TOT HARD	CACO3	MG/L	00900	275
05540095	11/18/1991	TOT HARD	CACO3	MG/L	00900	325
05540095	12/23/1991	TOT HARD	CACO3	MG/L	00900	419
05540095	02/04/1992	TOT HARD	CACO3	MG/L	00900	447
05540095	03/19/1992	TOT HARD	CACO3	MG/L	00900	395
05540095	04/29/1992	TOT HARD	CACO3	MG/L	00900	371
05540095	05/26/1992	TOT HARD	CACO3	MG/L	00900	319
05540095	07/07/1992	TOT HARD	CACO3	MG/L	00900	282
05540095	08/19/1992	TOT HARD	CACO3	MG/L	00900	259
05540095	10/13/1992	TOT HARD	CACO3	MG/L	00900	258
05540095	11/23/1992	TOT HARD	CACO3	MG/L	00900	262

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05540095	01/13/1993	TOT HARD	CACO3	MG/L	00900	319
05540095	02/08/1993	TOT HARD	CACO3	MG/L	00900	365
05540095	03/26/1993	TOT HARD	CACO3	MG/L	00900	289
05540095	05/06/1993	TOT HARD	CACO3	MG/L	00900	340
05540095	06/03/1993	TOT HARD	CACO3	MG/L	00900	331
05540095	08/16/1993	TOT HARD	CACO3	MG/L	00900	212
05540095	09/21/1993	TOT HARD	CACO3	MG/L	00900	321
05540095	11/12/1993	TOT HARD	CACO3	MG/L	00900	263
05540095	12/06/1993	TOT HARD	CACO3	MG/L	00900	315
05540095	01/11/1994	TOT HARD	CACO3	MG/L	00900	313
05540095	02/08/1994	TOT HARD	CACO3	MG/L	00900	338
05540095	03/17/1994	TOT HARD	CACO3	MG/L	00900	369
05540095	05/03/1994	TOT HARD	CACO3	MG/L	00900	329
05540095	06/16/1994	TOT HARD	CACO3	MG/L	00900	302
05540095	08/02/1994	TOT HARD	CACO3	MG/L	00900	304
05540095	09/28/1994	TOT HARD	CACO3	MG/L	00900	270
05540095	11/01/1994	TOT HARD	CACO3	MG/L	00900	244
05540095	12/02/1994	TOT HARD	CACO3	MG/L	00900	333
05540095	01/10/1995	TOT HARD	CACO3	MG/L	00900	347
05540095	02/15/1995	TOT HARD	CACO3	MG/L	00900	351
05540095	03/27/1995	TOT HARD	CACO3	MG/L	00900	325
05540095	05/02/1995	TOT HARD	CACO3	MG/L	00900	308
05540095	06/09/1995	TOT HARD	CACO3	MG/L	00900	306
05540095	07/12/1995	TOT HARD	CACO3	MG/L	00900	331
05540095	09/05/1995	TOT HARD	CACO3	MG/L	00900	363
05540095	10/10/1995	TOT HARD	CACO3	MG/L	00900	246
05540095	11/20/1995	TOT HARD	CACO3	MG/L	00900	323
05540095	01/23/1996	TOT HARD	CACO3	MG/L	00900	355
05540095	02/26/1996	TOT HARD	CACO3	MG/L	00900	315
05540095	04/10/1996	TOT HARD	CACO3	MG/L	00900	360
05540095	05/13/1996	TOT HARD	CACO3	MG/L	00900	340
05540095	07/03/1996	TOT HARD	CACO3	MG/L	00900	367
05540095	07/24/1996	TOT HARD	CACO3	MG/L	00900	315
05540095	09/10/1996	TOT HARD	CACO3	MG/L	00900	232
05540095	10/16/1996	TOT HARD	CACO3	MG/L	00900	241
05540095	12/03/1996	TOT HARD	CACO3	MG/L	00900	301
05540095	01/22/1997	TOT HARD	CACO3	MG/L	00900	261
05540095	02/24/1997	TOT HARD	CACO3	MG/L	00900	230
05540095	04/02/1997	TOT HARD	CACO3	MG/L	00900	387
05540095	05/05/1997	TOT HARD	CACO3	MG/L	00900	318
05540095	06/10/1997	TOT HARD	CACO3	MG/L	00900	294
05540095	07/22/1997	TOT HARD	CACO3	MG/L	00900	292
05540095	10/02/1997	TOT HARD	CACO3	MG/L	00900	268
05540095	12/16/1997	TOT HARD	CACO3	MG/L	00900	346
05540095	02/05/1998	TOT HARD	CACO3	MG/L	00900	376
05540095	03/18/1998	TOT HARD	CACO3	MG/L	00900	266
05540095	04/09/1998	TOT HARD	CACO3	MG/L	00900	289
05540095	05/12/1998	TOT HARD	CACO3	MG/L	00900	318
05540095	06/08/1998	TOT HARD	CACO3	MG/L	00900	334
05540095	08/03/1998	TOT HARD	CACO3	MG/L	00900	290

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05540095	09/09/1998	TOT HARD	CACO3	MG/L	00900	220
05540095	11/02/1998	TOT HARD	CACO3	MG/L	00900	304
05540095	12/02/1998	TOT HARD	CACO3	MG/L	00900	316
05540095	02/08/1999	TOT HARD	CACO3	MG/L	00900	386
05540095	03/23/1999	TOT HARD	CACO3	MG/L	00900	390
05540095	08/04/1999	TOT HARD	CACO3	MG/L	00900	320
05540095	09/09/1999	TOT HARD	CACO3	MG/L	00900	294
05540095	10/13/1999	TOT HARD	CACO3	MG/L	00900	302
05540095	11/17/1999	TOT HARD	CACO3	MG/L	00900	298
05540095	12/20/1999	TOT HARD	CACO3	MG/L	00900	288
05540095	02/14/2000	TOT HARD	CACO3	MG/L	00900	336
05540095	03/20/2000	TOT HARD	CACO3	MG/L	00900	292
05540095	04/25/2000	TOT HARD	CACO3	MG/L	00900	287
05540095	06/02/2000	TOT HARD	CACO3	MG/L	00900	226
05540095	07/18/2000	TOT HARD	CACO3	MG/L	00900	293
05540095	08/24/2000	TOT HARD	CACO3	MG/L	00900	280
05540095	10/16/2000	TOT HARD	CACO3	MG/L	00900	274
05539900	01/09/1990	TOT HARD	CACO3	MG/L	00900	298
05539900	02/06/1990	TOT HARD	CACO3	MG/L	00900	397
05539900	03/20/1990	TOT HARD	CACO3	MG/L	00900	390
05539900	05/18/1990	TOT HARD	CACO3	MG/L	00900	326
05539900	06/08/1990	TOT HARD	CACO3	MG/L	00900	293
05539900	07/20/1990	TOT HARD	CACO3	MG/L	00900	182
05539900	08/23/1990	TOT HARD	CACO3	MG/L	00900	254
05539900	10/10/1990	TOT HARD	CACO3	MG/L	00900	223
05539900	11/20/1990	TOT HARD	CACO3	MG/L	00900	335
05539900	01/03/1991	TOT HARD	CACO3	MG/L	00900	347
05539900	02/05/1991	TOT HARD	CACO3	MG/L	00900	232
05539900	03/15/1991	TOT HARD	CACO3	MG/L	00900	348
05539900	05/16/1991	TOT HARD	CACO3	MG/L	00900	314
05539900	06/05/1991	TOT HARD	CACO3	MG/L	00900	309
05539900	08/15/1991	TOT HARD	CACO3	MG/L	00900	253
05539900	09/10/1991	TOT HARD	CACO3	MG/L	00900	211
05539900	10/04/1991	TOT HARD	CACO3	MG/L	00900	213
05539900	11/18/1991	TOT HARD	CACO3	MG/L	00900	310
05539900	12/23/1991	TOT HARD	CACO3	MG/L	00900	375
05539900	02/04/1992	TOT HARD	CACO3	MG/L	00900	363
05539900	03/19/1992	TOT HARD	CACO3	MG/L	00900	385
05539900	04/29/1992	TOT HARD	CACO3	MG/L	00900	359
05539900	05/26/1992	TOT HARD	CACO3	MG/L	00900	281
05539900	07/07/1992	TOT HARD	CACO3	MG/L	00900	269
05539900	08/19/1992	TOT HARD	CACO3	MG/L	00900	204
05539900	10/13/1992	TOT HARD	CACO3	MG/L	00900	241
05539900	11/23/1992	TOT HARD	CACO3	MG/L	00900	266
05539900	01/13/1993	TOT HARD	CACO3	MG/L	00900	313
05539900	02/08/1993	TOT HARD	CACO3	MG/L	00900	347
05539900	03/26/1993	TOT HARD	CACO3	MG/L	00900	299
05539900	05/06/1993	TOT HARD	CACO3	MG/L	00900	322
05539900	06/03/1993	TOT HARD	CACO3	MG/L	00900	374
05539900	08/16/1993	TOT HARD	CACO3	MG/L	00900	315

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05539900	09/21/1993	TOT HARD	CACO3	MG/L	00900	276
05539900	11/12/1993	TOT HARD	CACO3	MG/L	00900	259
05539900	12/06/1993	TOT HARD	CACO3	MG/L	00900	295
05539900	01/11/1994	TOT HARD	CACO3	MG/L	00900	306
05539900	02/08/1994	TOT HARD	CACO3	MG/L	00900	317
05539900	03/17/1994	TOT HARD	CACO3	MG/L	00900	364
05539900	05/03/1994	TOT HARD	CACO3	MG/L	00900	324
05539900	06/16/1994	TOT HARD	CACO3	MG/L	00900	267
05539900	08/02/1994	TOT HARD	CACO3	MG/L	00900	249
05539900	09/28/1994	TOT HARD	CACO3	MG/L	00900	251
05539900	11/01/1994	TOT HARD	CACO3	MG/L	00900	252
05539900	12/02/1994	TOT HARD	CACO3	MG/L	00900	309
05539900	01/10/1995	TOT HARD	CACO3	MG/L	00900	318
05539900	02/15/1995	TOT HARD	CACO3	MG/L	00900	315
05539900	03/27/1995	TOT HARD	CACO3	MG/L	00900	315
05539900	05/02/1995	TOT HARD	CACO3	MG/L	00900	311
05539900	06/09/1995	TOT HARD	CACO3	MG/L	00900	321
05539900	07/12/1995	TOT HARD	CACO3	MG/L	00900	277
05539900	09/05/1995	TOT HARD	CACO3	MG/L	00900	265
05539900	10/10/1995	TOT HARD	CACO3	MG/L	00900	243
05539900	11/20/1995	TOT HARD	CACO3	MG/L	00900	316
05539900	01/23/1996	TOT HARD	CACO3	MG/L	00900	348
05539900	02/26/1996	TOT HARD	CACO3	MG/L	00900	308
05539900	04/10/1996	TOT HARD	CACO3	MG/L	00900	320
05539900	05/13/1996	TOT HARD	CACO3	MG/L	00900	358
05539900	07/03/1996	TOT HARD	CACO3	MG/L	00900	319
05539900	07/24/1996	TOT HARD	CACO3	MG/L	00900	314
05539900	09/10/1996	TOT HARD	CACO3	MG/L	00900	247
05539900	10/16/1996	TOT HARD	CACO3	MG/L	00900	233
05539900	12/03/1996	TOT HARD	CACO3	MG/L	00900	281
05539900	01/22/1997	TOT HARD	CACO3	MG/L	00900	250
05539900	02/24/1997	TOT HARD	CACO3	MG/L	00900	250
05539900	04/02/1997	TOT HARD	CACO3	MG/L	00900	367
05539900	05/05/1997	TOT HARD	CACO3	MG/L	00900	321
05539900	06/10/1997	TOT HARD	CACO3	MG/L	00900	296
05539900	07/22/1997	TOT HARD	CACO3	MG/L	00900	273
05539900	10/02/1997	TOT HARD	CACO3	MG/L	00900	220
05539900	12/16/1997	TOT HARD	CACO3	MG/L	00900	322
05539900	02/05/1998	TOT HARD	CACO3	MG/L	00900	392
05539900	03/18/1998	TOT HARD	CACO3	MG/L	00900	260
05539900	04/09/1998	TOT HARD	CACO3	MG/L	00900	317
05539900	05/12/1998	TOT HARD	CACO3	MG/L	00900	324
05539900	06/08/1998	TOT HARD	CACO3	MG/L	00900	274
05539900	08/03/1998	TOT HARD	CACO3	MG/L	00900	246
05539900	09/09/1998	TOT HARD	CACO3	MG/L	00900	244
05539900	11/02/1998	TOT HARD	CACO3	MG/L	00900	295
05539900	12/02/1998	TOT HARD	CACO3	MG/L	00900	283
05539900	02/08/1999	TOT HARD	CACO3	MG/L	00900	379
05539900	03/23/1999	TOT HARD	CACO3	MG/L	00900	380
05539900	08/04/1999	TOT HARD	CACO3	MG/L	00900	197

