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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

North Branch Chicago River Watershed TMDL Stage 1 Report

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Executive Summary

As required by Section 303(d) of the Clean Water Act (CWA), the Illinois Environmental Protection Agency (Illinois EPA) is required to identify and list all state waters that fail to meet water quality standards. This list is referred to as the 303(d) list and is revisited every two years to either remove those waters that have attained their designated uses, or to include additional waters not previously deemed impaired. Waterbodies included on the 303(d) list require Total Maximum Daily Load (TMDL) development.

A TMDL is an estimation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. It assesses contributing point and nonpoint sources to identify pollution reductions necessary for designated use attainment. A TMDL identifies the source of impairment and provides reduction estimates to meet water quality standards. Pollutant reductions are then allocated to contributing sources, thus triggering the need for pollution control and increased management responsibilities amongst sources in the watershed.

For the North Branch Chicago River Watershed nine impaired waterbodies were identified for TMDL development. The North Branch Chicago River Watershed is located in northern Illinois and drains approximately 87,000 acres. The North Branch Chicago River originates as three tributary streams: the 14.7 mile West Fork, 33.6 mile Middle Fork (also known as the West Skokie), and the 19.1 mile Skokie River. From their origins in Lake County, these tributaries flow south into Cook County where the West Fork and Skokie River flow into the Middle Fork. The Middle Fork continues to flow south through Cook County till its confluence with the North Shore Channel, forming the main stem of the North Branch. It then joins the South Branch of the river in downtown Chicago. The South Branch flows into the Chicago Sanitary and Ship Canal where it is diverted westward joining with the Des Plaines River as a tributary of the Illinois River. The Illinois River flows southwest across the state and is a major tributary of the Mississippi River (SMC 2007). The watershed is within Lake and Cook Counties.

The only waterbody classification applicable to the North Branch Chicago River Watershed is the General Use classification which includes designated uses such as aquatic life, aesthetic quality, fish consumption and primary contact recreation uses. The identified impairments include total phosphorus, fecal coliform, pH, dissolved oxygen, temperature, manganese, and chloride. The water quality standard criteria identified for these impairments provide an explicit assessment as to whether or not these waterbodies are in compliance.

Available data used for assessing these waterbodies originated from numerous water quality stations within the North Branch Chicago River Watershed. Data were obtained from both legacy and modernized USEPA Storage and Retrieval (STORET) databases, Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) data, Lake County, and Illinois EPA database data. Data relevant to impairments were compiled for each impaired waterbody and summary statistics were calculated to further characterize each pollutant.

Various models were recommended for TMDL development, the level of which was primarily based on the complexity of the system and the availability of data. Simple spreadsheet models were recommended for DO TMDLs and the ENSR Lake Response Model (ENSR LRM) was recommended to analyze total phosphorus impairment. Load duration curves were recommended for fecal coliform and metals analyses and could also be used to estimate BOD loading for the DO TMDL. If the system requires a more complex DO model for creek simulation, then QUAL2K could be used. QUAL2K was recommended for the pH and temperature TMDL, but is capable of simulating instream DO concentrations.

1.0 Introduction

This Stage 1 Total Maximum Daily Load (TMDL) report is presented as partial fulfillment by the Illinois Environmental Protection Agency (Illinois EPA) and the United States Environmental Protection Agency (U.S.EPA) in the development of TMDLs, as part of that state's Clean Water Act (CWA) Section 303(d) compliance. The purpose of the project is to develop TMDLs for nine impaired waterbodies in the North Branch Chicago River Watershed in northeastern Illinois.

Section 303(d) of the CWA and U.S. EPA's Water Quality Planning Regulations (40 CFR Part 130) require states to develop TMDLs for impaired waterbodies that are not supporting designated uses or meeting water quality standards. A TMDL is a calculation of the maximum amount of pollutants that a waterbody can receive and still meet the water quality standards necessary to protect the designated beneficial use (or uses) for that waterbody. The TMDL process establishes the allowable loadings of pollutants for a waterbody based on the relationship between pollutant sources and water quality conditions, so that states and local communities can establish water quality based controls to reduce pollutants from both point and nonpoint sources and restore and maintain the quality of their water resources.

Water is an essential resource for the inhabitants of the Earth and protecting this resource is the goal for many across the globe. United States policies and regulations, such as the CWA, were created and are implemented to help maintain the quality of our water resources in the United States. The U.S. EPA, via the CWA, charged each state with developing water quality standards (WQS). These WQS are laws or regulations that states authorize to protect and/or enhance water quality, to ensure that a waterbody's designated use (or uses) is (are) not compromised by poor water quality and to protect public health and welfare. In general, WQS consist of three elements:

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

The Illinois Pollution Control Board (IPCB) established its WQS and includes it in Title 35: Environmental Protection, Subtitle C: Water Pollution, Chapter 1: Pollution Control Board, Part 302: Water Quality Standards. Every two years Illinois EPA submits the Illinois Integrated Water Quality Report and Section 303(d) List. This report documents surface and groundwater conditions throughout the state. The 303(d) List portion of this report identifies impaired water bodies, grouped by watershed, and identifies suspected sources of impairment. These waters are prioritized for TMDL development into high, medium, and low categories based on designated use and pollution severity and are then targeted for TMDL development. Non-pollutant causes of impairment, such as habitat degradation and aquatic algae are not addressed under the TMDL, but are addressed by programs such as the 319 program and other nonpoint source grant programs. Some non-pollutants may be addressed by reducing pollutants for which a TMDL is developed. For example, some implementation activities to reduce phosphorus can reduce excessive algae and improve habitat.

A TMDL is a calculation of the maximum load a waterbody can be receive without exceeding water quality standards or result in non attainment of a designated use. A watershed's TMDL report consists of data analysis to quantitatively assess water quality, documentation of waterbodies or segments of waterbodies that are impaired, and identification of potential contributing sources to impairment. Based on these data, the amount and type of load reduction that is needed to bring water quality into compliance is calculated. The TMDL report provides the scientific basis for states and local communities to establish water quality-based controls to reduce pollutant loads from both point (i.e., wasteload allocations) and non-point sources (i.e., load allocations).

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

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

The purpose of Stage 1 is to characterize the watershed background; verify impairments in the listed waterbody by comparing observed data with water quality standards or appropriate targets; evaluate spatial and temporal water quality variation; provide a preliminary assessment of sources contributing to impairments; and describe potential TMDL development approaches. If available water quality data collected for the watershed are deemed sufficient by Illinois EPA, Stage 2 may be omitted and Stage 3 will be completed. If sufficient water quality data or supporting information are lacking for an impaired waterbody, then Stage 2 is required and field samplings will be conducted in order to obtain necessary data to complete Stage 3.

This report documents Stage 1 in the Illinois EPA approach for TMDL development. The report is organized into six main sections. Section 1.0 discusses the definition of TMDLs and targeted impaired waterbodies in the North Branch Chicago River Watershed, for which TMDLs will be developed. Section 2.0 describes the characteristics of the watershed, and Section 3.0 briefly discusses the process of public participation and involvement. Section 4.0 describes the applicable water quality standards and water quality assessment. Section 5.0 presents the assessment and analysis of available water quality data. Section 6.0 discusses the methodology selection for the TMDL development, the data gaps, and provides recommendations for additional data collection, if necessary.

1.1 Definition of a Total Maximum Daily Load (TMDL)

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

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

Where:

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

TMDLs can be expressed in terms of either mass per time, toxicity or other appropriate measures [40 CFR, Part 130.2 (i)]. US EPA recommends that all TMDLS and associated LA and WLAs be expressed in terms of daily increments but may include alternative non-daily expression of pollutant loads to facilitate implementation of the applicable water quality standard. TMDLs also shall take into account the seasonal variability of pollutant loading and hydrology to ensure water quality standards are met in all seasons and during all hydrologic conditions. Though not required by CWA, Illinois EPA requires that an implementation plan be developed for each watershed, which may be used as a guideline for local stakeholders to restore water quality. This implementation plan will include recommendations for implementing best management practices (BMPs), cost estimates, institutional needs to implement BMPs and controls throughout the watershed, and time frame for completion of implementation activities.

The MOS accounts for the lack of knowledge or uncertainty concerning the true relationship between loading and attainment of water quality standards. This uncertainty is often a product of data gaps, either temporally or spatially, in the measurement of water quality. The MOS should be proportional to the anticipated level of uncertainty; the higher the uncertainty, the greater the MOS. The MOS is generally based on a qualitative assessment of the relative amount of uncertainty as a matter of best professional judgment (BPJ). The MOS can be either explicit or implicit. If an explicit MOS is used, a portion of the total allowable loading is allocated to the MOS. If the MOS is implicit, a specific value is not assigned to the MOS, but is already factored in during the TMDL development process. Use of an implicit MOS is appropriate when assumptions used to develop the TMDL are believed to be so conservative that they sufficiently account for the MOS.

1.2 Targeted Waterbodies for TMDL Development

In May 2008, Illinois EPA prepared a draft Illinois Integrated Water Quality Report and Section 303(d) List-2008 (commonly referred to as the 303(d) List) to fulfill the requirement of Section 305(b), 303(d) and 314 of the CWA (Illinois EPA, 2008). Under US EPA's review and approval, the report presents a detailed water quality assessment process and results for streams and lakes in the State of Illinois. The water quality assessments are based on biological, physicochemical, physical habitat, and toxicity data. Each waterbody has one or more of designated uses which may include aquatic life, aesthetic quality, indigenous aquatic life (for specific Chicago-area waterbodies), primary contact (swimming), secondary contact (recreation), public and food processing water supply, and fish consumption. The degree of support (attainment) of a designated use in a waterbody (or segment) is assessed as Fully Supporting (good), Not Supporting (fair), or Not Supporting (poor). Waters in which at least one applicable use is not fully supported is designated as "impaired." Potential causes and sources of impairment are also identified for these waters. The 303(d) List is prioritized on a watershed basis based on the requirements of 40 CFR Part 130.7(b)(4). Watershed boundaries are based on United States Geological Survey (USGS) ten-digit hydrologic units, to provide the state with the ability to address watershed issues at a manageable level and document improvements to a watershed's health (Illinois EPA, 2008). TMDL development is also conducted on a watershed basis so that the impaired waters upstream of an individual segment may be addressed at the same time.

Six river segments and three lakes are identified as impaired and selected for TMDL development in the North Branch Chicago River Watershed (Illinois EPA, 200 8). Table 1-1 presents the 2008 303(d) list for the North Branch Chicago River Watershed. The table includes impaired designated uses and potential causes. The segments in bold font are scheduled for TMDL development and are the focus of this report. TMDLs will not be developed for the lakes with surface area of less than 20 acres since the Illinois phosphorus standards apply to only those lakes where surface acreage is 20 or more acres. Nor will TMDLs be developed for segments impaired by water quality variables that do not have numerical WQS.