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05539900	09/09/1999	TOT HARD	CACO3	MG/L	00900	234
05539900	10/13/1999	TOT HARD	CACO3	MG/L	00900	239
05539900	11/17/1999	TOT HARD	CACO3	MG/L	00900	254
05539900	12/20/1999	TOT HARD	CACO3	MG/L	00900	255
05539900	02/14/2000	TOT HARD	CACO3	MG/L	00900	331
05539900	03/20/2000	TOT HARD	CACO3	MG/L	00900	287
05539900	04/25/2000	TOT HARD	CACO3	MG/L	00900	315
05539900	06/02/2000	TOT HARD	CACO3	MG/L	00900	248
05539900	07/18/2000	TOT HARD	CACO3	MG/L	00900	252
05539900	08/24/2000	TOT HARD	CACO3	MG/L	00900	225
05539900	10/16/2000	TOT HARD	CACO3	MG/L	00900	237
05539900	06/18/79	COPPER	CU,TOT	UG/L	01042	10
05539900	07/18/79	COPPER	CU,TOT	UG/L	01042	10
05539900	07/18/79	COPPER	CU,TOT	UG/L	01042	10
05539900	08/13/79	COPPER	CU,TOT	UG/L	01042	10
05539900	09/20/79	COPPER	CU,TOT	UG/L	01042	0
05539900	09/20/79	COPPER	CU,TOT	UG/L	01042	0
05539900	10/22/79	COPPER	CU,TOT	UG/L	01042	10
05539900	11/20/79	COPPER	CU,TOT	UG/L	01042	10
05539900	12/06/79	COPPER	CU,TOT	UG/L	01042	10
05539900	01/09/80	COPPER	CU,TOT	UG/L	01042	10
05539900	01/09/80	COPPER	CU,TOT	UG/L	01042	10
05539900	02/26/80	COPPER	CU,TOT	UG/L	01042	29.99
05539900	04/07/80	COPPER	CU,TOT	UG/L	01042	0
05539900	05/15/80	COPPER	CU,TOT	UG/L	01042	10
05539900	06/11/80	COPPER	CU,TOT	UG/L	01042	10
05539900	07/24/80	COPPER	CU,TOT	UG/L	01042	10
05539900	08/13/80	COPPER	CU,TOT	UG/L	01042	19.99
05539900	09/05/80	COPPER	CU,TOT	UG/L	01042	10
05539900	10/07/80	COPPER	CU,TOT	UG/L	01042	10
05539900	11/14/80	COPPER	CU,TOT	UG/L	01042	0
05539900	12/11/80	COPPER	CU,TOT	UG/L	01042	0
05539900	01/05/81	COPPER	CU,TOT	UG/L	01042	0
05539900	02/03/81	COPPER	CU,TOT	UG/L	01042	10
05539900	03/03/81	COPPER	CU,TOT	UG/L	01042	10
05539900	03/25/81	COPPER	CU,TOT	UG/L	01042	0
05539900	06/01/81	COPPER	CU,TOT	UG/L	01042	10
05539900	06/24/81	COPPER	CU,TOT	UG/L	01042	14
05539900	07/08/81	COPPER	CU,TOT	UG/L	01042	5
05539900	07/20/81	COPPER	CU,TOT	UG/L	01042	5
05539900	08/12/81	COPPER	CU,TOT	UG/L	01042	5
05539900	10/23/81	COPPER	CU,TOT	UG/L	01042	5
05539900	11/25/81	COPPER	CU,TOT	UG/L	01042	5
05539900	01/06/82	COPPER	CU,TOT	UG/L	01042	5
05539900	03/15/82	COPPER	CU,TOT	UG/L	01042	7
05539900	04/21/82	COPPER	CU,TOT	UG/L	01042	5
05539900	06/07/82	COPPER	CU,TOT	UG/L	01042	6
05539900	07/06/82	COPPER	CU,TOT	UG/L	01042	8
05539900	07/21/82	COPPER	CU,TOT	UG/L	01042	5
05539900	09/01/82	COPPER	CU,TOT	UG/L	01042	5

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05539900	10/05/82	COPPER	CU,TOT	UG/L	01042	5
05539900	12/13/82	COPPER	CU,TOT	UG/L	01042	10
05539900	01/31/83	COPPER	CU,TOT	UG/L	01042	5
05539900	03/07/83	COPPER	CU,TOT	UG/L	01042	9
05539900	03/28/83	COPPER	CU,TOT	UG/L	01042	9
05539900	05/11/83	COPPER	CU,TOT	UG/L	01042	5
05539900	08/25/83	COPPER	CU,TOT	UG/L	01042	7
05539900	11/02/83	COPPER	CU,TOT	UG/L	01042	10
05539900	12/02/83	COPPER	CU,TOT	UG/L	01042	8
05539900	01/11/84	COPPER	CU,TOT	UG/L	01042	12
05539900	03/02/84	COPPER	CU,TOT	UG/L	01042	9
05539900	04/16/84	COPPER	CU,TOT	UG/L	01042	5
05539900	05/21/84	COPPER	CU,TOT	UG/L	01042	8
05539900	07/02/84	COPPER	CU,TOT	UG/L	01042	12
05539900	07/26/84	COPPER	CU,TOT	UG/L	01042	10
05539900	09/10/84	COPPER	CU,TOT	UG/L	01042	6
05539900	10/09/84	COPPER	CU,TOT	UG/L	01042	11
05539900	11/19/84	COPPER	CU,TOT	UG/L	01042	8
05539900	01/14/85	COPPER	CU,TOT	UG/L	01042	11
05539900	03/18/85	COPPER	CU,TOT	UG/L	01042	8
05539900	04/18/85	COPPER	CU,TOT	UG/L	01042	7
05539900	05/02/85	COPPER	CU,TOT	UG/L	01042	7
05539900	06/07/85	COPPER	CU,TOT	UG/L	01042	6
05539900	07/15/85	COPPER	CU,TOT	UG/L	01042	7
05539900	08/16/85	COPPER	CU,TOT	UG/L	01042	7
05539900	10/31/85	COPPER	CU,TOT	UG/L	01042	8
05539900	11/18/85	COPPER	CU,TOT	UG/L	01042	7
05539900	12/12/85	COPPER	CU,TOT	UG/L	01042	12
05539900	01/29/86	COPPER	CU,TOT	UG/L	01042	7
05539900	03/18/86	COPPER	CU,TOT	UG/L	01042	6
05539900	05/02/86	COPPER	CU,TOT	UG/L	01042	5
05539900	06/27/86	COPPER	CU,TOT	UG/L	01042	14
05539900	07/21/86	COPPER	CU,TOT	UG/L	01042	5
05539900	09/12/86	COPPER	CU,TOT	UG/L	01042	14
05539900	10/07/86	COPPER	CU,TOT	UG/L	01042	14
05539900	12/03/86	COPPER	CU,TOT	UG/L	01042	5
05539900	02/05/87	COPPER	CU,TOT	UG/L	01042	12
05539900	03/02/87	COPPER	CU,TOT	UG/L	01042	7
05539900	04/03/87	COPPER	CU,TOT	UG/L	01042	10
05539900	05/15/87	COPPER	CU,TOT	UG/L	01042	8
05539900	06/23/87	COPPER	CU,TOT	UG/L	01042	5
05539900	07/28/87	COPPER	CU,TOT	UG/L	01042	6
05539900	08/27/87	COPPER	CU,TOT	UG/L	01042	7
05539900	10/02/87	COPPER	CU,TOT	UG/L	01042	5
05539900	11/12/87	COPPER	CU,TOT	UG/L	01042	5
05539900	01/08/88	COPPER	CU,TOT	UG/L	01042	7
05539900	02/08/88	COPPER	CU,TOT	UG/L	01042	7
05539900	03/25/88	COPPER	CU,TOT	UG/L	01042	6
05539900	05/26/88	COPPER	CU,TOT	UG/L	01042	8
05539900	07/01/88	COPPER	CU,TOT	UG/L	01042	6

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05539900	08/22/88	COPPER	CU,TOT	UG/L	01042	5
05539900	09/09/88	COPPER	CU,TOT	UG/L	01042	5
05539900	10/07/88	COPPER	CU,TOT	UG/L	01042	8
05539900	11/21/88	COPPER	CU,TOT	UG/L	01042	8
05539900	01/31/89	COPPER	CU,TOT	UG/L	01042	7
05539900	03/02/89	COPPER	CU,TOT	UG/L	01042	5
05539900	04/06/89	COPPER	CU,TOT	UG/L	01042	6
05539900	05/12/89	COPPER	CU,TOT	UG/L	01042	5
05539900	06/14/89	COPPER	CU,TOT	UG/L	01042	11
05539900	07/20/89	COPPER	CU,TOT	UG/L	01042	14
05539900	08/30/89	COPPER	CU,TOT	UG/L	01042	5
05539900	10/11/89	COPPER	CU,TOT	UG/L	01042	9
05539900	12/12/89	COPPER	CU,TOT	UG/L	01042	7
05539900	01/09/90	COPPER	CU,TOT	UG/L	01042	6
05539900	02/06/90	COPPER	CU,TOT	UG/L	01042	7
05539900	03/20/90	COPPER	CU,TOT	UG/L	01042	5
05539900	05/18/90	COPPER	CU,TOT	UG/L	01042	8
05539900	06/08/90	COPPER	CU,TOT	UG/L	01042	12
05539900	07/20/90	COPPER	CU,TOT	UG/L	01042	10
05539900	08/23/90	COPPER	CU,TOT	UG/L	01042	7
05539900	10/10/90	COPPER	CU,TOT	UG/L	01042	9
05539900	11/20/90	COPPER	CU,TOT	UG/L	01042	10
05539900	01/03/91	COPPER	CU,TOT	UG/L	01042	5
05539900	02/05/91	COPPER	CU,TOT	UG/L	01042	9
05539900	03/15/91	COPPER	CU,TOT	UG/L	01042	5
05539900	05/16/91	COPPER	CU,TOT	UG/L	01042	13
05539900	06/05/91	COPPER	CU,TOT	UG/L	01042	5
05539900	08/15/91	COPPER	CU,TOT	UG/L	01042	5
05539900	09/10/91	COPPER	CU,TOT	UG/L	01042	5
05539900	10/04/91	COPPER	CU,TOT	UG/L	01042	13
05539900	11/18/91	COPPER	CU,TOT	UG/L	01042	6
05539900	12/23/91	COPPER	CU,TOT	UG/L	01042	5
05539900	02/04/92	COPPER	CU,TOT	UG/L	01042	5
05539900	03/19/92	COPPER	CU,TOT	UG/L	01042	5
05539900	04/29/92	COPPER	CU,TOT	UG/L	01042	5
05539900	05/26/92	COPPER	CU,TOT	UG/L	01042	8
05539900	07/07/92	COPPER	CU,TOT	UG/L	01042	5
05539900	08/19/92	COPPER	CU,TOT	UG/L	01042	5
05539900	10/13/92	COPPER	CU,TOT	UG/L	01042	5
05539900	11/23/92	COPPER	CU,TOT	UG/L	01042	5
05539900	01/13/93	COPPER	CU,TOT	UG/L	01042	10
05539900	02/08/93	COPPER	CU,TOT	UG/L	01042	11
05539900	03/26/93	COPPER	CU,TOT	UG/L	01042	10
05539900	05/06/93	COPPER	CU,TOT	UG/L	01042	6
05539900	06/03/93	COPPER	CU,TOT	UG/L	01042	21
05539900	08/16/93	COPPER	CU,TOT	UG/L	01042	22
05539900	09/21/93	COPPER	CU,TOT	UG/L	01042	5
05539900	11/12/93	COPPER	CU,TOT	UG/L	01042	5
05539900	12/06/93	COPPER	CU,TOT	UG/L	01042	5
05539900	01/11/94	COPPER	CU,TOT	UG/L	01042	6