Table 1-1 summarizes these waterbodies, designated uses, and impairments identified by Illinois EPA and Table 1-2 indicates potential causes. The designated uses for these waterbodies are primarily aquatic life and primary contact recreation with some aesthetic quality and fish consumption uses. The identified causes for impairments include dissolved oxygen, fecal coliform, chloride, and total phosphorus. WQS provide numerical criteria to measure compliance for each of these water quality variables. However, DO is considered a non-pollutant by Illinois EPA. The Illinois EPA will ascertain potential causes for low dissolved oxygen using the TMDL process and will develop a TMDL only if the cause is attributable to a pollutant that has a numerical WQS. For example, if a 50-acre lake suffers from low DO due to excessive algal densities which is related to elevated phosphorus concentrations, the Illinois EPA will develop a phosphorus TMDL for this waterbody. TMDLs will not be developed for waterbodies listed as impaired based on non numerical WQSs (e.g., excessive algae) or statistical guidelines (e.g., total suspended solids). For other causes such as total suspended solids, the TMDL implementation plan can potentially address the impairment by reducing TMDL parameters that are associated with this impairment.

Table 1-1: Illinois 2008 Integrated Report 303(d) and Assessment Report Information for North Branch Chicago River Watershed

Water ID	Water Name	Designated Uses	Impairments
IL_HCC-07	North Branch Chicago River	Aquatic Life	Aldrin, DDT, Hexachlorobenzene, Alteration in Streamside or Littoral Vegetation, **Dissolved Oxygen (1), Chloride (1), pH (1),** Phosphorus, Total Suspended Solids
		Fish Consumption	Polychlorinated biphenyls
		Primary Contact Recreation	**Fecal Coliform (1)**
IL_HCCB-05	West Fork. North Branch Chicago River	Aquatic Life	Alteration in Streamside or Littoral Vegetation, **Chloride (1),** DDT, **Dissolved Oxygen (1),** Phosphorus, Total Suspended Solids
		Primary Contact Recreation	**Fecal Coliform (1)**
IL_HCCC-02	Middle Fork North Branch Chicago River	Aquatic Life	Alteration in Streamside or Littoral Vegetation**, Chloride (1),** DDT, **Dissolved Oxygen (1),** Hexachlorobenzene, **Manganese (1),** Sedimentation/Siltation, Total Suspended Solids (TSS)
		Primary Contact Recreation	**Fecal Coliform (1)**
IL_HCCC-04	Middle Fork North Branch Chicago River	Aquatic Life	Aldrin, Alteration in Streamside or Littoral Vegetation, Chlordane, **Chloride (1**), DDT, **Dissolved Oxygen (1),** Hexachlorobenzene, **pH (1),** Phosphorus (Total), Sedimentation/ Siltation, Total Suspended Solids (TSS), **Water Temperature (1)**
		Primary Contact Recreation	**Fecal Coliform (1)**
IL_HCCD-01	Skokie River	Aquatic Life	**pH (1), Dissolved Oxygen (1),** Phosphorus (Total), Total Suspended Solids (TSS)
		Primary Contact Recreation	**Fecal Coliform (1)**
IL_HCCD-09	Skokie River	Aquatic Life	Alteration in Streamside or Littoral Vegetation, Aquatic Algae, Other Flow Regime Alterations, **pH (1),** Phosphorus, Sedimentation/Siltation
		Primary Contact	**Fecal Coliform (1)**

Water ID	Water Name	Designated Uses	Impairments
		Recreation	
IL_RHJ	Skokie Lagoons	Aesthetic Quality	Aquatic Algae, Aquatic Plants (Macrophytes),**Phosphorus (Total) (1)**, Total Suspended Solids (TSS)
		Fish Consumption	Mercury
IL_RHJA	Chicago Botanic Garden	Aesthetic Quality	Aquatic Algae, **Phosphorus (Total) (1)**
IL_UHH	Eagle Lake	Aesthetic Quality	Aquatic Plants, **Phosphorus (Total) (1)**, Total Suspended Solids (TSS)

(1) These parameters have numeric standards and will have TMDL allocations.

Table 1-2: Waterbodies targeted for TMDL development in the North Branch Chicago River Watershed

Water ID	Water Name	Impairments	Potential Sources
IL_HCC-07	North Branch Chicago River	Dissolved Oxygen	CSOs
		Chloride	Combined Sewer Overflows, Highway/Road/Bridge Runoff (Non-construction Related), Municipal Point Source Discharges, Urban Runoff/Storm Sewers
		pH	Urban Runoff/Storm Sewers
		Fecal Coliform	CSOs, Source Unknown
IL_HCCB-05	West Fork North Branch Chicago River	Chloride	Highway/Road/Bridge Runoff (Non-construction Related), Municipal Point Source Discharges, Urban Runoff/Storm Sewers
		Dissolved Oxygen	Source Unknown
		Fecal Coliform	Urban Runoff/Storm Sewers
IL_HCCC-02	Middle Fork North Branch Chicago River .	Chloride, Manganese	Urban Runoff/Storm Sewers
		Dissolved Oxygen	Channelization, Urban Runoff/Storm Sewers
		Fecal Coliform	Source Unknown
IL_HCCC-04	Middle Fork North Branch Chicago River	Chloride	Municipal Point Source Discharges, Urban Runoff/Storm Sewers
		Dissolved Oxygen	Channelization, Municipal Point Source Discharges, Urban Runoff/ Storm Sewers
		pH	Urban Runoff/Storm Sewers
		Water Temperature	Source Unknown
		Fecal Coliform	Urban Runoff/Storm Sewers
IL_HCCD-01	Skokie River	pH, Dissolved Oxygen	Urban Runoff/Storm Sewers, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO)
		Fecal Coliform	Urban Runoff/Storm Sewers, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO)
IL_HCCD-09	Skokie River	pH	
		Fecal Coliform	Combined Sewer Overflows, Urban Runoff/Storm Sewers
IL_RHJ	Skokie Lagoons	Phosphorus (Total)	Littoral/shore Area Modifications (Non-riverine), Runoff from Forest/Grassland/Parkland, Urban Runoff/Storm Sewers, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO)

Water ID	Water Name	Impairments	Potential Sources
IL_RHJA	Chicago Botanic Garden	Phosphorus (Total)	Littoral/shore Area Modifications (Non-riverine), Runoff from Forest/Grassland/Parkland, Waterfowl, Specialty Crop Production
IL_UHH	Eagle Lake	Phosphorus (Total)	Source Unknown

1.3 Previous Projects Done Within the Watershed

Skokie Lagoons- Years after the lagoons were developed, winter fish kills were the result of the lagoons silting in and pollution from Lake County. Through the EPA Clean Lake Program, a dredging project occurred from 1986 to 1988 and also treated wastewater was rerouted around the lagoons. Starting in 1995, the Forest Preserve District initiated a shoreline stabilization project.

Chicago Botanic Garden Lagoons - In the 1990s, the Botanical Garden undertook an ambitious Skokie River Corridor Enhancement Project. Shoreline restoration has also taken place in the 1990s.

The following 319 projects were also performed within the watershed:

319 Project- 1993

Title: Skokie River Restoration Project

Subgrantee: Chicago Botanic Gardens

Through the implementation of bank stabilization and restoration techniques, this project mitigated nonpoint source pollution to the Skokie River (ILHCCD09) and downstream lagoons. The project also enhanced the aquatic habitat and uses of the Skokie River. Restoration measures applied include: prairie buffer plantings, created oxbow excavations, restored floodplain wetlands (1.1 acre), bank stabilization through brush layering with willows and dogwoods, bank toe protection and redirected thalweg through use of biologs with prairie cord grass and emergent wetland plants, willow posts for protection of rip rap and outlet pipes and weir wall, in-stream habitat structure (riffles), and bank stabilization through 3 foot buffer along entire stream (9,550 feet). A multi-faceted educational program was also implemented as part of the project.

Project Reports and Other Informational Materials:

- "Restoration of the Skokie River: Natural Techniques at Work." 1996 (videotape). Chicago Botanic Garden.
- "Skokie River Restoration Project." May 1996. Chicago Botanic Garden.

319 Project- 1994

Title: Skokie Lagoons Shoreline Stabilization Project

Subgrantee: Forest Preserve District of Cook County

This project implemented shoreline restoration aimed at vegetative stabilization along approximately 2.5 miles of shoreline. The restoration focused on areas where the most erosion has occurred because these are the most significant targets for addressing nonpoint source pollutants. Treatment of the shoreline extended beyond the water's edge and into the floodplain for a distance of approximately 200 feet. Where feasible, the vegetative cover was extended into the water for further stabilization. Restoration measures used included coir fascines, gravel access points, coir mattresses, dead brush layers, sand and gravel stabilizer, live brush mattresses, rock toes, temporary wood stakes, and coir webbing.

Project Reports and Other Informational Materials:

- "Skokie Lagoons Shoreline Stabilization Project – Final Report." October 1, 1997. Forest Preserve District of Cook County.

319 Project- 2000

Title: Chicago Botanic Garden Lake WRAS Implementation

Subgrantee: Chicago Botanic Garden

This project installed best management practices along 5,783 linear feet of shoreline on the Chicago Botanic Garden Lagoon (ILRHJA) to arrest shoreline erosion and reduce nonpoint source pollution while protecting or enhancing habitat and aesthetic qualities. The installation of shoreline stabilization practices was consistent with the recommendations of the Chicago Botanic Garden's "Aquatic Initiative – Lagoon Shoreline Restoration Master Plan" and "Clean Lakes Diagnostic/Feasibility Study," which together served as a watershed restoration action strategy. Shoreline stabilization practices included sheet-pilings, stone walls, cobbles, fiber rolls, A-jacks, lunkers, native grasses and shrubs, erosion control blankets, live fascines, branch-packing, and vegetated geogrids. The project also included an education component including meetings, tours, and construction of a webpage about the project and the shoreline restoration techniques.

Project Reports and Other Informational Materials:

- "Chicago Botanic Garden Lakes Watershed Restoration Action Strategy Implementation – Final Report." August 2006. Chicago Horticultural Society – Botanic Garden. http://www.cbgscience.org/shoreline/index.htm

2.0 Watershed Characterization

This section describes the general characteristics of the North Branch Chicago River Watershed including location (Section 2.1), topography (Section 2.2), land use (Section 2.3), soil information (Section 2.4), population (Section 2.5), climate and precipitation (Section 2.6), and hydrology (Section 2.7).