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05539900	02/08/94	COPPER	CU,TOT	UG/L	01042	5
05539900	03/17/94	COPPER	CU,TOT	UG/L	01042	5
05539900	05/03/94	COPPER	CU,TOT	UG/L	01042	5
05539900	06/16/94	COPPER	CU,TOT	UG/L	01042	6
05539900	08/02/94	COPPER	CU,TOT	UG/L	01042	5
05539900	09/28/94	COPPER	CU,TOT	UG/L	01042	5
05539900	11/01/94	COPPER	CU,TOT	UG/L	01042	15
05539900	12/02/94	COPPER	CU,TOT	UG/L	01042	6
05539900	01/10/95	COPPER	CU,TOT	UG/L	01042	5
05539900	02/15/95	COPPER	CU,TOT	UG/L	01042	5
05539900	03/27/95	COPPER	CU,TOT	UG/L	01042	5
05539900	05/02/95	COPPER	CU,TOT	UG/L	01042	5
05539900	06/09/95	COPPER	CU,TOT	UG/L	01042	5
05539900	07/12/95	COPPER	CU,TOT	UG/L	01042	10
05539900	09/05/95	COPPER	CU,TOT	UG/L	01042	10
05539900	10/10/95	COPPER	CU,TOT	UG/L	01042	10
05539900	11/20/95	COPPER	CU,TOT	UG/L	01042	10
05539900	01/23/96	COPPER	CU,TOT	UG/L	01042	10
05539900	02/26/96	COPPER	CU,TOT	UG/L	01042	10
05539900	04/10/96	COPPER	CU,TOT	UG/L	01042	5
05539900	05/13/96	COPPER	CU,TOT	UG/L	01042	10
05539900	07/03/96	COPPER	CU,TOT	UG/L	01042	10
05539900	07/24/96	COPPER	CU,TOT	UG/L	01042	10
05539900	09/10/96	COPPER	CU,TOT	UG/L	01042	10
05539900	10/16/96	COPPER	CU,TOT	UG/L	01042	260
05539900	12/03/96	COPPER	CU,TOT	UG/L	01042	10
05539900	01/22/97	COPPER	CU,TOT	UG/L	01042	19
05539900	02/24/97	COPPER	CU,TOT	UG/L	01042	10
05539900	04/02/97	COPPER	CU,TOT	UG/L	01042	10
05539900	05/05/97	COPPER	CU,TOT	UG/L	01042	10
05539900	06/10/97	COPPER	CU,TOT	UG/L	01042	10
05539900	07/22/97	COPPER	CU,TOT	UG/L	01042	11
05539900	10/02/97	COPPER	CU,TOT	UG/L	01042	10
05539900	12/16/97	COPPER	CU,TOT	UG/L	01042	10
05539900	02/05/98	COPPER	CU,TOT	UG/L	01042	10
05539900	03/18/98	COPPER	CU,TOT	UG/L	01042	10
05539900	04/09/98	COPPER	CU,TOT	UG/L	01042	10
05539900	05/12/98	COPPER	CU,TOT	UG/L	01042	10
05539900	06/08/98	COPPER	CU,TOT	UG/L	01042	10
05539900	08/03/98	COPPER	CU,TOT	UG/L	01042	10
05539900	09/09/98	COPPER	CU,TOT	UG/L	01042	10
05539900	11/02/98	COPPER	CU,TOT	UG/L	01042	10
05539900	12/02/98	COPPER	CU,TOT	UG/L	01042	10
05539900	02/08/99	COPPER	CU-TOT	UG/L	01042	10
05539900	02/23/99	COPPER	CU-TOT	UG/L	01042	10
05539900	04/28/99	COPPER	CU-TOT	UG/L	01042	10
05539900	09/09/99	COPPER	CU-TOT	UG/L	01042	10
05539900	04/25/00	COPPER	CU-TOT	UG/L	01042	10
05539900	08/24/00	COPPER	CU-TOT	UG/L	01042	10
05539900	10/13/99	COPPER	CU-TOT	UG/L	01042	10

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05539900	11/17/99	COPPER	CU-TOT	UG/L	01042	10
05539900	12/20/99	COPPER	CU-TOT	UG/L	01042	10
05539900	02/14/00	COPPER	CU-TOT	UG/L	01042	10
05539900	03/20/00	COPPER	CU-TOT	UG/L	01042	10
05539900	06/02/00	COPPER	CU-TOT	UG/L	01042	10
05539900	07/18/00	COPPER	CU-TOT	UG/L	01042	10
05539900	10/16/00	COPPER	CU-TOT	UG/L	01042	10
05540095	03/17/78	COPPER	CU-TOT	UG/L	01042	20
05540095	04/19/78	COPPER	CU-TOT	UG/L	01042	20
05540095	05/24/78	COPPER	CU-TOT	UG/L	01042	29.99
05540095	06/19/78	COPPER	CU-TOT	UG/L	01042	19.99
05540095	07/17/78	COPPER	CU,TOT	UG/L	01042	20
05540095	08/17/78	COPPER	CU,TOT	UG/L	01042	20
05540095	09/12/78	COPPER	CU,TOT	UG/L	01042	20
05540095	10/10/78	COPPER	CU,TOT	UG/L	01042	20
05540095	11/17/78	COPPER	CU,TOT	UG/L	01042	20
05540095	12/15/78	COPPER	CU,TOT	UG/L	01042	20
05540095	01/23/79	COPPER	CU,TOT	UG/L	01042	20
05540095	02/22/79	COPPER	CU,TOT	UG/L	01042	20
05540095	03/22/79	COPPER	CU,TOT	UG/L	01042	20
05540095	04/19/79	COPPER	CU,TOT	UG/L	01042	19.99
05540095	05/10/79	COPPER	CU,TOT	UG/L	01042	19.99
05540095	06/13/79	COPPER	CU,TOT	UG/L	01042	20
05540095	07/31/79	COPPER	CU,TOT	UG/L	01042	20
05540095	08/28/79	COPPER	CU,TOT	UG/L	01042	20
05540095	09/17/79	COPPER	CU,TOT	UG/L	01042	19.99
05540095	10/24/79	COPPER	CU,TOT	UG/L	01042	10
05540095	11/27/79	COPPER	CU,TOT	UG/L	01042	10
05540095	12/19/79	COPPER	CU,TOT	UG/L	01042	29.99
05540095	01/17/80	COPPER	CU,TOT	UG/L	01042	10
05540095	02/13/80	COPPER	CU,TOT	UG/L	01042	10
05540095	03/10/80	COPPER	CU,TOT	UG/L	01042	10
05540095	04/09/80	COPPER	CU,TOT	UG/L	01042	29.99
05540095	05/06/80	COPPER	CU,TOT	UG/L	01042	19.99
05540095	06/17/80	COPPER	CU,TOT	UG/L	01042	5
05540095	07/10/80	COPPER	CU,TOT	UG/L	01042	19.99
05540095	08/06/80	COPPER	CU,TOT	UG/L	01042	19.99
05540095	09/24/80	COPPER	CU,TOT	UG/L	01042	10
05540095	10/28/80	COPPER	CU,TOT	UG/L	01042	0
05540095	11/17/80	COPPER	CU,TOT	UG/L	01042	19.99
05540095	12/18/80	COPPER	CU,TOT	UG/L	01042	10
05540095	01/19/81	COPPER	CU,TOT	UG/L	01042	10
05540095	02/26/81	COPPER	CU,TOT	UG/L	01042	0
05540095	04/07/81	COPPER	CU,TOT	UG/L	01042	0
05540095	05/13/81	COPPER	CU,TOT	UG/L	01042	0
05540095	06/25/81	COPPER	CU,TOT	UG/L	01042	6
05540095	07/28/81	COPPER	CU,TOT	UG/L	01042	10
05540095	08/12/81	COPPER	CU,TOT	UG/L	01042	5
05540095	08/20/81	COPPER	CU,TOT	UG/L	01042	9
05540095	10/07/81	COPPER	CU,TOT	UG/L	01042	8

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05540095	11/18/81	COPPER	CU,TOT	UG/L	01042	8
05540095	01/19/82	COPPER	CU,TOT	UG/L	01042	8
05540095	02/17/82	COPPER	CU,TOT	UG/L	01042	13
05540095	03/24/82	COPPER	CU,TOT	UG/L	01042	10
05540095	05/12/82	COPPER	CU,TOT	UG/L	01042	9
05540095	06/21/82	COPPER	CU,TOT	UG/L	01042	5
05540095	07/26/82	COPPER	CU,TOT	UG/L	01042	5
05540095	09/08/82	COPPER	CU,TOT	UG/L	01042	6
05540095	10/27/82	COPPER	CU,TOT	UG/L	01042	13
05540095	12/02/82	COPPER	CU,TOT	UG/L	01042	12
05540095	01/12/83	COPPER	CU,TOT	UG/L	01042	7
05540095	02/24/83	COPPER	CU,TOT	UG/L	01042	7
05540095	03/28/83	COPPER	CU,TOT	UG/L	01042	19
05540095	04/11/83	COPPER	CU,TOT	UG/L	01042	8
05540095	05/31/83	COPPER	CU,TOT	UG/L	01042	6
05540095	06/30/83	COPPER	CU,TOT	UG/L	01042	13
05540095	08/04/83	COPPER	CU,TOT	UG/L	01042	6
05540095	09/28/83	COPPER	CU,TOT	UG/L	01042	17
05540095	11/08/83	COPPER	CU,TOT	UG/L	01042	11
05540095	11/23/83	COPPER	CU,TOT	UG/L	01042	41
05540095	12/21/83	COPPER	CU,TOT	UG/L	01042	16
05540095	02/07/84	COPPER	CU,TOT	UG/L	01042	39
05540095	02/07/84	COPPER	CU,TOT	UG/L	01042	13
05540095	03/20/84	COPPER	CU,TOT	UG/L	01042	7
05540095	05/02/84	COPPER	CU,TOT	UG/L	01042	11
05540095	06/13/84	COPPER	CU,TOT	UG/L	01042	10
05540095	08/01/84	COPPER	CU,TOT	UG/L	01042	12
05540095	08/28/84	COPPER	CU,TOT	UG/L	01042	12
05540095	10/10/84	COPPER	CU,TOT	UG/L	01042	13
05540095	10/10/84	COPPER	CU,TOT	UG/L	01042	11
05540095	12/05/84	COPPER	CU,TOT	UG/L	01042	11
05540095	01/23/85	COPPER	CU,TOT	UG/L	01042	11
05540095	02/27/85	COPPER	CU,TOT	UG/L	01042	12
05540095	04/10/85	COPPER	CU,TOT	UG/L	01042	17
05540095	04/10/85	COPPER	CU,TOT	UG/L	01042	9
05540095	05/21/85	COPPER	CU,TOT	UG/L	01042	10
05540095	07/09/85	COPPER	CU,TOT	UG/L	01042	8
05540095	08/14/85	COPPER	CU,TOT	UG/L	01042	9
05540095	10/01/85	COPPER	CU,TOT	UG/L	01042	14
05540095	10/29/85	COPPER	CU,TOT	UG/L	01042	13
05540095	12/10/85	COPPER	CU,TOT	UG/L	01042	8
05540095	01/23/86	COPPER	CU,TOT	UG/L	01042	11
05540095	03/04/86	COPPER	CU,TOT	UG/L	01042	18
05540095	04/24/86	COPPER	CU,TOT	UG/L	01042	12
05540095	06/03/86	COPPER	CU,TOT	UG/L	01042	11
05540095	07/10/86	COPPER	CU,TOT	UG/L	01042	12
05540095	08/21/86	COPPER	CU,TOT	UG/L	01042	12
05540095	10/02/86	COPPER	CU,TOT	UG/L	01042	5
05540095	11/13/86	COPPER	CU,TOT	UG/L	01042	11
05540095	12/17/86	COPPER	CU,TOT	UG/L	01042	7

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05540095	02/04/87	COPPER	CU,TOT	UG/L	01042	10
05540095	03/25/87	COPPER	CU,TOT	UG/L	01042	9
05540095	06/10/87	COPPER	CU,TOT	UG/L	01042	14
05540095	07/22/87	COPPER	CU,TOT	UG/L	01042	17
05540095	09/09/87	COPPER	CU,TOT	UG/L	01042	8
05540095	10/02/87	COPPER	CU,TOT	UG/L	01042	5
05540095	11/12/87	COPPER	CU,TOT	UG/L	01042	6
05540095	01/08/88	COPPER	CU,TOT	UG/L	01042	16
05540095	02/08/88	COPPER	CU,TOT	UG/L	01042	6
05540095	03/25/88	COPPER	CU,TOT	UG/L	01042	13
05540095	05/26/88	COPPER	CU,TOT	UG/L	01042	7
05540095	07/01/88	COPPER	CU,TOT	UG/L	01042	9
05540095	08/22/88	COPPER	CU,TOT	UG/L	01042	15
05540095	09/09/88	COPPER	CU,TOT	UG/L	01042	12
05540095	10/07/88	COPPER	CU,TOT	UG/L	01042	16
05540095	11/21/88	COPPER	CU,TOT	UG/L	01042	9
05540095	01/31/89	COPPER	CU,TOT	UG/L	01042	5
05540095	03/02/89	COPPER	CU,TOT	UG/L	01042	8
05540095	04/06/89	COPPER	CU,TOT	UG/L	01042	20
05540095	05/12/89	COPPER	CU,TOT	UG/L	01042	10
05540095	06/14/89	COPPER	CU,TOT	UG/L	01042	24
05540095	07/20/89	COPPER	CU,TOT	UG/L	01042	24
05540095	08/30/89	COPPER	CU,TOT	UG/L	01042	8
05540095	10/11/89	COPPER	CU,TOT	UG/L	01042	16
05540095	12/12/89	COPPER	CU,TOT	UG/L	01042	19
05540095	01/09/90	COPPER	CU,TOT	UG/L	01042	13
05540095	02/06/90	COPPER	CU,TOT	UG/L	01042	7
05540095	03/20/90	COPPER	CU,TOT	UG/L	01042	6
05540095	05/18/90	COPPER	CU,TOT	UG/L	01042	10
05540095	06/28/90	COPPER	CU,TOT	UG/L	01042	5
05540095	07/20/90	COPPER	CU,TOT	UG/L	01042	10
05540095	08/23/90	COPPER	CU,TOT	UG/L	01042	11
05540095	10/10/90	COPPER	CU,TOT	UG/L	01042	28
05540095	11/20/90	COPPER	CU,TOT	UG/L	01042	16
05540095	01/03/91	COPPER	CU,TOT	UG/L	01042	9
05540095	02/05/91	COPPER	CU,TOT	UG/L	01042	33
05540095	03/15/91	COPPER	CU,TOT	UG/L	01042	11
05540095	05/16/91	COPPER	CU,TOT	UG/L	01042	7
05540095	06/05/91	COPPER	CU,TOT	UG/L	01042	5
05540095	08/15/91	COPPER	CU,TOT	UG/L	01042	6
05540095	09/10/91	COPPER	CU,TOT	UG/L	01042	9
05540095	10/04/91	COPPER	CU,TOT	UG/L	01042	18
05540095	11/18/91	COPPER	CU,TOT	UG/L	01042	9
05540095	12/23/91	COPPER	CU,TOT	UG/L	01042	9
05540095	02/04/92	COPPER	CU,TOT	UG/L	01042	14
05540095	03/19/92	COPPER	CU,TOT	UG/L	01042	6
05540095	04/29/92	COPPER	CU,TOT	UG/L	01042	10
05540095	05/26/92	COPPER	CU,TOT	UG/L	01042	11
05540095	07/07/92	COPPER	CU,TOT	UG/L	01042	18
05540095	08/19/92	COPPER	CU,TOT	UG/L	01042	9

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05540095	10/13/92	COPPER	CU,TOT	UG/L	01042	6
05540095	11/23/92	COPPER	CU,TOT	UG/L	01042	9
05540095	01/13/93	COPPER	CU,TOT	UG/L	01042	10
05540095	02/08/93	COPPER	CU,TOT	UG/L	01042	10
05540095	03/26/93	COPPER	CU,TOT	UG/L	01042	10
05540095	05/06/93	COPPER	CU,TOT	UG/L	01042	5
05540095	06/03/93	COPPER	CU,TOT	UG/L	01042	5
05540095	08/16/93	COPPER	CU,TOT	UG/L	01042	12
05540095	09/21/93	COPPER	CU,TOT	UG/L	01042	6
05540095	11/12/93	COPPER	CU,TOT	UG/L	01042	5
05540095	12/06/93	COPPER	CU,TOT	UG/L	01042	6
05540095	01/11/94	COPPER	CU,TOT	UG/L	01042	7
05540095	02/08/94	COPPER	CU,TOT	UG/L	01042	5
05540095	03/17/94	COPPER	CU,TOT	UG/L	01042	5
05540095	05/03/94	COPPER	CU,TOT	UG/L	01042	5
05540095	06/16/94	COPPER	CU,TOT	UG/L	01042	10
05540095	08/02/94	COPPER	CU,TOT	UG/L	01042	8
05540095	09/28/94	COPPER	CU,TOT	UG/L	01042	5
05540095	11/01/94	COPPER	CU,TOT	UG/L	01042	11
05540095	12/02/94	COPPER	CU,TOT	UG/L	01042	6
05540095	01/10/95	COPPER	CU,TOT	UG/L	01042	5
05540095	02/15/95	COPPER	CU,TOT	UG/L	01042	5
05540095	03/27/95	COPPER	CU,TOT	UG/L	01042	5
05540095	05/02/95	COPPER	CU,TOT	UG/L	01042	5
05540095	06/09/95	COPPER	CU,TOT	UG/L	01042	5
05540095	07/12/95	COPPER	CU,TOT	UG/L	01042	10
05540095	09/05/95	COPPER	CU,TOT	UG/L	01042	25
05540095	10/10/95	COPPER	CU,TOT	UG/L	01042	10
05540095	11/20/95	COPPER	CU,TOT	UG/L	01042	10
05540095	01/23/96	COPPER	CU,TOT	UG/L	01042	10
05540095	02/26/96	COPPER	CU,TOT	UG/L	01042	10
05540095	04/10/96	COPPER	CU,TOT	UG/L	01042	13
05540095	05/13/96	COPPER	CU,TOT	UG/L	01042	10
05540095	07/03/96	COPPER	CU,TOT	UG/L	01042	10
05540095	07/24/96	COPPER	CU,TOT	UG/L	01042	10
05540095	09/10/96	COPPER	CU,TOT	UG/L	01042	10
05540095	10/16/96	COPPER	CU,TOT	UG/L	01042	13
05540095	12/03/96	COPPER	CU,TOT	UG/L	01042	10
05540095	01/22/97	COPPER	CU,TOT	UG/L	01042	16
05540095	02/24/97	COPPER	CU,TOT	UG/L	01042	10
05540095	04/02/97	COPPER	CU,TOT	UG/L	01042	10
05540095	05/05/97	COPPER	CU,TOT	UG/L	01042	10
05540095	06/10/97	COPPER	CU,TOT	UG/L	01042	10
05540095	07/22/97	COPPER	CU,TOT	UG/L	01042	12
05540095	10/02/97	COPPER	CU,TOT	UG/L	01042	16
05540095	12/16/97	COPPER	CU,TOT	UG/L	01042	11
05540095	02/05/98	COPPER	CU,TOT	UG/L	01042	10
05540095	03/18/98	COPPER	CU,TOT	UG/L	01042	10
05540095	04/09/98	COPPER	CU,TOT	UG/L	01042	10
05540095	05/12/98	COPPER	CU,TOT	UG/L	01042	10

TABLE B-1
Water Quality Data for Copper, Hardness, Specific Conductance, and Chloride

Station	Date	Parameter	Parameter Type	Units	Parameter No.	Nummeriv Value
05540095	06/08/98	COPPER	CU,TOT	UG/L	01042	10
05540095	08/03/98	COPPER	CU,TOT	UG/L	01042	10
05540095	09/09/98	COPPER	CU,TOT	UG/L	01042	11
05540095	11/02/98	COPPER	CU,TOT	UG/L	01042	10
05540095	12/02/98	COPPER	CU,TOT	UG/L	01042	10
05540095	02/08/99	COPPER	CU-TOT	UG/L	01042	10
05540095	02/23/99	COPPER	CU-TOT	UG/L	01042	10
05540095	08/04/99	COPPER	CU-TOT	UG/L	01042	10
05540095	09/09/99	COPPER	CU-TOT	UG/L	01042	12
05540095	04/25/00	COPPER	CU-TOT	UG/L	01042	10
05540095	08/24/00	COPPER	CU-TOT	UG/L	01042	10
05540095	10/13/99	COPPER	CU-TOT	UG/L	01042	10
05540095	11/17/99	COPPER	CU-TOT	UG/L	01042	10
05540095	12/20/99	COPPER	CU-TOT	UG/L	01042	10
05540095	02/14/00	COPPER	CU-TOT	UG/L	01042	11
05540095	03/20/00	COPPER	CU-TOT	UG/L	01042	10
05540095	06/02/00	COPPER	CU-TOT	UG/L	01042	10
05540095	07/18/00	COPPER	CU-TOT	UG/L	01042	10
05540095	10/16/00	COPPER	CU-TOT	UG/L	01042	10