2.1 Watershed Location

A watershed is a geographic area that shares a hydrologic connection - all the water within that area drains to a common waterway. Water movement can be influenced by topography, soil composition and water recharge (i.e. precipitation, snow melt, groundwater) ("What is a Watershed", 2007). Watersheds are important because pollution at the water's source may impact water quality in all downgradient areas including its convergence with a common waterway. Understanding the watershed is an essential step in the TMDL process – an essential tool in maintaining water quality standards within Illinois.

The North Branch Chicago River Watershed is located in northern Illinois and drains approximately 135 mi^2 (86,400 acres). The North Branch Chicago River originates as three tributary streams: the 14.7 mile West Fork, 33.6 mile Middle Fork (also known as the West Skokie), and the 19.1 mile Skokie River. From their origins in Lake County, these tributaries flow south into Cook County where the West Fork and Skokie River flow into the Middle Fork. The Middle Fork continues to flow south through Cook County till its confluence with the North Shore Channel, forming the main stem of the North Branch. It then joins the South Branch of the river in downtown Chicago. The South Branch flows into the Chicago Sanitary and Ship Canal where it is diverted westward joining with the Des Plaines River as a tributary of the Illinois River. The Illinois River flows southwest across the state and is a major tributary of the Mississippi River (SMC 2007). The watershed is within Lake and Cook Counties.

Figure 2-1: North Branch Chicago River Watershed Overview

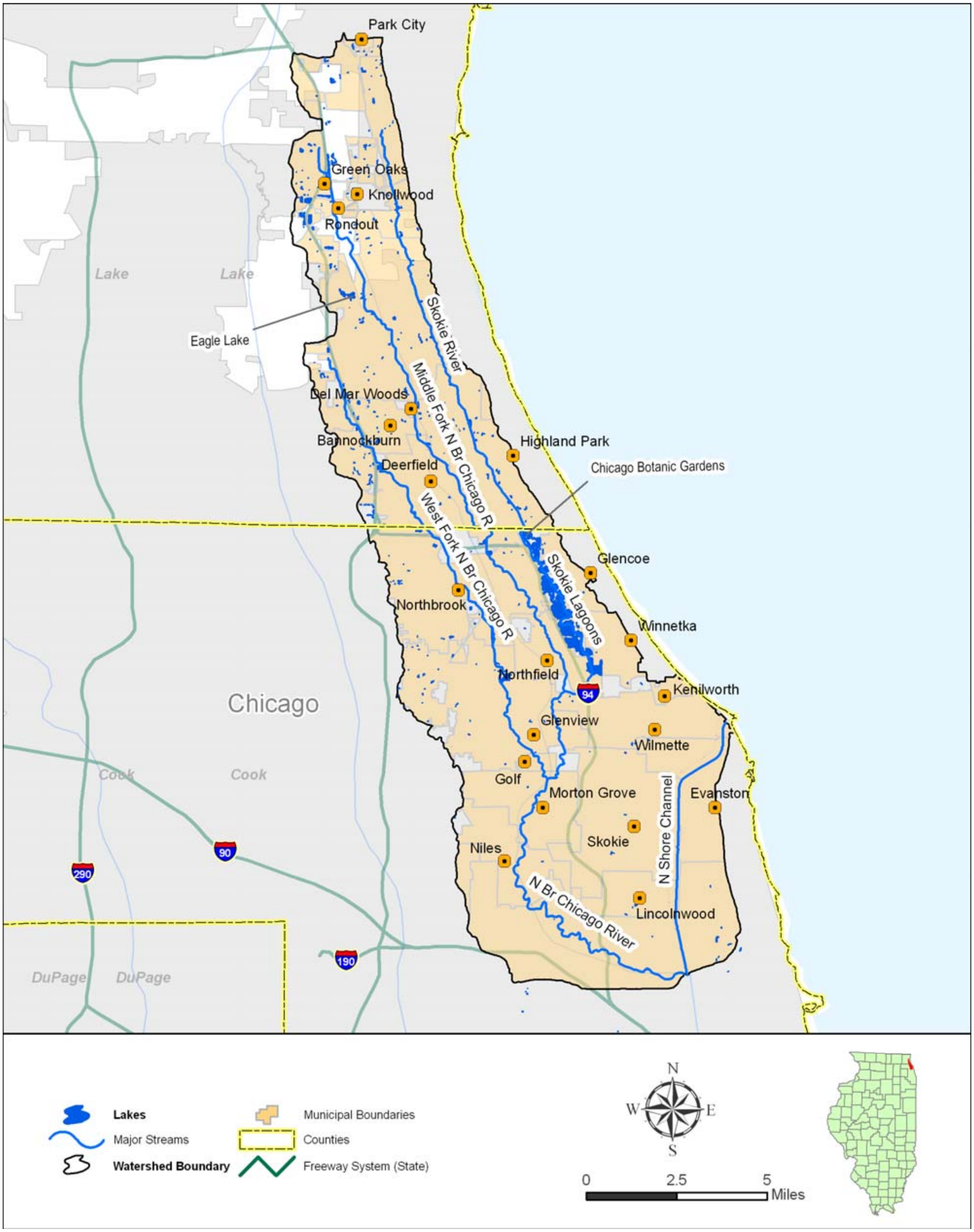
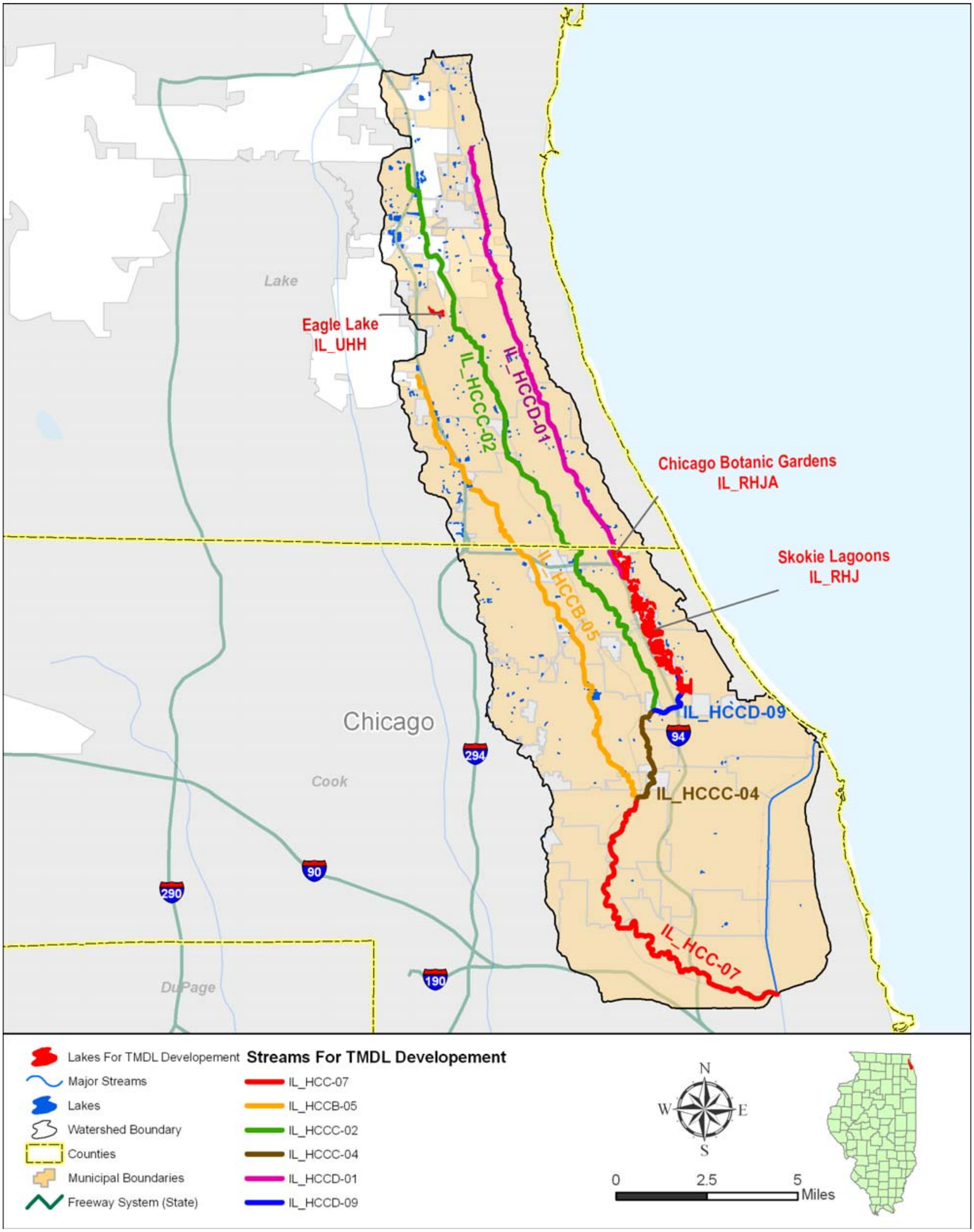