Appendix C

Hydrologic Calibration Data

FIGURE C-1
Plot of Snow Pack Depth on the West Branch DuPage Watershed

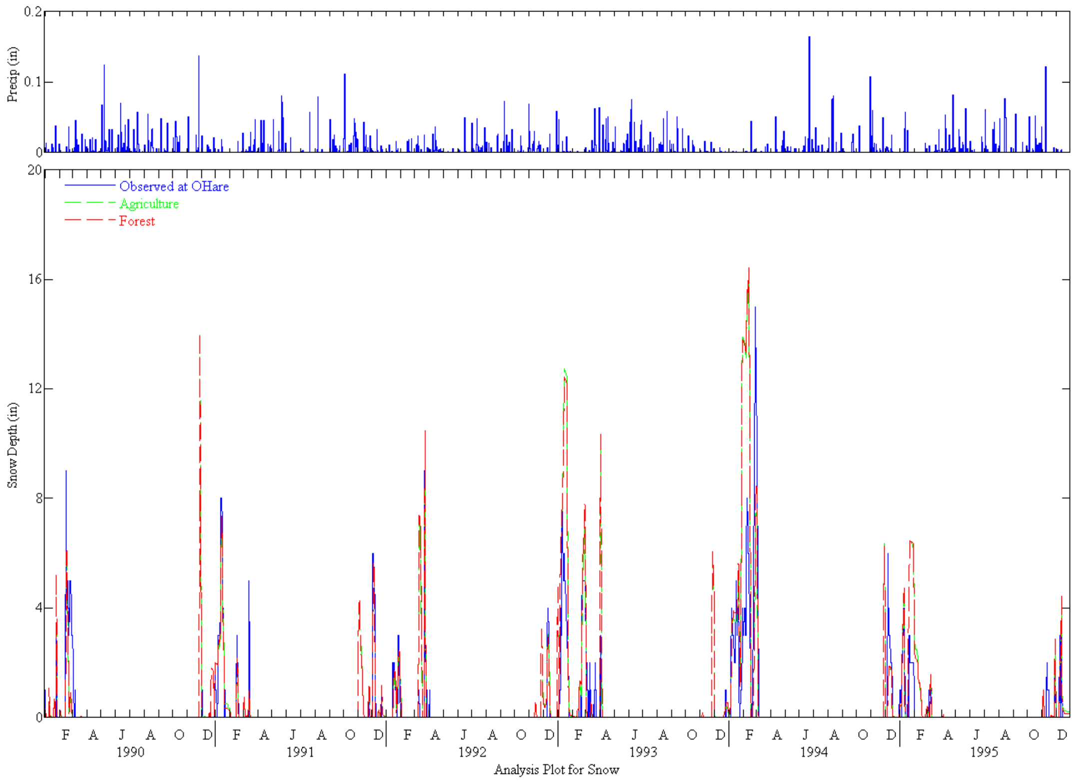


FIGURE C-2
Flow Duration Plot—West Branch DuPage River at West Chicago

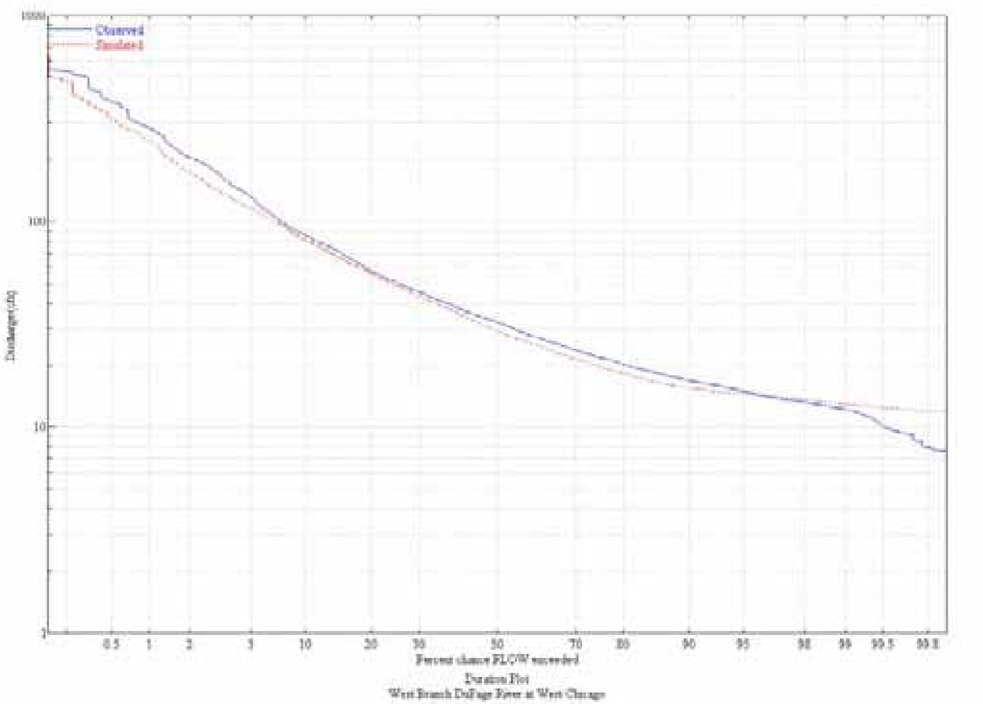


FIGURE C-3
Flow Duration Plot—West Branch DuPage River at Warrenville

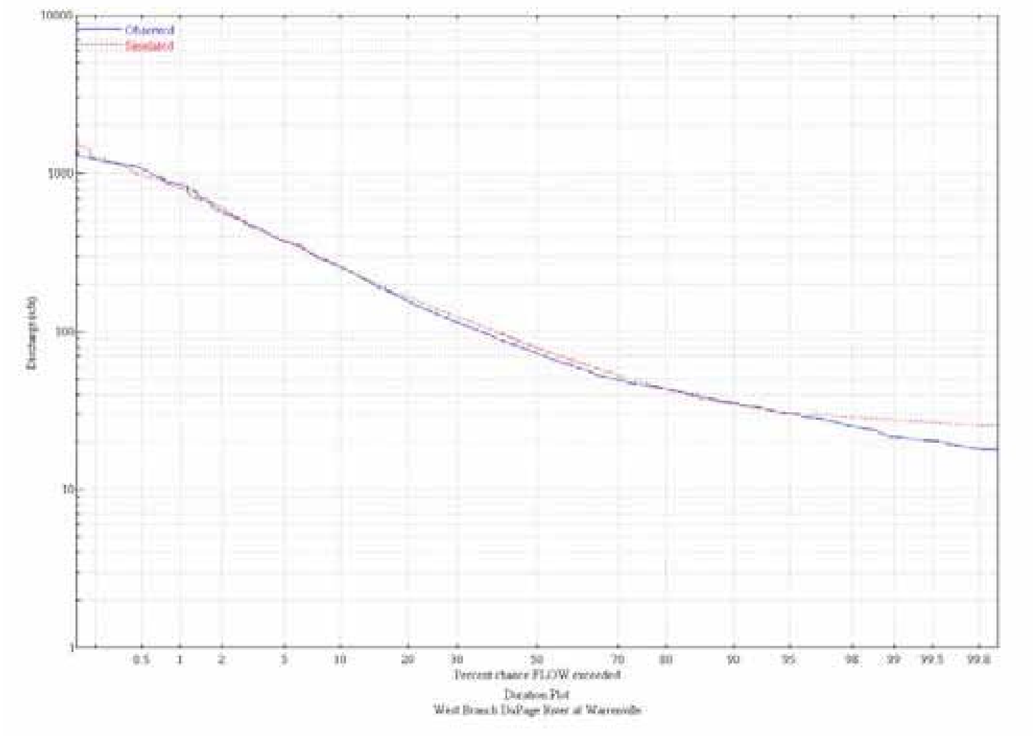


FIGURE C-4
Flow Duration Plot—West Branch DuPage River at Naperville

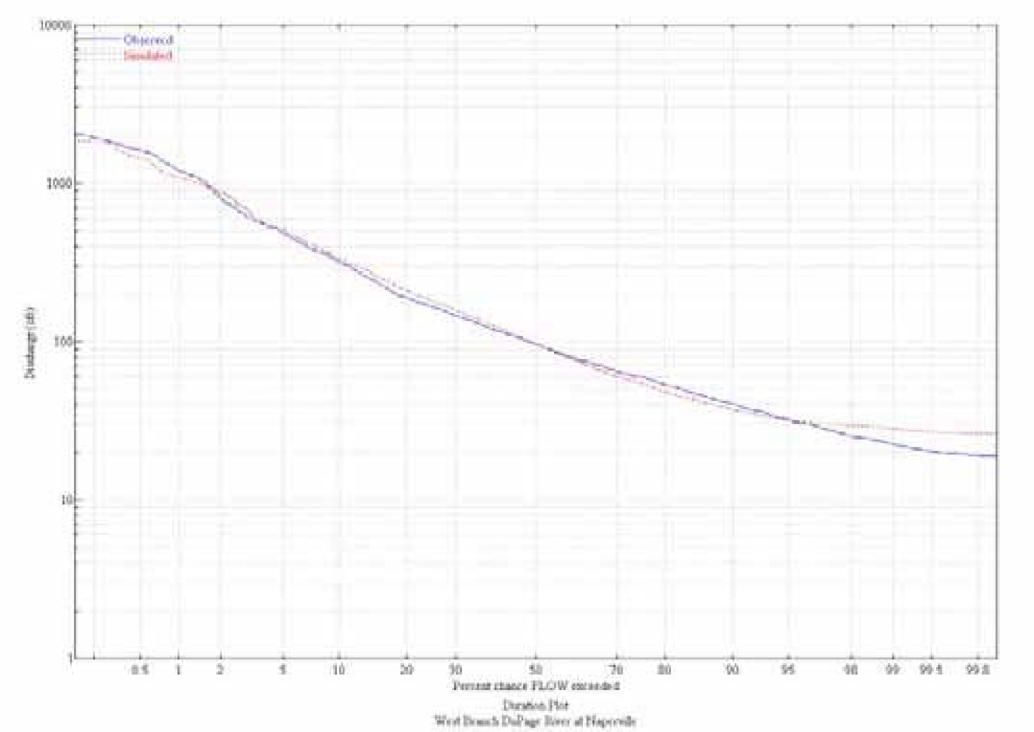


FIGURE C-5
Scatter Plot—West Branch DuPage River at West Chicago

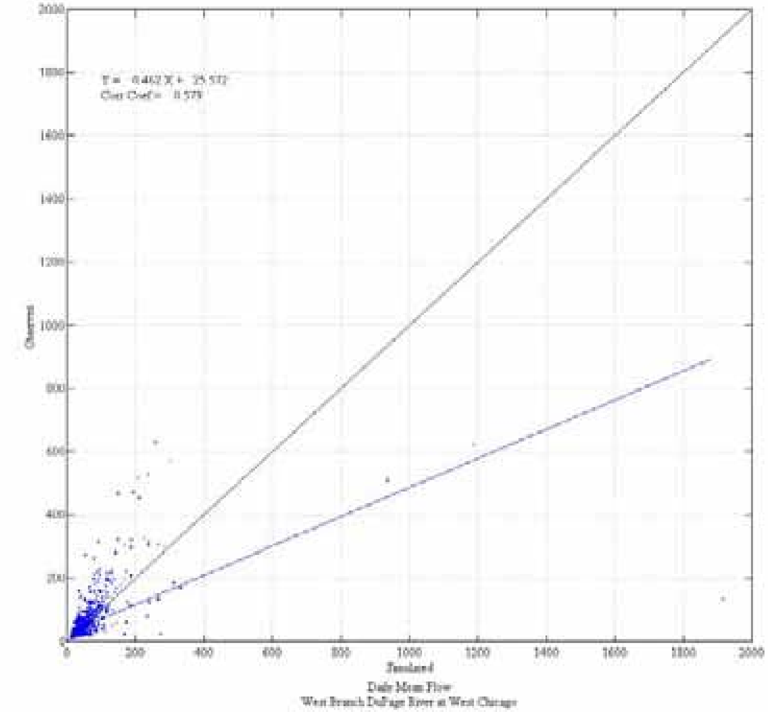


FIGURE C-6
Scatter Plot—West Branch DuPage River at Warrenville

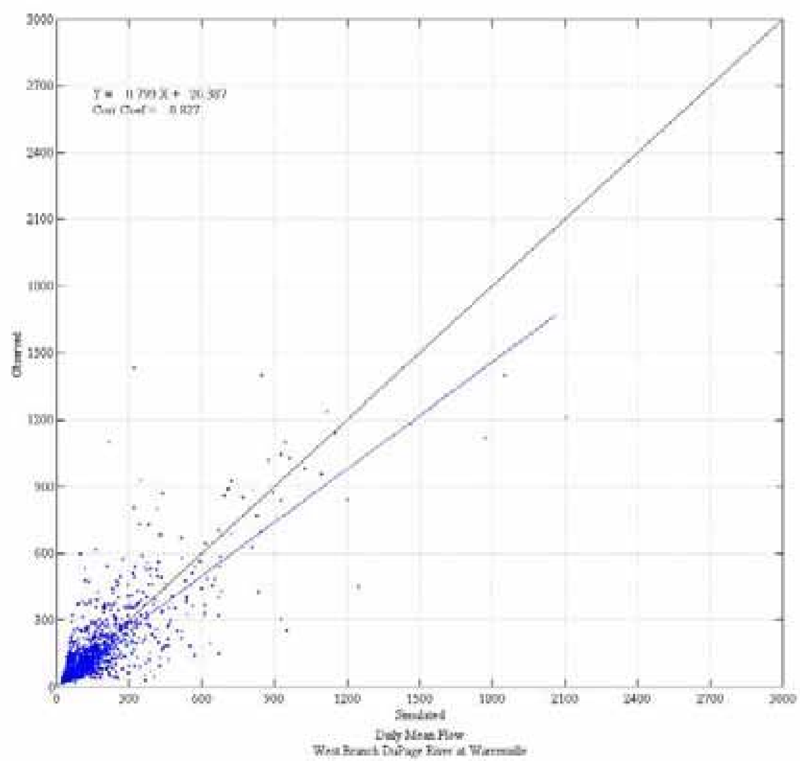
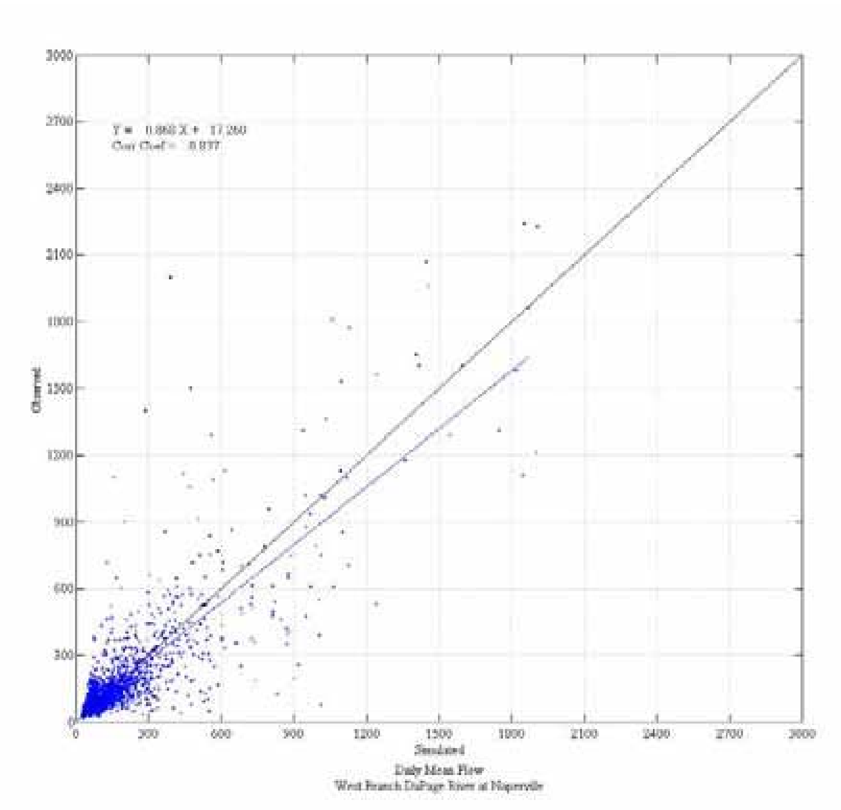


FIGURE C-7
Scatter Plot—West Branch DuPage River at Naperville



Appendix D

Salt Application Data from West Branch DuPage River Watershed and Chloride Alternatives

TABLE D-1
Salt application history from Village of Carol Stream, Illinois

Year	Street Miles	Salt Usage (tons)	Average Salt Use per Mile (ton/mile)	Average Salt Use per Lane per Mile (tons/lane-mile)
90/91	90	1300	14.44	7.22
91/92	93	1036	11.14	5.57
92/93	95	1076	11.33	5.66
93/94	97	1236	12.74	6.37
94/95	97	1199	12.36	6.18
95/96	97	2421	24.96	12.48
96/97	98	2659	27.13	13.57
97/98	100	1996	19.96	9.98
98/99	100	1980	19.80	9.90
99/00	101	2174	21.52	10.76
00/01	101	2925	28.96	14.48
01/02	101	1514	14.99	7.50

TABLE D-2
Salt Application History from Wheaton, Illinois

Year	Street Miles	Salt Usage (tons)	Average Salt Use per Mile (ton/mile)	Average Salt Use per Lane per Mile (tons/lane-mile)
90/91	162.76	2911	17.89	8.94
91/92	162.82	2316	14.22	7.11
92/93	162.82	3560	21.86	10.93
93/94	165.1	3535	21.41	10.71
94/95	165.1	2810	17.02	8.51
95/96	165.62	3752	22.65	11.33
96/97	166.56	3889	23.35	11.67
97/98	166.56	3117	18.71	9.36
98/99	166.64	3340	20.04	10.02
99/00	166.74	3667	21.99	11.00
00/01	167.1	3868	23.15	11.57
01/02	167.17	2524	15.10	7.55

TABLE D-3
Salt Application History from West Chicago, Illinois

Year	Street Miles	Salt Usage (tons)	Average Salt Use per Mile (ton/mile)	Average Salt Use per Lane per Mile (tons/lane-mile)
90/91	—	—	—	—
91/92	70	916	13.09	6.54
92/93	78	1378	17.67	8.83
93/94	86	1347	15.66	7.83
94/95	92	849	9.23	4.61
95/96	100	1332	13.32	6.66
96/97	106	1701	16.05	8.02
97/98	107	1099	10.27	5.14
98/99	110	1440	13.09	6.55
99/00	114	1740	15.26	7.63
00/01	116	1955	16.85	8.43
01/02	122	1397	11.45	5.73

TABLE D-4
Salt application history from Bartlett, Illinois

Year	Street Miles	Salt Usage (ton)	Average Salt Use per Mile (ton/mile)	Average Salt Use per Lane per Mile (tons/lane-mile)
90/91	130	—	—	—
91/92	130	—	—	—
92/93	130	—	—	—
93/94	130	—	—	—
94/95	130	—	—	—
95/96	130	3052	23.48	11.74
96/97	130	3652.5	28.10	14.05
97/98	130	1310	10.08	5.04
98/99	130	1925.5	14.81	7.41
99/00	130	2654	20.42	10.21
00/01	130	4284	32.95	16.48
01/02	130	1323	10.18	5.09

TABLE D-5
Salt Application History Summary—All Communities

Year	Average Salt Use per Mile (ton/mile)	Average Salt Use per Lane per Mile (tons/lane-mile)
90/91	16.66	8.33
91/92	13.10	6.55
92/93	17.91	8.95
93/94	17.58	8.79
94/95	13.72	6.86
95/96	21.43	10.72
96/97	23.78	11.89
97/98	14.94	7.47
98/99	17.14	8.57
99/00	20.00	10.00
00/01	25.35	12.67
01/02	12.99	6.50

Deicing Alternatives Summary

TO: Tone Nordberg/WDC
Mark Mittag/MKE

FROM: Phil Blonn/MKE

DATE: July 31, 2002

A search of the worldwide web was conducted to gather information related to alternative deicing materials. Suppliers of these materials were contacted for additional information including cost. This memorandum describes the effectiveness, cost, and environmental factors of 9 alternatives.

Sodium Chloride

Sodium chloride is the most commonly used deicing salt. It is readily available, very inexpensive, and effective. The use of this deicing material, as well as other salts, have led to water quality problems. In particular, high chloride concentrations in streams have a negative impact on the environment and have been traced to the use of road salts such as sodium chloride as a deicing material. The cost of sodium chloride for road-salting is roughly $30/ton.

Calcium Chloride

Calcium chloride is another salt solution used commonly on roads and highways as a deicing material. It is commonly applied in a liquid salt solution, making it immediately effective. Crystalline forms are slower, but longer acting. Because it is a salt, its use results in the same negative chloride fate environmental impacts as sodium chloride. The cost of calcium chloride for road-salting is roughly $300/ton.

Magnesium Chloride

Magnesium chloride is yet another salt solution used on roads and highways as a deicing material. Although it is less toxic than calcium chloride, it shares the same environmental concerns due to chloride fate as sodium chloride. The cost of magnesium chloride for road-salting is roughly $300/ton.

Urea

Urea is used commonly as a deicer at airports. Its effectiveness is similar to road salts. Although it is effective and relatively inexpensive, it rapidly degrades into ammonia. Where it is used, ammonia concentrations in runoff may be ten to several hundred times higher than typically allowed in surface water discharges. Its cost is roughly $300/ton.

Sodium Formate

Sodium formate is more effective at lower temperatures than other deicers. It does not, however, match the performance of acetate deicers. It also does not act as quickly as liquids such as calcium chloride. The net cost for use is roughly 1.5 times that of urea or $450/ton.

Sodium Acetate

Sodium acetate is more effective and less toxic than urea. It is also less harmful to the environment. Sodium acetate also works as quickly as calcium chloride. Roughly two-thirds as much sodium acetate is required as urea to achieve the same amount of deicing. Although its cost is roughly $1,200/ton, its cost per unit area is about three times that of urea and thirty times that of sodium chloride.

Calcium Magnesium Acetate

Calcium magnesium acetate (CMA) has fewer harmful effects on the environment than salts and other deicers. CMA acts more slowly and is less effective than road salt. Its cost is roughly $1,700/ton, but the amount of CMA required for de-icing is about 1.7 times the amount of road salt. Its cost per unit area is about 100 times that of sodium chloride.

Potassium Acetate

Potassium acetate is very similar to CMA, but slightly more effective. Its use is relatively new, so less information is available about it. Its cost is about the same as CMA.

Propylene and Ethylene Glycol

These deicers are commonly used on aircraft and in areas that can be easily contained. They have extremely high BOD concentrations and therefore would not be suitable for use over wide areas.

Sources

Mericas, Dean, Ph.D. and Wagoner, Bryan, P.E. “Runway Deicers: A Varied Menu.” *Airport Magazine.* http://www.airportnet.org/depts/publications/airmags/am7896/deice.htm

http://www.peterschemical.com

Wegner, Willam and Yaggi, Marc. “Environmental Impacts of Road Salt and Alternatives in the New York City Watershed.” *Stormwater*. http://www.forester.net/sw_0107_environmental.html

Appendix E

303d List Prioritization Changes

APPENDIX E

303(d) List Prioritization Changes

Using the 1998 Illinois Section 303(d) list, the West Branch of the DuPage River was initially listed as impaired for the following parameters: phosphorus, nitrogen, nitrate, salinity/total dissolved solids (TDS)/chlorides, total suspended solids (TSS), ammonia, pathogens, siltation, flow alterations and other habitat alterations.

In Developing the 2002 Illinois Section 303(d) List, the Illinois EPA has revised its method of prioritization that accounts for severity of pollution and the uses to be made of such waters. This prioritization was done on a watershed basis. A brief explanation of the process will be given here. For a detailed explanation, please refer to the Illinois 2002 Section 303(d) list, available at http://www.epa.state.il.us/water/watershed/reports/303d-report/index.html.

The prioritization process involves three steps:

- **Step 1:** The first step in the prioritization process is based on use designations, establishing a High, Medium, and Low Priority for specific uses.
  - *High Priority* – Watersheds containing one or more water bodies in which potential causes of impairments pose a threat to a drinking water use.
  - *Medium Priority* – Watersheds containing one or more water bodies in which potential causes of impairments pose a threat to aquatic life use, fishing use, or swimming use.
  - *Low Priority* – Watersheds containing one or more water bodies in which potential causes of impairment pose a threat to secondary contact recreation.
- **Step 2:** The second step in the prioritization process is based on the degree of confidence assigned to potential causes in the water bodies within a watershed. A Confidence Level of "3" indicates Illinois EPA has relatively high confidence that the identified potential cause is contributing to impairment of the water body. A Confidence Level of "2" indicates moderate confidence, and a confidence level of "1" indicates low confidence.

  The watersheds in Step 1 were prioritized by taking into consideration watersheds which contain one or more water bodies that have potential causes with a Confidence Level of "3". The numbers of Confidence Level 3's were summed using the major cause categories (i.e., 900—nutrients, 1200—organic enrichment) for each watershed. Watersheds with a greater number of Confidence Level 3's were identified as a higher priority for TMDL development within each of the priority groups identified in Step 1. Step 2 was used only when a Confidence Level 3 was assigned to potential causes of impairment in a water body within a watershed.
- **Step 3:** Those watersheds with potential causes of impairment without an assigned Confidence Level 3 were prioritized based on the overall severity of pollution. For the purposes of this process, "severity of pollution" is determined by summing the major

cause categories (i.e., 900—nutrients, 1200—organic enrichment) for potential causes of impairment to a water body segment. The watersheds with more causes of impairments were identified and listed as lower priority than those listed with Confidence Level 3 watersheds within each of the priority groups identified in Step 1.

Within each priority category (High, Medium and Low priorities), Illinois EPA has identified several criteria, which generally indicate a low priority. These criteria are detailed in the Illinois 2002 Section 303(d) list part II, D, (i)-(viii). The West Branch of the DuPage River has impairments that fall under the following criteria:

(1) 303(d) listed waters where the potential causes of impairment are "pollutants" for which there is no numeric water quality standard in Illinois—e.g., nitrogen, phosphorus in streams, and others.

(2) 303(d) listed waters where a potential cause of impairment of a water body is "pollution"—e.g., habitat alterations, dams, and others. The Illinois EPA will continue to work with watershed planning groups and others to identify causes and treat potential sources of impairment.