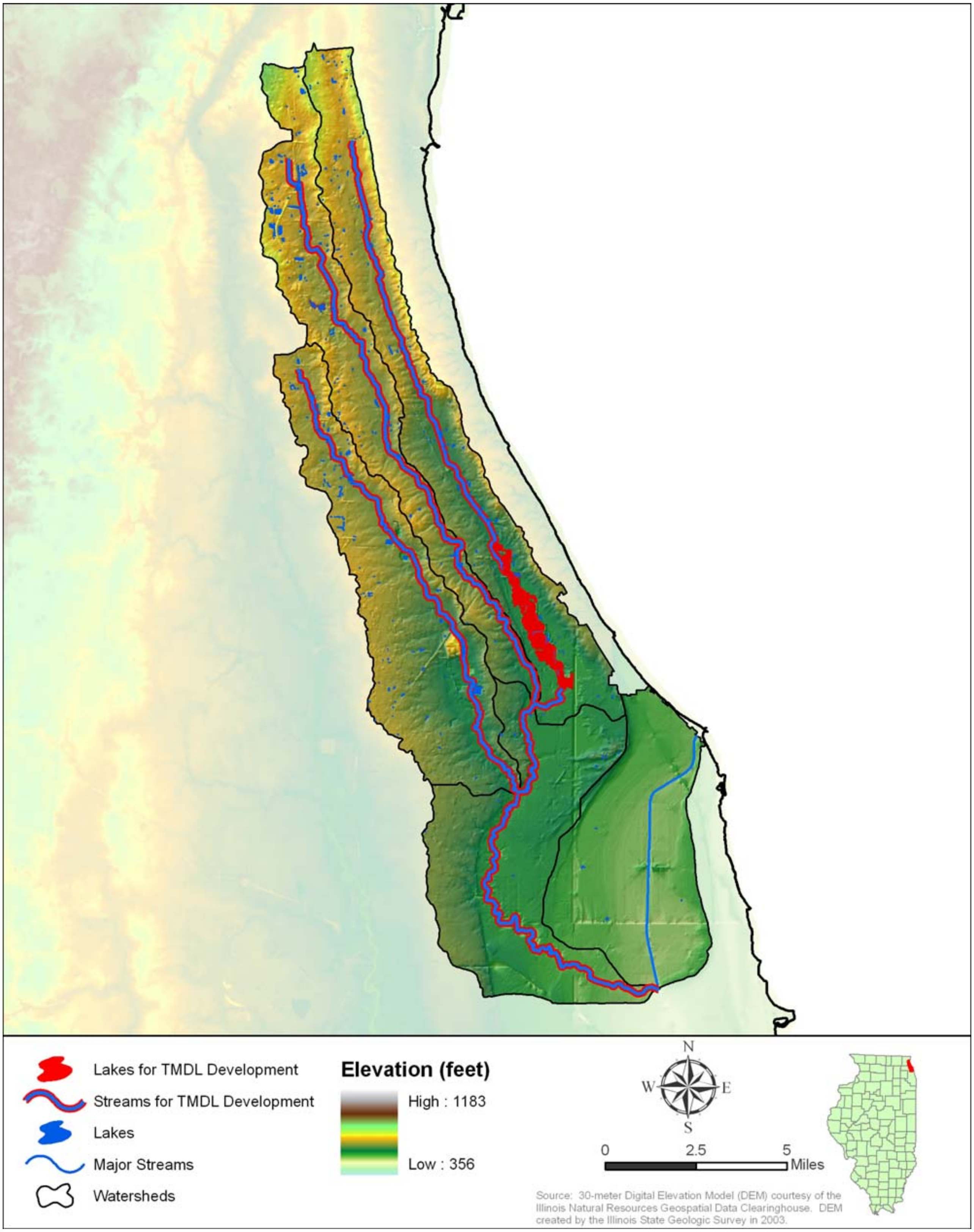
Figure 2-2: North Branch Chicago River Watershed TMDL Waterbodies



2.2 Topography

Topography influences soil types, precipitation, and subsequently watershed hydrology and pollutant loading. For the North Branch Chicago River Watershed, a USGS 30-meter resolution digital elevation model (DEM) was obtained from the Illinois Natural Resources Geospatial Data Clearinghouse to characterize the topography. The DEM was then cropped to the northern extent of the North Branch Chicago River Watershed, as provided by Illinois EPA, and analyzed. Figure 2-3 displays elevations in color ramp throughout the North Branch Chicago River Watershed. Elevation in the North Branch Chicago River Watershed ranges from 700 feet above sea level in the headwaters of the watershed to 356 feet at its most downstream point in the southern end of the watershed. The absolute elevation change is 444 feet over the approximately 41.46 river mile length of watershed, which yields a stream gradient of approximately 0.09 feet per mile or a slope of 0.002, resulting in a percent change of approximately 63%.

Figure 2-3: North Branch Chicago River Watershed Digital Elevation Model (DEM)



2.3 Land Use

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

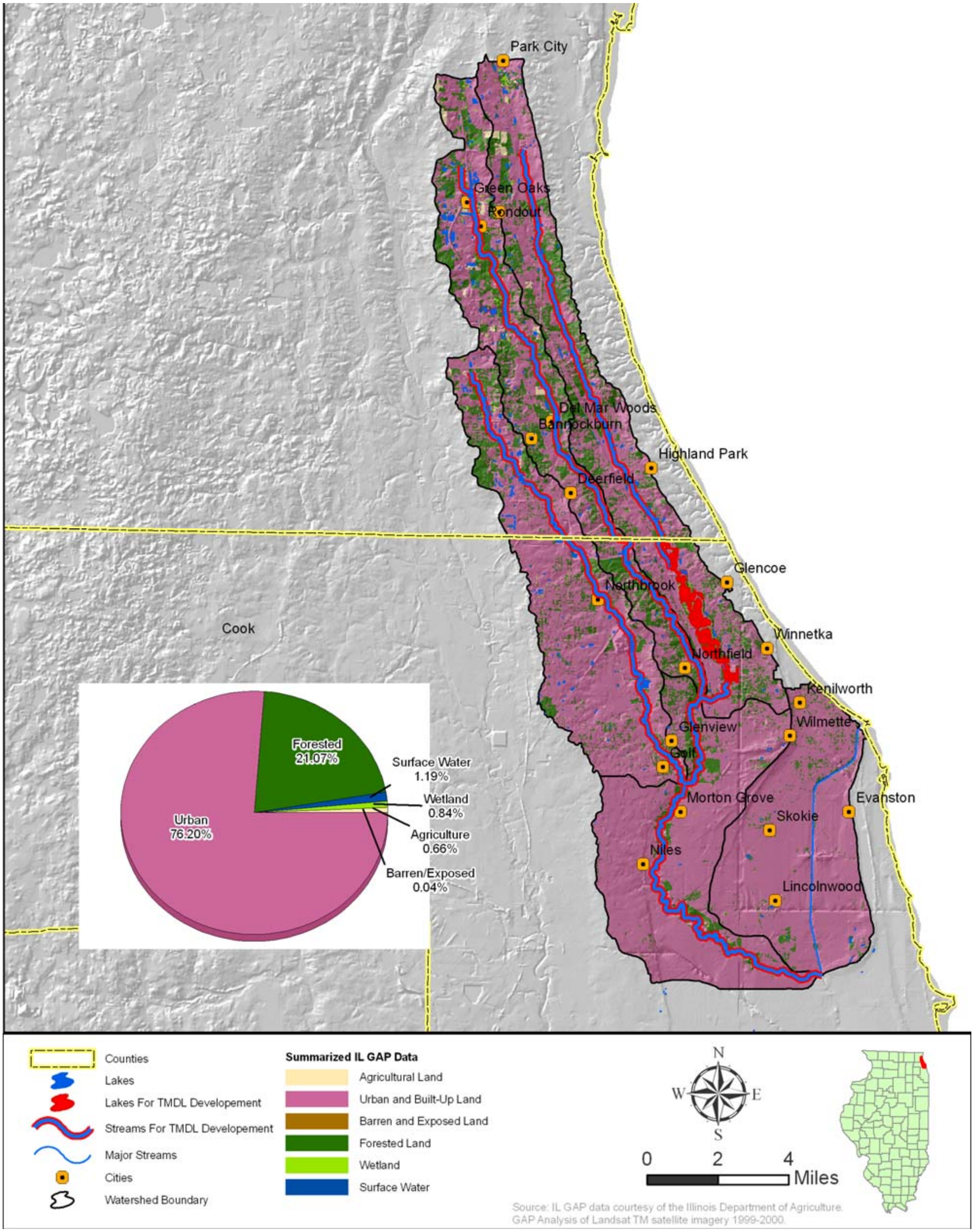
Figure 2-4 displays land use and land cover in the North Branch Chicago River. Table 2-1 summarizes the land use for the watershed. It shows that the predominant land uses in the North Branch watershed are urban, accounting for 76.2% of the watershed. Forested land accounts for 21.1% of the watershed, or approximately 18,300 acres. Upland mesic forest is the most dominant forest type, accounting for 10.0% of the total watershed. Surface water (1.2%), wetlands (0.8%), barren land (0.0%), and agriculture (0.7%) make up the remainder of the watershed. Overall, the watershed is almost entirely urban along the headwaters and watershed boundaries, with some forested lands existing at the higher elevations.

Table 2-1: Summary of ILGAP Data in the North Branch Chicago River Watershed

IL Gap Classification	Acreage	Percent	Summarized Acreage	Summarized Percentage
Urban and Built-up Land: Low/Medium Density: Medium (TM Scene 2331)	30177.9	34.7%	66248.8	76.2%
Urban and Built-up Land: High Density	10516.8	12.1%		
Urban and Built-up Land: Urban Open Space	15591.7	17.9%		
Urban and Built-up Land: Low/Medium Density: Low (TM Scene 2331)	9962.4	11.5%		
Forested Land: Upland: Mesic	8671.4	10.0%	18314.0	21.1%
Forested Land: Partial Canopy/Savanna Upland	6127.9	7.1%		
Forested Land: Upland: Dry-Mesic	3514.7	4.0%		
Other: Surface Water	1038.6	1.2%	1038.6	1.2%
Wetland: Shallow Marsh/Wet Meadow	346.3	0.4%	728.8	0.8%
Wetland: Deep Marsh	193.3	0.2%		
Wetland: Floodplain Forest: Wet	151.5	0.2%		
Wetland: Floodplain Forest: Wet-Mesic	29.4	0.03%		
Wetland: Shallow Water	8.5	0.04%		

IL Gap Classification	Acreage	Percent	Summarized Acreage	Summarized Percentage
Agricultural Land: Corn	332.0	0.4%	575.1	0.7%
Agricultural Land: Soybeans	168.8	0.2%		
Agricultural Land: Other Small Grains and Hay	73.2	0.1%		
Agricultural Land: Winter Wheat	1.1	0.0%		
Other: Barren and Exposed Land	32.0	0.0%	32.0	0.0%

Figure 2-4: North Branch Chicago River Watershed Land Use Map



2.4 Soils

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

The SSURGO data were analyzed based on drainage class, hydrologic group and K-factor. The drainage class, as stated in the SSURGO database is, "The natural drainage condition of the soil [which] refers to the frequency and duration of wet periods" (Soil Survey Staff, "Table Column Descriptions", p. 78). Figure 2-5 exhibits the drainage classes of SSURGO data in the North Branch Chicago River Watershed. Poorly drained soils are the predominant soil in the north, especially along the rivers. However, some excessively drained areas can be found on the slopes near streams in the southern portions of the watershed and closer to the city of Chicago. These excessively drained areas may be in part due to the natural geology or due to pipes leading into the stream. In general, the majority of the watershed and the entire southern section were not surveyed due to intense urban alteration near the center of Chicago.

The hydrologic soil group classification identifies soil groups with similar infiltration and runoff characteristics during periods of prolonged wetting. Typically, clay soils that are poorly drained have lower infiltration rates, while well-drained sandy soils have the greatest infiltration rates. United States Department of Agriculture (USDA) has defined four hydrologic groups (A, B, C, or D) for soils. Type A soil has high infiltration while D soil has very low infiltration rate. Figure 2-6 show the distribution of hydrologic soil groups. Generally, areas to the east along Lake Michigan have a moderately slow infiltration rate (hydrologic group C) with very poorly drained areas along the western border of the watershed. The central portion of the watershed all the way to the south has no data due to the reasons stated previously.