As a result of this prioritization, this TMDL will focus on the parameter Chloride, which has a Water Quality Standard of 500 mg/L. We are aware of the parameters previously listed and those parameters will be given attention through methods other than a TMDL.

Pending development of appropriate water quality standards as may be proposed by the Agency and adopted by the Pollution Control Board, Illinois EPA will continue to work towards improving water quality throughout the state by promoting and administering existing programs and working to innovate and create new methods of treating potential causes of impairment.

Appendix F

MS4 Permittees in the West Branch DuPage River Watershed

Permitees are in the West Branch DuPage County Watershed are highlighted

Additional MS4s in West Branch DuPage Watershed

Permit #	Operator Name
ILR400288	Batavia
ILR400009	Batavia Township
ILR400298	Bolingbrook
ILR400341	Geneva
ILR400210	Hoffman Estates
ILR400454	St. Charles
ILR400131	St. Charles Township
ILR400456	Streamwood
ILR400443	Schaumburg

Schaumburg Township, Cook County, Fermilab, IDOT have not applied.

MS4 Permittees by County

County: DU PAGE

Number of 44

Permit No.	Operator Name	Address	Date Recd	Final Act	Fin Action
ILR400001	ADDISON ADDISON TOWNSHIP	441 W POTTER ST, ADDISON, IL. 60191	3/10/2003		
ILR400277	ADDISON VILLAGE OF ADDISON	ONE FRIENDSHIP PLAZA, ADDISON, IL. 60101	3/10/2003		
ILR400283	AURORA CITY OF AURORA	44 E DOWNER PL, AURORA, IL. 60507	3/14/2003		
ILR400286	BARTLETT VILLAGE OF BARTLETT	228 S MAIN ST, BARTLETT, IL. 60103	3/10/2003		
ILR400292	BENSENVILLE VILLAGE OF BENSENVILLE	12 S CENTER STREET, BENSENVILLE, IL. 60106	3/10/2003		
ILR400013	BLOOMINGDALE BLOOMINGDALE TOWNSHIP	123 N ROSEDALE RD, BLOOMINGDALE, IL. 60108	3/10/2003		
ILR400295	BLOOMINGDALE VILLAGE OF BLOOMINGDALE	201 S BLOOMINGDALE RD, BLOOMINGDALE, IL. 60108	3/10/2003		
ILR400538	Campton Township Campton Township	4N928 Brown Road, Saint Charles, IL. 60175			
ILR400308	CAROL STREAM VILLAGE OF CAROL STREAM	500 N GARY AVE, CAROL STREAM, IL. 60187	3/10/2003		
ILR400175	CLARENDON CLARENDON HILLS VILLAGE	1 N PROSPECT AVE, CLARENDON HILLS, IL. 60514	3/10/2003		
ILR400180	DARIEN DARIEN CITY	1702 PLAINFIELD RD, DARIEN, IL. 60561	3/10/2003		
ILR400040	DOWNERS GROVE DOWNERS GROVE TOWNSHIP	4340 PRINCE ST, DOWNERS GROVE, IL. 60515	3/10/2003		

Permit No.	Operator Name	Address	Date Recd	Final Act	Fin Action
ILR400183	DOWNERS GROVE DOWNERS GROVE VILLAGE	801 BURLINGTON AVENUE, DOWNERS GROVE, IL. 60515	3/10/2003		
ILR400502	DUPAGE COUNT DUPAGE COUNTY	421 N COUNTY FARM ROAD, WHEATON, IL. 60187	3/10/2003		
ILR400187	ELMHURST ELMHURST CITY	209 N YORK ST, ELMHURST, IL. 60126	3/10/2003		
ILR400199	GLEN ELLYN GLEN ELLYN VILLAGE	30 S LAMBERT ROAD, GLEN ELLYN, IL. 60137	3/10/2003		
ILR400342	GLENDALE HEIGHTS VILLAGE OF GLENDALE HEIGHTS	300 CIVIC CENTER, GLENDALE HEIGHTS, IL. 60139	3/10/2003		
ILR400347	HANOVER PARK VILLAGE OF HANOVER PARK	2121 WEST LAKE ST, HANOVER PARK, IL. 60103	3/10/2003		
ILR400355	HINSDALE VILLAGE OF HINSDALE	19 EAST CHICAGO AVE, HINSDALE, IL. 60521	3/10/2003		
ILR400494	ILLINOIS STATE TOLL HIGHWAY AUTHORITY ILLINOIS STATE TOLL HIGHWAY AUTHORITY	2700 OGDEN AVENUE, DOWNERS GROVE, IL. 60515	3/7/2003		
ILR400360	ITASCA VILLAGE OF ITASCA	100 N WALNUT ST, ITASCA, IL. 60143	3/10/2003		
ILR400497	LEMONT VILLAGE OF LEMONT	418 MAIN STREET, LEMONT, IL. 60439	2/28/2003		
ILR400079	LISLE LISLE TOWNSHIP	4721 INDIANA AVE, LISLE, IL. 60532	3/10/2003		
ILR400376	LISLE VILLAGE OF LISLE	1040 BURLINGTON AVE, LISLE, IL. 60532	3/10/2003		
ILR400378	LOMBARD VILLAGE OF LOMBARD	255 E WILSON, LOMBARD, IL. 60148	3/10/2003		
ILR400086	MILTON MILTON TOWNSHIP	1492 N MAIN ST, WHEATON, IL. 60187	3/10/2003		

Permit No.	Operator Name	Address	Date Recd	Final Act	Fin Action
ILR400092	NAPERVILLE NAPERVILLE TOWNSHIP	31W331 NORTH AURORA ROAD, NAPERVILLE, IL. 60563	3/10/2003		
ILR400396	NAPERVILLE CITY OF NAPERVILLE	400 S EAGLE ST POB 3020, NAPERVILLE, IL. 60566	3/10/2003		
ILR400407	OAK BROOK VILLAGE OF OAK BROOK	1200 OAK BROOK RD, OAK BROOK, IL. 60521	3/10/2003		
ILR400232	OAKBROOK TERRACE OAKBROOK TERRACE CITY	17W275 BUTTERFIELD RD, OAKBROOK TERRACE, IL. 60181	3/10/2003		
ILR400437	ROSELLE VILLAGE OF ROSELLE	31 S PROSPECT STREET, ROSELLE, IL. 60172	3/10/2003		
ILR400463	VILLA PARK VILLAGE OF VILLA PARK	20 S ARDMORE AVE, VILLA PARK, IL. 60181	3/10/2003		
ILR400274	WARRENVILLE CITY OF WARRENVILLE	28 W 701 STAFFORD PLACE, WARRENVILLE, IL. 60555	3/10/2003		
ILR400149	WAYNE WAYNE TOWNSHIP	4N 230 KLEIN ROAD, WEST CHICAGO, IL. 60185	3/10/2003		
ILR400500	WAYNE VILLAGE OF WAYNE	5N430 RAILROAD STREET, WAYNE, IL. 60184	3/10/2003		
ILR400466	WEST CHICAGO CITY OF WEST CHICAGO	475 MAIN STREET POB 488, WEST CHICAGO, IL. 60185	3/10/2003		
ILR400254	WESTMONT WESTMONT VILLAGE	31 W QUINCY ST, WESTMONT, IL. 60559	3/10/2003		
ILR400470	WHEATON CITY OF WHEATON	303 W WESLEY ST POB 727, WHEATON, IL. 60187	3/10/2003		
ILR400255	WILLOWBROOK WILLOWBROOK VILLAGE	7760 S QUINCY ST, WILLOWBROOK, IL. 60521	3/10/2003		
ILR400155	WINFIELD WINFIELD TOWNSHIP	30W575 ROOSEVELT RD, WEST CHICAGO, IL. 60185	3/10/2003		

Permit No.	Operator Name	Address	Date Recd	Final Act	Fin Action
ILR400474	WINFIELD VILLAGE OF WINFIELD	27W465 JEWELL ROAD, WINFIELD, IL. 60190	3/10/2003		
ILR400478	WOOD DALE CITY OF WOOD DALE	404 NORTH WOOD DALE ROAD, WOOD DALE, IL. 60191	3/10/2003		
ILR400480	WOODRIDGE VILLAGE OF WOODRIDGE	ONE PLAZA DR, WOODRIDGE, IL. 60517	3/10/2003		
ILR400159	YORK YORK TOWNSHIP	19W475 ROOSEVELT ROAD, LOMBARD, IL. 60148	3/10/2003		

Appendix G
Responsiveness Summary

WEST BRANCH OF THE DUPAGE RIVER TMDL

APPENDIX G

RESPONSIVENESS SUMMARY

CONTENTS

RESPONSIVENESS SUMMARY

This responsiveness summary responds to substantive questions and comments received during the public comment period from September 17, 2003, through October 24, 2003 (postmarked).

WHAT IS A TMDL?

A Total Maximum Daily Load (TMDL) is the sum of the allowable amount of a single pollutant that a water body can receive from all contributing sources and still meet water quality standards or designated uses. The West Branch of the DuPage River TMDL report contains a plan detailing the actions necessary to reduce pollutant loads to West Branch of the DuPage River 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 the regulations thereunder.

BACKGROUND

The watershed targeted for TMDL development is the West Branch of the DuPage River (ILGBK05). The targeted waterbody segments are GBK 05, GBK 07 and GBK 09, GBK 12 Located in DuPage, Kane, Cook and Will Counties, Illinois. The West Branch DuPage River was placed on the Illinois 303(d) list for water quality impairments potentially caused by a number of parameters. This report describes and presents the methods and procedures used to develop a chloride TMDL for the West Branch DuPage River.

The West Branch watershed encompasses about 127.2 square miles of northeastern Illinois. It is located in the Des Plaines hydrologic unit code (HUC 7120004). Almost one third (32.8 percent) of the land use in the watershed is residential; agriculture accounts for about 17 percent of the land use. Nearly 14 percent of the total watershed area is impervious surfaces (based upon 1990 land use data). There are 14 major point sources in the watershed, of which half are wastewater treatment plants. The Illinois EPA contracted CH2MHILL, St. Louis, Missouri, to prepare a TMDL report for Illinois EPA on this waterbody.

PUBLIC MEETING

A public meeting was held at the Illinois Institute of Technology Campus in Wheaton, IL on March 6, 2002. The draft TMDL Report for the West Branch of the DuPage River was available for review in the reference area of the Naperville/Nichols Public Library, 200 West Jefferson Avenue, Naperville, Illinois from September 24, 2003 until October 24, 2003. The Draft TMDL Report was also available for review on the Agency's web page. Notices were sent to all individuals and organizations on the Agency's mailing list by first class mail. The Draft TMDL Report is available for review on the Agency's web page at:
http://www.epa.state.il.us/water/tmdl/tmdl-reports.html.
The report is also available by mail upon request.

QUESTIONS AND COMMENTS

1. In the Executive Summary, page iii, last paragraph, third sentence, where it states the average copper data as "10.7 mg/l", I believe that should read "10.7 µg/l".

   Response: Thank you for bringing this error to our attention. This has been corrected in the Final Report. Since copper has been requested for delisting, no TMDL has been developed on that parameter.

2. A report entitled Hydrologic Calibration of HSPF Model for DuPage County (Price 1994) is used to establish the average monthly point source discharge. The value determined in the report is apparently the average monthly dry weather flow from wastewater treatment plants, not all point sources, and is based on the average monthly discharge from the treatment plants in the driest month over a several year period. The period is not stated. The data used in the report are from 1980 to 1988.

   Response: The Price report does not provide the details regarding which point sources were included in the evaluation. But note that the report categorizes the sources of all streamflow as either runoff-related or wastewater discharge-related. It follows that the term 'wastewater discharge' in this report refers to all point sources, not just wastewater from wastewater treatment plants. Nonetheless, the majority of the point source discharge from NPDES permitted facilities in this watershed is from wastewater treatment plants. Seasonal fluctuation in point source flows was obtained from 1996 through 2001 DMR data. These values were averaged to develop monthly average seasonal flow variations. HSPF modeling inherently accounts for infiltration and inflow and modeling the higher wet weather point source flows would essentially double-count the water volume. To alleviate this water double-counting issue, the monthly average values were pro-rated down based upon the values documented in the Price report for use in the hydrologic calibration and TMDL analysis.