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

The compilation of K-factors from SSURGO data was a multi-stepped process. Soils are classified in the SSURGO database by map unit symbol. Each map unit symbol is made up of components consisting of several horizons (or layers). The K-factor was determined by selecting the dominant components in the most surficial horizon per each map unit. The distribution of K-factor values in the North Branch Chicago River Watershed is shown in Figure 2-7. Values range from 0 to 0.43 with the same urbanized area unsurveyed and therefore showing no data.

Figure 2-5: North Branch Chicago River Watershed SSURGO Drainage Class

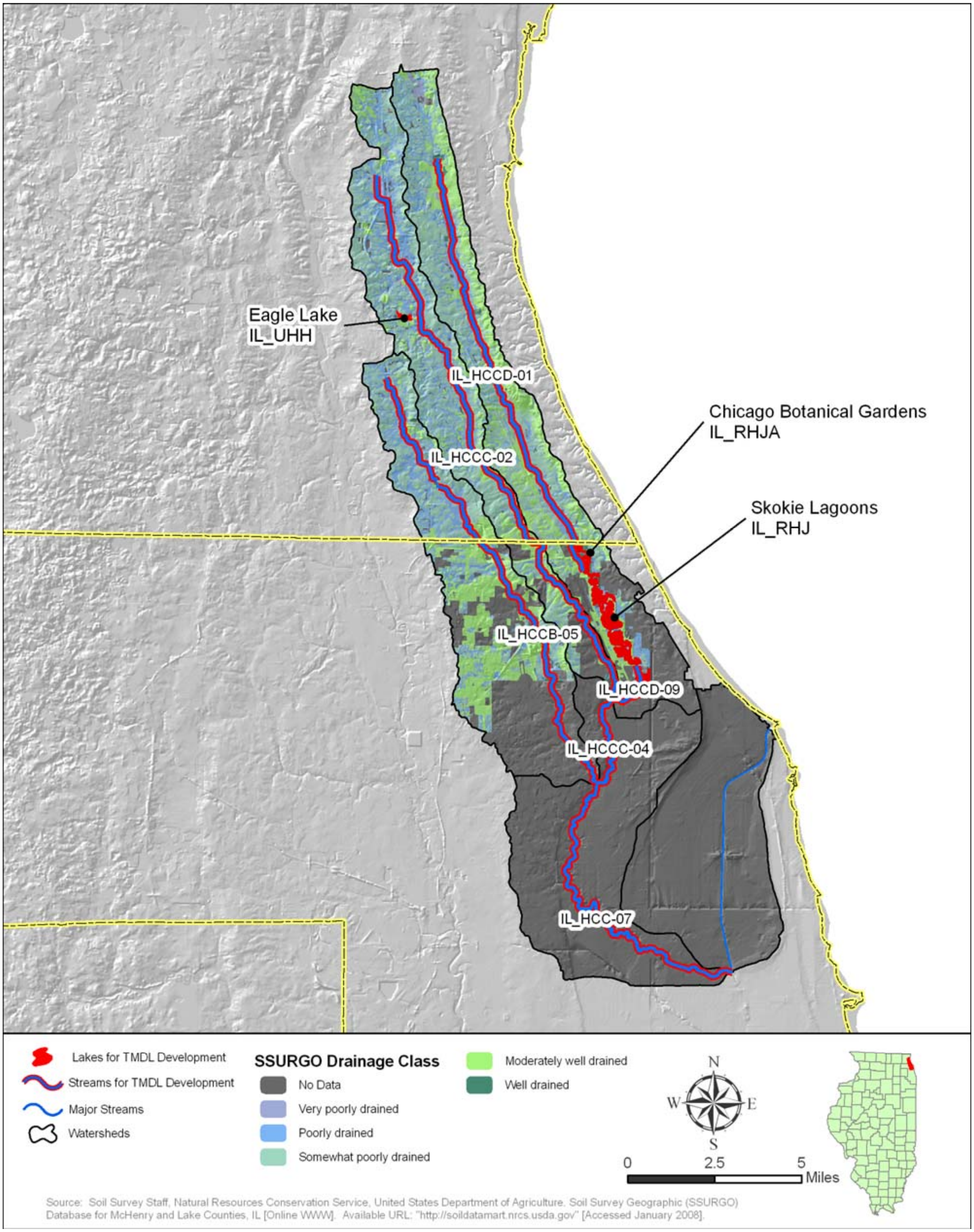


Figure 2-6: North Branch Chicago River Watershed SSURGO Hydrologic Group

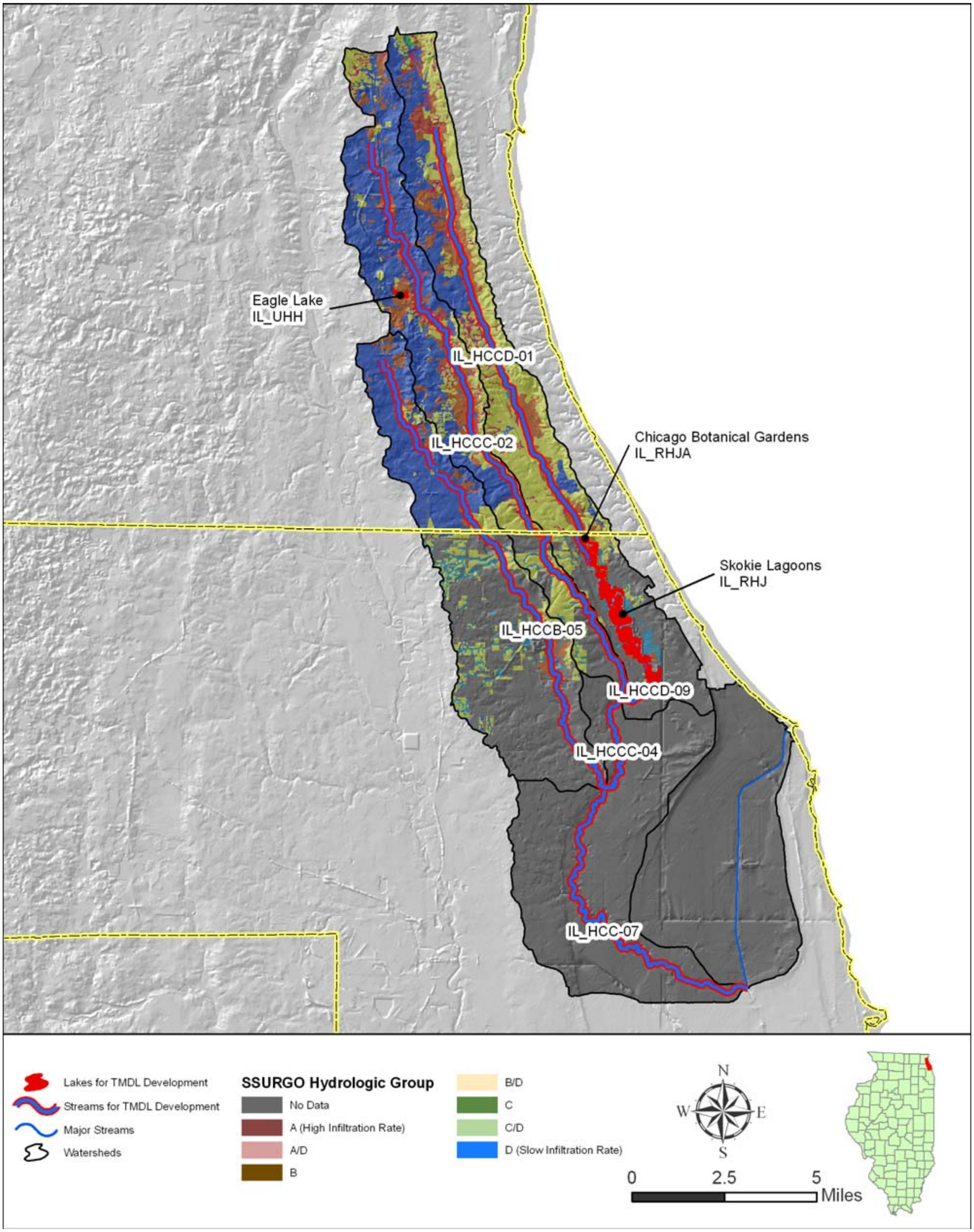
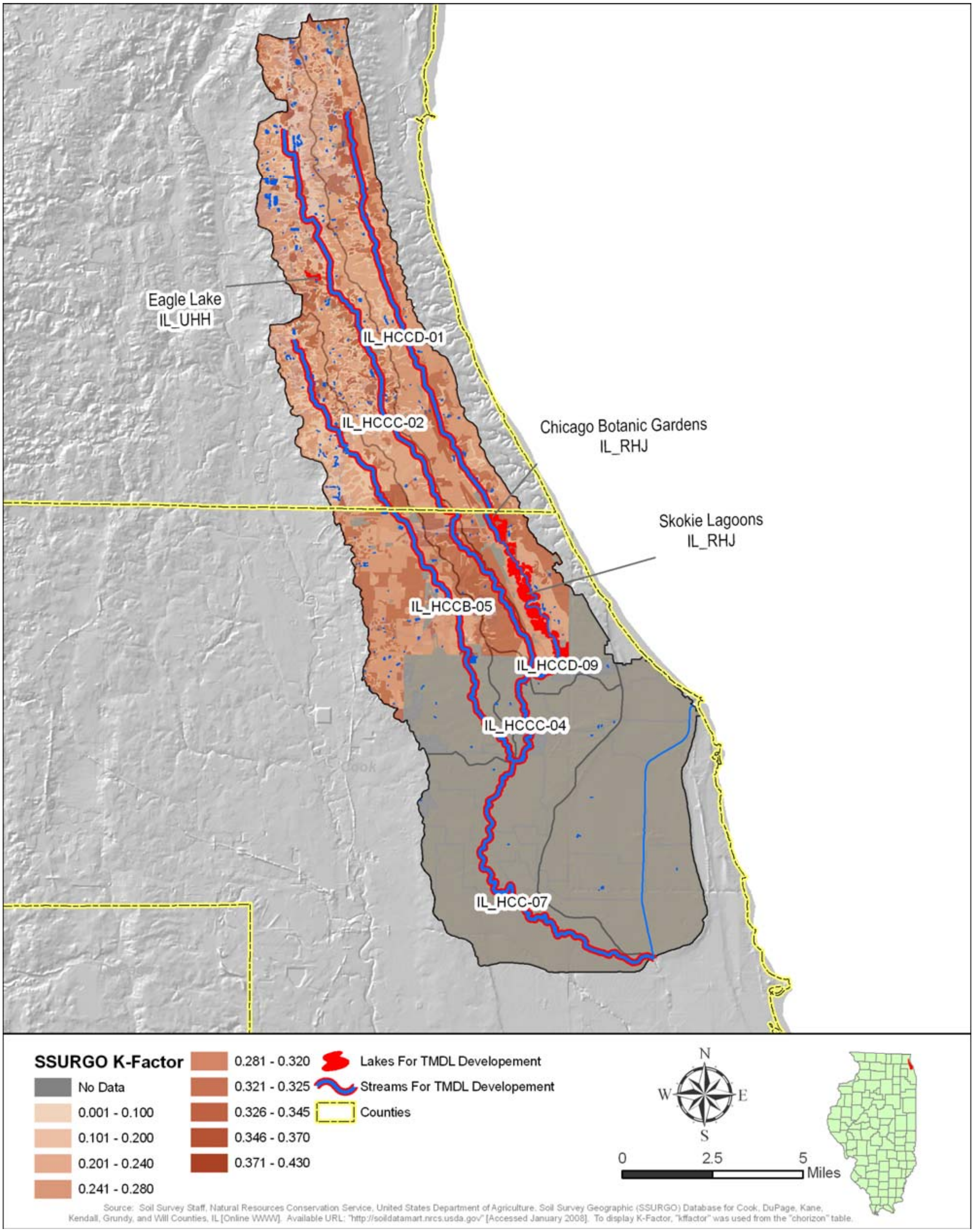


Figure 2-7: North Branch Chicago River Watershed SSURGO K-Factor



2.5 Population

Conditions in the North Branch watershed today are not only a reflection of the geologic and natural processes that have occurred in the watershed, but also reflect human settlement over the past 170 years. As population in the watershed has increased, so have alterations to the land and the hydrologic and hydraulic flows of the watershed's natural drainage system. Census 2000 data in format of TIGER/Line Shape file were downloaded to analyze the population in the North Branch Chicago River Watershed. Census data were also available for groups of census blocks, but the original census block data was used since it is a finer resolution and therefore, more accurate.

According to the Northeastern Illinois Planning Commission (NIPC), in 2000 approximately 1.5 million people resided in the North Branch Chicago Watershed. The best available information on future development trends in Lake and Cook County originates from local comprehensive plans, local zoning maps and demographic forecasts made by NIPC. Projected population changes from 2000 to 2030 are depicted in Figure 2-8. Two sets of forecast numbers were developed based on the following alternative scenarios for airport service in the Chicago region:

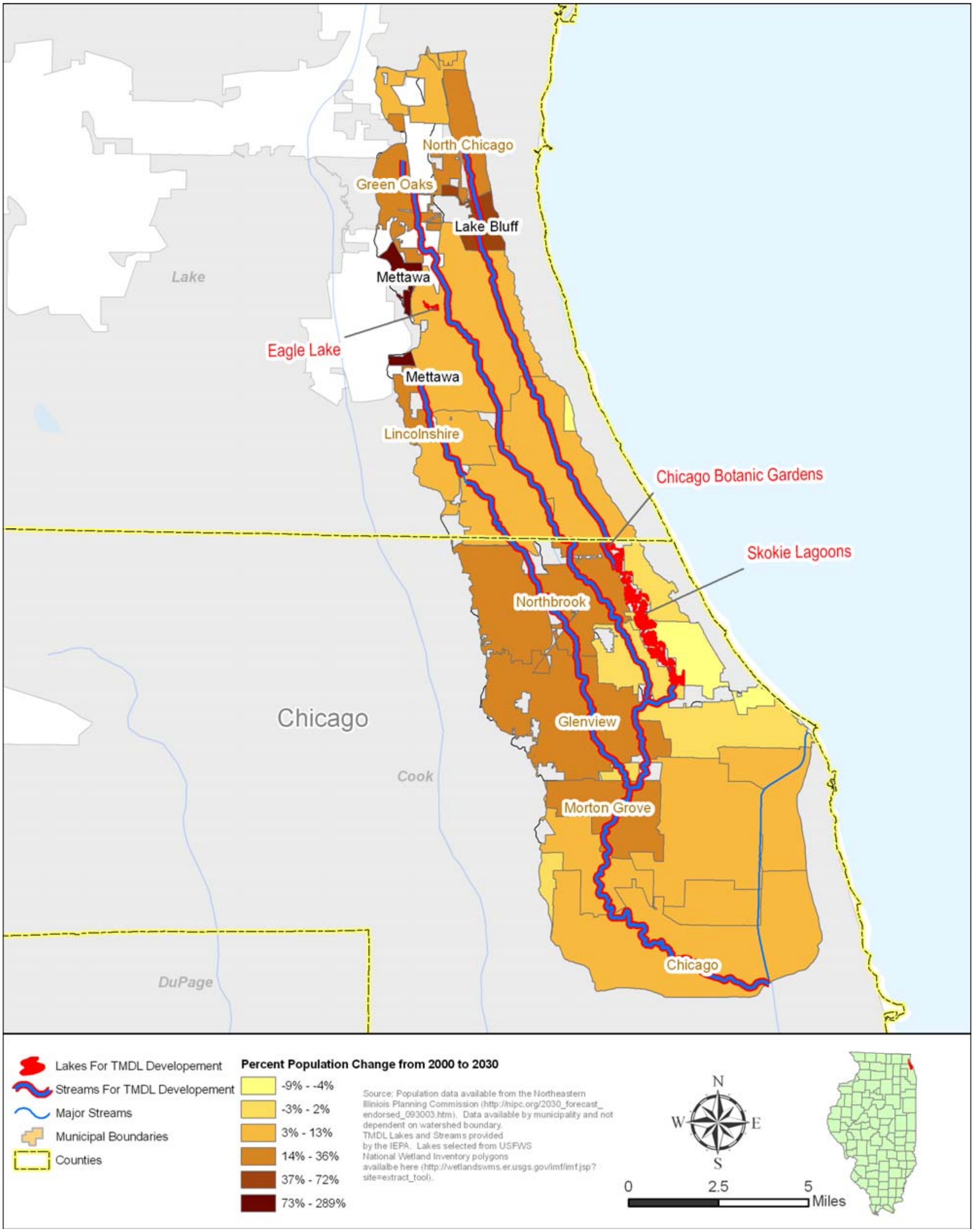
1. Growth in transportation demand will be satisfied through improvements at existing airports;
2. A new south suburban airport will be constructed.

NIPC considered both scenarios when preparing the population projections discussed below.

In the Cook County portion of the North Branch, the 1990 population was estimated to be 135,000. Population density varied within the study area as the greatest densities occurred in the southern portion of the study area and lower densities were found in the northern portions. The average of the two NPIC scenarios projects a 15 percent population increase in municipalities within the Cook County portion of the North Branch watershed. The largest anticipated population increase (30%) is projected to occur in Glenview from 2000 to 2030 due to the redevelopment of the former naval air station (SMC 2007).

Although the North Branch Chicago River Watershed in Lake County is considered a suburban/urban watershed that is fairly well built-out, it is still projected to have significant growth through 2020. Both forecast alternatives prepared by NIPC project significant increases in population for the North Branch watershed in Lake County. A comparison of the two NIPC forecasts shows an eight percent difference in projected increases for population, with Alternative 1 projected to be more conservative. Based on this scenario, the Lake County portion of the North Branch is expected to have a 48 percent increase in population by the year 2020. However, projected increases within the North Branch watershed are less than the 60% increases projected for Lake County as a whole (SMC 2007). The greatest increase is expected to occur in the village of Mettawa at a 289% in the western headwaters.

Figure 2-8: North Branch Chicago River Population Projection



2.6 Climate and Precipitation

The climate in the North Branch of Chicago watershed is predominantly continental. Continental climates range greatly in temperature and exhibit high humidity levels. The proximity to Lake Michigan also influences the climate of the watershed by moderating temperature extremes.

In winter, total snowfall is generally heavy with an average annual snowfall of approximately 37.5 inches, and a minimum of 32 days during which there is at least one inch of snow on the ground. The average winter temperature is 25 degrees Fahrenheit with an average daily minimum of 17 degrees. The average summer temperature in the North Branch watershed is 71 degrees with an average daily maximum of 81 degrees. Average precipitation, more than half of which falls between May and September, is approximately 33 inches. The North Branch watershed is also subject to ‘lake effect’ winds from Lake Michigan which provide a cooling effect during the summer. Relative humidity is approximately 65 percent in the springtime and 72 percent the remainder of the year based on data collected at O’Hare International Airport (SMC 2007).

The climate significantly impacts conditions within the North Branch watershed as it can impact the frequency and timing of precipitation. Because more than half of the rainfall in the North Branch occurs from May to September, flood events in the watershed are more likely to occur during that time. Flood events in the North Branch watershed are also common in late winter through early spring during major snowmelts and/or rain events when the ground is still frozen (SMC 2007).

Warm summer temperatures and occasional long dry spells in the North Branch also impact water quality in the watershed. These conditions lead to shallow water depth, warm water temperatures and low dissolved oxygen in the three forks creating a potentially adverse environment for less tolerant fish and invertebrate species (SMC 2007).

Data used in this assessment originated from the Chicago Botanical Gardens monitoring station which is located longitudinally central within the watershed and dates back to 1981. Based on these data, the mean high summer temperature is 80.6 degrees Fahrenheit and the mean low temperature in winter is 18.7 degrees Fahrenheit. Mean annual high temperatures are approximately 58 degrees Fahrenheit, while mean annual low temperatures are approximately 40 degrees Fahrenheit.