3. Using these data are extremely conservative. No sanitary sewer system is water tight. Even the Illinois Design Standards for Sewage Works permits infiltration at the rate of 200 gallons per day per inch diameter mile of sewer and exfiltration of 240 gallons per day per inch diameter mile. In the driest month of the several year periods, there was, more than likely, significant exfiltration from the sewage flow resulting in the average flow from sewage treatment plants being understated. In the addition, the infiltration during normal flows would result in higher average flows from treatment plants.

   Response: The report (and methodology used) acknowledges that the sanitary sewer system is not water tight. At issue here is not how much infiltrates or exfiltrates, but the quantity of sanitary discharge that actually reaches the stream. The data used are intended to reflect only the sanitary portion of the plant discharge, because the infiltration portion of the discharge is already reflected in the runoff contributing to the stream.

4. The data used to establish the dry weather flow from treatment plants are based on the years 1980 to 1988, yet the TMDL is based on data from 1990 to 1999. It is likely that the average flow from treatment plants increased significantly from one decade to the other, especially if the driest month cited in the report occurred in the early 80s. Unfortunately, the report does not specify which month was used. I believe that the dry weather flow from treatment plants should be adjusted upward to account for normal discharges, not the driest month's discharge, and should reflect the discharges as they currently exist. The average flow from several months of average rainfall might be more appropriate.

   Response: The same type of analysis on the USGS flow gages over the period 1990 to 1999 yields similar results to the numbers cited in the Price report. Consequently, adjusting the treatment plant discharges upward to account for average rainfall conditions would not be appropriate because it would result in double-counting in the model; water from rainfall that infiltrates the sanitary system would be counted once as runoff and again as sanitary discharge. Additional TMDL modeling considers point source flow as described below.

5. Future growth is stated to be discussed in Section 6.4. Future growth is discussed in Section 6.5.

   Response: This has been corrected in the Final Report. Thank you for your comment.

The margin of safety is stated as being "implicit" based on conservative assumptions. These conservative assumptions appear to be applicable mainly to point source discharges. The two major assumptions that appear to be explicit are the dry weather flow from treatment plants in section 5.2.4, and the assumed chloride concentration from point sources of 300 mg/L in section 6.5.

Response: Responses to the dry weather flow and assumed point source chloride concentration are provided in the answers to questions 7 and 8.

7. WLAs for point sources are calculated at 300 mg/L of chloride and the average/design flow of the point sources. No point source has an effluent limit for chlorides at present. This, in effect, establishes an effluent limit for the point sources of 300 mg/L, a 40 percent reduction from the water quality standard of 500 mg/L. From the data collected by the Conservation Foundation in 2001/2002, at least one point source discharged at a higher concentration during the short sampling period. The model should be run with the treatment plant discharge at the water quality standard of 500 mg/L and the model run at varying percentage reductions for both point sources and non point sources to determine the reduction required to maintain water quality standards with an explicit margin of safety. The 300 mg/L assumption locks the treatment plants into a loading that cannot be increased

as the plants expand to accommodate growth.

Response: The total point source chloride load was reanalyzed (flow and concentration). The West Chicago plant had one measurement which exceeded the 300 mg/L used in the TMDL, from the Conservation Foundation lead sampling effort. The TMDL was based on scaled back WWTP flows in order to calibrate the hydraulic model (see response to comment 8). Consequently, the point source chloride concentration and flow rates were re-analyzed to determine what influence on chloride exceedances would occur if flows were increased to account for some growth and if a higher chloride discharge concentration were used. Daily chloride values predicted at stations 05539900 (West Chicago) and 05540095 (Warrenville) under the 35 percent NPS reduction scenario were reviewed. Besides the 300 mg/L analysis presented in the report, additional scenarios were evaluated at 400 and 500 mg/L point source discharges. A summary of the findings is shown in the attached Table 1 below. The analysis was done using the same modeled flows, however the mass allowance was determined using estimates of future flows based upon average point source values (DMR data from 1996 to 2001) with estimated future flow increases of 20 percent growth at West Chicago and 10 percent growth at the other facilities. For example, assuming a 400 mg/L point source allowance, there would be 2 exceedances over the 3 year period analyzed under the existing landuse conditions. Using 400 mg/L versus 300 mg/L produces no change in the frequency of exceedances over this time frame.

If 400 mg/L were selected for the TMDL, the revised TMDL based upon the assumption of future condition landuse and estimated future flow rates would yield: a WLA of 38,507,000 pounds per year, a MS4 WLA of 27,421,000 pounds per year for a TMDL of 65,928,000 pounds per year (implicit margin of safety). To avoid exceedances of the chloride standard, a mass limit over a standard permitting averaging period (lb/week or lb/month) could be considered.

TABLE 1
Chloride exceedance summary by point source discharge concentration 1996-1998

Point Source Discharge Concentration	300 mg/l	400 mg/l	500 mg/l
Number of Model Predicted Exceedances 1996-1998 gage 5539900 (West Chicago) (seg28)	2	2	3
Number of Model Predicted Exceedances 1996-1998 gage 5540095 (Warrenville) (seg3)	2	2	4
Exceedance Percentage of Time gage 5539900 (West Chicago) (seg28)	0.18%	0.18%	0.27%
Exceedance Percentage of Time gage 5540095 (Warrenville) (seg3)	0.18%	0.18%	0.36%

8. It is also unclear what flow is used for this calculation. Is it the average flow determined from the Price report cited in 5.2.4, or the average design dry weather flow, or the actual

average flow?

Response: The point source flows were based on average effluent flows, but then were scaled back as a water balance measure during the hydrologic calibration to account for the additional infiltration and inflow experienced in the sewer system. As described in Section 5.2.4, during storm events, stormwater enters the WWTP collection systems. In order to properly calibrate the hydraulics, the WWTP flows were scaled back. Based on data provided, the actual annual average point source flow from the seven largest facilities was 44.5 cubic feet per second (cfs). However, 25.5 cfs was included in the model on average as point source flows, with the remaining included in the NPS hydraulics. The TMDL analysis has been revised to allow for the flow increases described in response seven above. The current average point source flows and the flows used in the analysis described in response seven are summarized below. The TMDL report will be modified to address this issue which will be protective of water quality as described above.

TABLE 2
Selected Point Source Flows

WWTP	Permit Number	Average DMR Flow (cfs)	Flow used in Analysis (cfs)
MWRDGC Hanover Park STP	IL0036137	14.20	15.62
Roselle-Botterman WWTF	IL0048721	1.25	1.38
Hanover Park STP #1	IL0034479	1.55	1.70
Bartlett WWTP	IL0027618	3.28	3.61
Carol Stream STP	IL0026352	5.08	5.59
West Chicago STP	IL0023469	6.78	8.14
Wheaton S.D.	IL0031739	11.69	12.86

Reference is made to the Conservation Foundation's sampling program, without further clarification anywhere in the report. I believe that somewhere in the report, the fact that this program was conducted under an approved Quality Assurance Project Plan, as well as the extent of the sampling and the participants, should be documented.

Response: Chloride concentrations of wastewater treatment plan point sources obtained under the Conservation Foundation's IEPA approved Quality Assurance Project Plan (QAPP) were used as part of the TMDL modeling analysis. The Conservation Foundation, Wheaton Sanitary District, City of West Chicago and the Village of Bartlett, together with Strand and Associates formed the West Branch of the DuPage TMDL group for the purposes of wet weather event sampling and POTW effluent sampling. Two rain events were sampled at eleven points in the West Branch DuPage River Watershed. These events occurred on November 24, 2001 and April 7, 2002. Bi-weekly effluent samples were taken from November 2001 through April 2002.

Table 1 (in the TMDL) gives a false impression that alternate road deicing chemicals are significantly more expensive than rock salt. The significant cost of alternate deicing chemicals (cost per lane mile) is shown in Table 7-2. In Table 7-2, Calcium Chloride is shown with a cost (in $/lane mile/year) of $6, 977 to $7, 529, only about 10% more expensive than the $6,371 to $6,606 per lane mile cited for Sodium Chloride. The cost per lane mile of Calcium Magnesium Acetate is also not 20 times more expensive than rock salt as indicated in Table 7-1, but about twice as expensive in cost per lane mile. If these apparent discrepancies are corrected, the Section 7.3.1.4 may need to be corrected also. It would seem that Calcium Chloride can be substituted for Sodium Chloride at a slight increase in cost but would have less impact on the water quality because it could be used in less quantity (according to Table 7-1) and be effective to a lower temperature (according to Table 7-1 and 7-2).

Response: The two tables illustrate relative cost comparisons of alternative methods based upon reference literature values. Table 7-2 is based upon lane miles and reflects relative deicing efficiencies and effective operating temperature ranges. The values presented in these tables provide a starting point for deicing material usage alternative screening and applicability. Entities which reduce their chloride application will have to consider what is most practical as well as cost effective.

If adaptive implementation does not work and the TMDL is reopened, the conservative assumptions used to justify an implicit margin of safety would be detrimental to the point sources because their WLA would be further reduced from the already reduced level of the WQS.

Response: This TMDL has shown that chloride impairment is a nonpoint source issue. We plan to take steps to adequately address the sources of nonpoint source pollution as detailed in the TMDL Implementation Plan. The WLA for this TMDL is effectively zero and point sources are not anticipated to be affected by this TMDL.

12. The TMDL should explain why or why not a cause of impairment listed in the 1998 303(d) List for any waterbody in the three watersheds was addressed in the TMDL. Impairments in the 1998 303(d) List included phosphorus, nitrogen, nitrate, salinity, total dissolved solids (TDS), chlorides, total suspended solids (TSS), ammonia, pathogens, siltation, flow alterations, and other habitat alterations. Since the 303(d) List has been updated (in 2002) after the TMDLs for the three watersheds got underway, the TMDL should also list any new impairments that have been identified and explain how these issues will be addressed in the future.

    Response: The TMDL for the West Branch of the DuPage officially began in May of 2001. In determining the parameters to target for TMDL development, the Agency strives to be dynamic in our analysis and use the most recent data available at the time. In May of 2001, the most recent documents were the 1998 303(d) List and 2000 305(b) (Illinois Water Quality Report). The Agency was not required to compile a 2000 303(d) List.

The Agency attempts to ensure that the TMDL is developed with the most recent information possible. As we update our assessments, we make corresponding changes in the reports. However, there is a point in every report where no further changes can be made. The 2000 305(b) Report was the most recent document used in developing the West Branch TMDL. The TMDL report was nearly completed when the 2002 303(d) List was released for public comment and it was not feasible to make substantial changes to the report at that time.

The Agency has adopted a policy of developing TMDLs only on potential causes of impairment that have a water quality standard. We feel the need for a legally designated endpoint is necessary for us to implement the needed regulation that may result from a TMDL. Nutrients, siltation, suspended solids, habitat and flow alterations and several other parameters listed in the 1998 and 2002 303(d) Lists do not presently have water quality standards and will not have TMDLs completed on them at this time. (Please see Appendix E of this document for a detailed explanation of the Agency's prioritization process.) For this reason, there may be some differences between the 1998 303(d) List, the 2000 305(b) Report and the parameters addressed in this TMDL report. The Agency will continue to work with stakeholders in the watershed to address the remaining causes of impairment, through methods other than a TMDL.

GLOSSARY AND ACRONYMS

AWQMN	Ambient Water Quality Monitoring Network
BMPs	Best Management Practices. These are practices that have been determined to be effective and practical means of preventing or reducing pollution from nonpoint sources.
DMR	Discharge Monitoring Reports
HSPF	Hydrologic Simulation Program Fortran
IEPA	The Illinois Environmental Protection Agency (also referred to as the Agency or Illinois EPA)
LA	Load Allocation – the sum of allocated pollutants from nonpoint sources
mg/L	Milligram per Liter
µg/L	Microgram per Liter
NPDES	National Pollutant Discharge Elimination System
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WLA	Waste Load Allocation – the sum of allocated pollutants from point sources
WWTP	Wastewater Treatment Plant

DISTRIBUTION OF RESPONSIVENESS SUMMARY

Additional copies of this responsiveness summary are available from Mark Britton, Illinois EPA Office of Community Relations, phone 217-524-7342 or e-mail Mark.Britton@epa.state.il.us

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