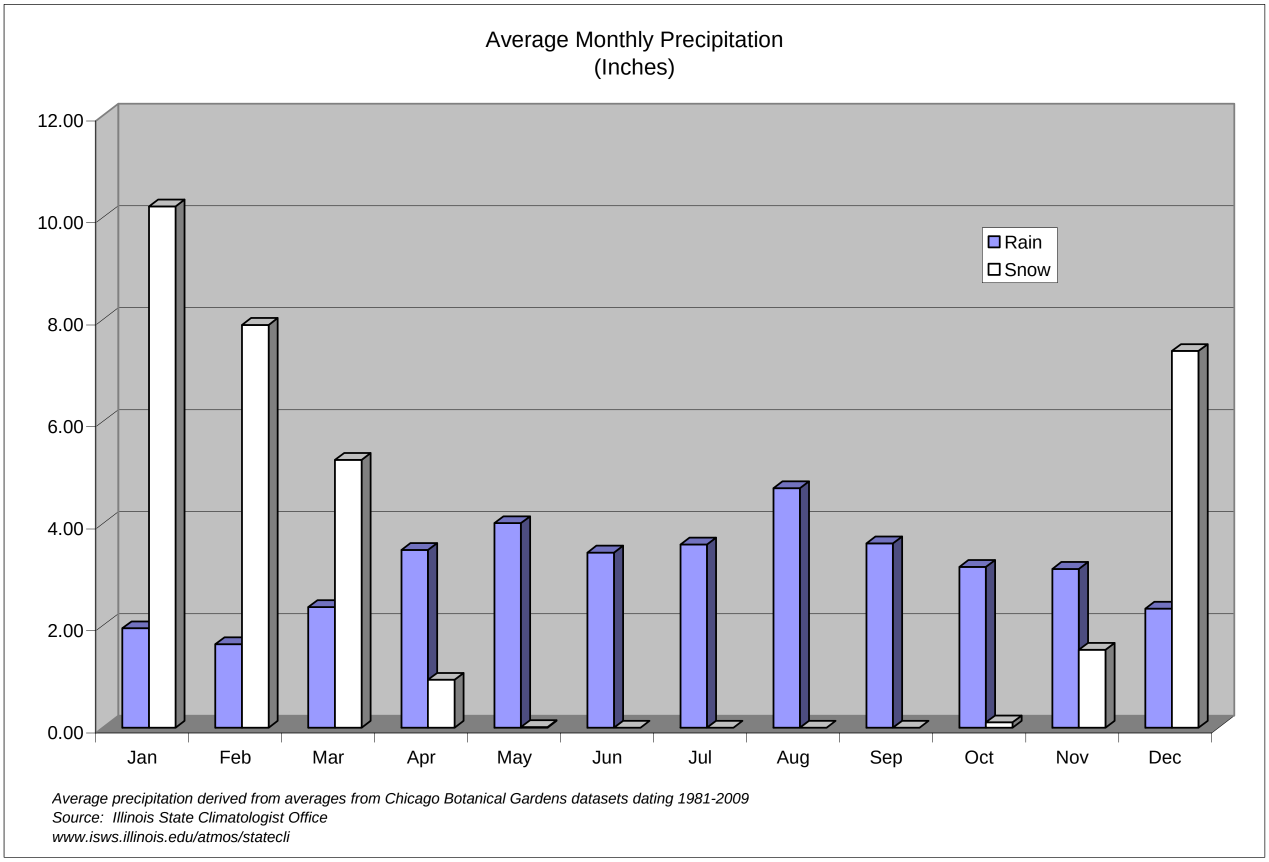
The mean monthly precipitation at the Chicago Botanical Gardens from 1981 to 2009 can be found in Figure 2-9. The Botanical Gardens receive the majority of precipitation during the spring and summer months, with most potential for precipitation occurring in August (4.7 inch average) and the least precipitation occurring in February (1.6 inches). Annual average total precipitation is approximately 37.5 inches.

Table 2-2: Temperature Characterization, Chicago Botanical Gardens, IL (1981-2009)

	High (°F)	Low (°F)	High > 90 (°F)	Low < 32 (°F)	Mean (°F)
January	31.90	16.22	0.00	28.41	24.08
February	35.75	19.17	0.00	25.11	27.49
March	45.10	28.18	0.00	21.56	36.66
April	56.35	37.89	0.04	7.70	47.14
May	67.28	47.19	0.59	0.48	57.27
June	77.73	56.89	3.70	0.00	67.34
July	82.67	63.14	5.89	0.00	72.93
August	81.23	62.29	4.26	0.00	71.79
September	74.48	53.81	1.42	0.15	64.16
October	62.65	42.32	0.00	4.31	52.52
November	48.30	32.57	0.00	14.65	40.46
December	35.85	20.55	0.00	26.79	28.22
Annual	58.34	40.05	14.76	121.38	49.21
Spring	56.24	37.75	0.21	9.91	47.02
Summer	80.55	60.77	4.62	0.00	70.69
Fall	61.81	42.90	0.47	6.37	52.38
Winter	34.50	18.65	0.00	26.77	26.60

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

Figure 2-9: Mean Monthly Precipitation at Chicago Botanical Gardens, IL (1981-2009)



2.7 Hydrology

Understanding how water moves and flows is an important component of understanding a watershed. All of the parameters listed in the previous sections (i.e. topography, soils, and precipitation) impact hydrology. *Hydrology* refers to the way that water behaves from its origins as precipitation, through its movement on or beneath the surface of the earth, to its entry into sewers, streams, lakes, oceans and its eventual return to the atmosphere. More specifically for the North Branch, a hydrological assessment attempts to model how much precipitation falls in the watershed, what volume ends up in the river and the rate that it is discharged at critical locations. *Hydraulics* addresses how water flows over the land surface, within sewers and stream channels, over and under bridges and dams and through culverts, wetlands, lakes and impoundments (detention basins and reservoirs). (SMC 2007)

Prior to extensive land settlement, most of the precipitation was intercepted by vegetation or was stored in the depressional wetlands and floodplains of the watershed. Under natural conditions the river channels had less water to transport, however, they were generally wider and more shallow (more marsh-like) than they are today. In the late 1800s and early 1900s, wetlands and other poorly drained lands in the watershed were tiled to improve drainage for agriculture. The channels of the river were subsequently straightened and ditched in the early 1900s to better collect and transport the increased drainage from the land. Suburbanization of the watershed throughout the 1900s has resulted in improved drainage to the land, and North Branch hydrology continues to change as farmland and open space is converted to residences and businesses. (SMC 2007)

Like many other urban watersheds, large-scale drainage of wetlands, substantial increases in impervious surface, and drain tile and storm sewer drainage improvements in the North Branch have resulted in a watershed with an extremely flashy hydrology and very little stormwater storage capacity. A “flashy” hydrology means that the water level in the river goes up very quickly during a storm and down quickly afterward.

Hydrological data available from the USGS website (www.usgs.gov, 2008) were used. The USGS maintains stream gages throughout the U.S. and they monitor conditions such as gage height and stream flow, and at some locations, precipitation. Two gages chosen within the North Branch Chicago River Watershed maintain stream flow or discharge information: Skokie River near Highland Park, IL (05535070) and North Branch Chicago River at Albany Avenue in Chicago, IL (05536105). The Skokie River gage is located immediately above the Skokie Lagoons in the northeastern portion of the watershed. The North Branch Chicago River gage is located in the south central portion of the watershed at the confluence with the North Shore Channel. Figure 2-10 shows the location of these two USGS gages, and others, throughout the watershed. Complete summaries of watershed USGS stations follow in Tables 2-2 to 2-7.

Figure 2-11 depicts the stream flow measured at Skokie River for the period ranging from 1967 to 2007. This gage has a drainage area of 21.1 square miles. The highest stream flow amounts at Skokie River were measured in April at 37.0 cfs while the lowest amounts were measured in October (14.8 cfs). Overall the highest stream flow for this gage occurs during the late winter and spring months, while low flows occur during the fall. The annual stream flow for the Grass Lake gage is approximately 22.1 cfs.

The North Branch Chicago River gage has been active since 1989 and drains an area of 113 square miles. Over these years the average stream flow of the North Branch Chicago River was 132.8 cfs. Please refer to Figure 2-12 for mean monthly stream flow measured at this gage. Unlike the Skokie River gage, stream flows are highest in the late winter and spring months, with lower flows in the fall. The highest flows occurred in March (186.9 cfs) while September had the lowest flows (88.1 cfs).

Eagle Lake was created in 1906 by dredging and damming a wetland area. It is owned by the Lake Forest Academy and there is no public access. There are three private houses on the lake with access. Surface area is approximately 22 acres which consists of 2 lobes (east and west lobes). The volume is 108.5 acre feet with a maximum depth of 10 feet for the east lobe/7.5 feet for the west and an average depth of 5 feet.

Skokie Lagoons are 7 interconnected lagoons developed for flood control and recreational activities. This area was swampland called “the Skokie Marsh” that was partially drained for farming purposes. The soil then dried to peat after farming was unsuccessful and floods during spring rains. The Cook County Forest Preserve District bought the peat marsh and the impoundments were constructed during 1933- 1942. The Civilian Conservation Corps excavated 4 million cubic yards of soil to create the lagoons. The main control structure for the lagoons is the Willow Road Dam, located at the downstream end near Willow Road. Below this dam, three intermediate low head dams were constructed to maintain water pools.

Chicago Botanical Gardens is a 75 acre lagoon system just north of the Skokie Lagoons. It was part of the Skokie Marsh that has been transformed. It has nine islands surrounded by eight lagoons and lakes and 6.4 miles of shoreline. The Chicago Horticultural Society started work on the botanical gardens around 1965. The garden along with the Forest Preserve District negotiated with the village of Northbrook to tap into a water main running from Lake Michigan to the Northbrook filtration plant on an off-peak basis for irrigation in dry periods and to maintain the lagoons in the garden (Hill 2000). For two years, the gardens were created.

Figure 2-10: North Branch Chicago River Watershed USGS Gaging Stations

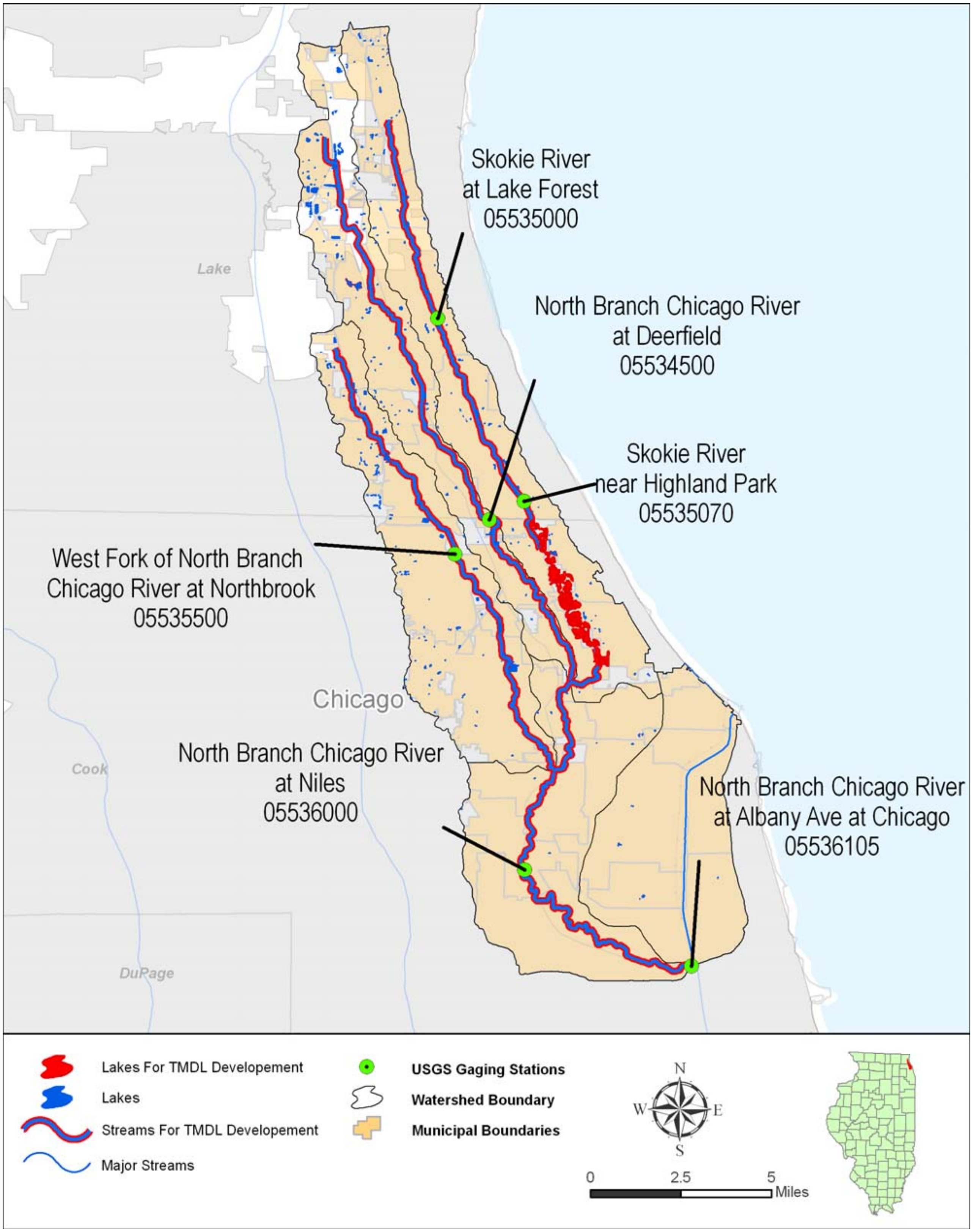


Table 2-3: USGS Daily Flow Data

USGS Gage	Location	Drainage Area (Sq. Miles)	Data Begin Date	Data End Date
05534500	North Branch Chicago River at Deerfield, IL	19.7	8/1/1952	Present
05535000	Skokie River at Lake Forest, IL	13	10/1/1951	Present
05535070	Skokie river Near Highland Park, IL	21.1	8/21/1967	Present
05535500	WF of NB Chicago River at Northbrook, IL	11.5	8/8/1952	Present
05536000	North Branch Chicago River at Niles, IL	100	10/1/1950	Present
05536105	NB Chicago River at Albany Avenue	113	10/1/1989	Present

Figure 2-11: Mean Monthly Flow for Skokie River near Highland Park, IL USGS Station 1967-2007

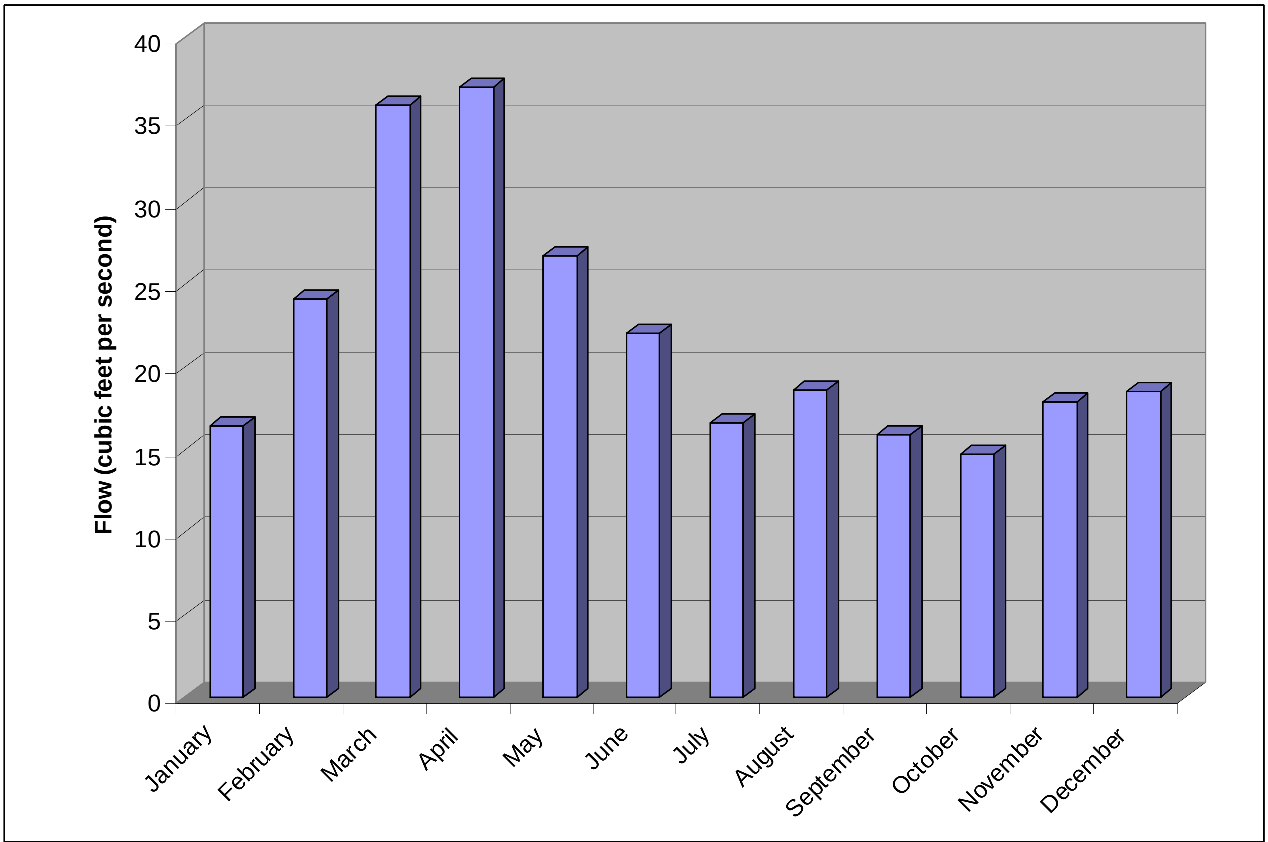
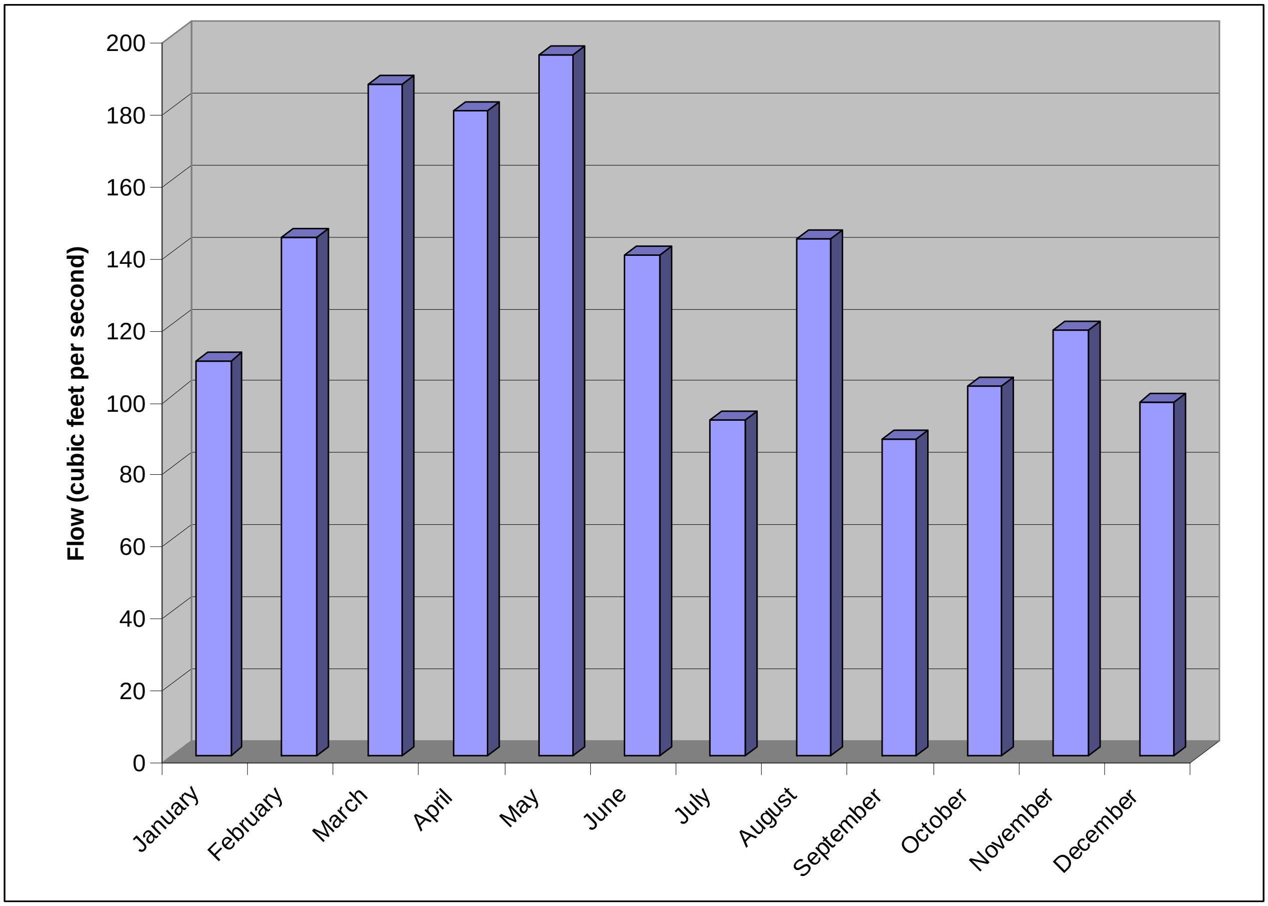


Figure 2-12: Mean Monthly Flow for North Branch Chicago River at Albany Avenue in Chicago, IL USGS Station 1989-2007



2.8 Hydraulic Structures

Hydraulic structures on the North Branch of the Chicago River include seven flood control reservoirs, Lake Eleanor on the West Fork in Lake County and the Skokie Lagoons on the Skokie River in Cook County as indicated on Figure 2-13. The seven existing flood control reservoirs on the Middle and West Forks of the river are:

West Fork

- Structure 27 - Bannockburn Reservoir (Duffy Lane)
- Structure 29A - Deerfield Reservoir
- Structure 32A – Northbrook Reservoir
- Structure 32B – Techny Reservoir
- Structure 32C – Glenview Reservoir

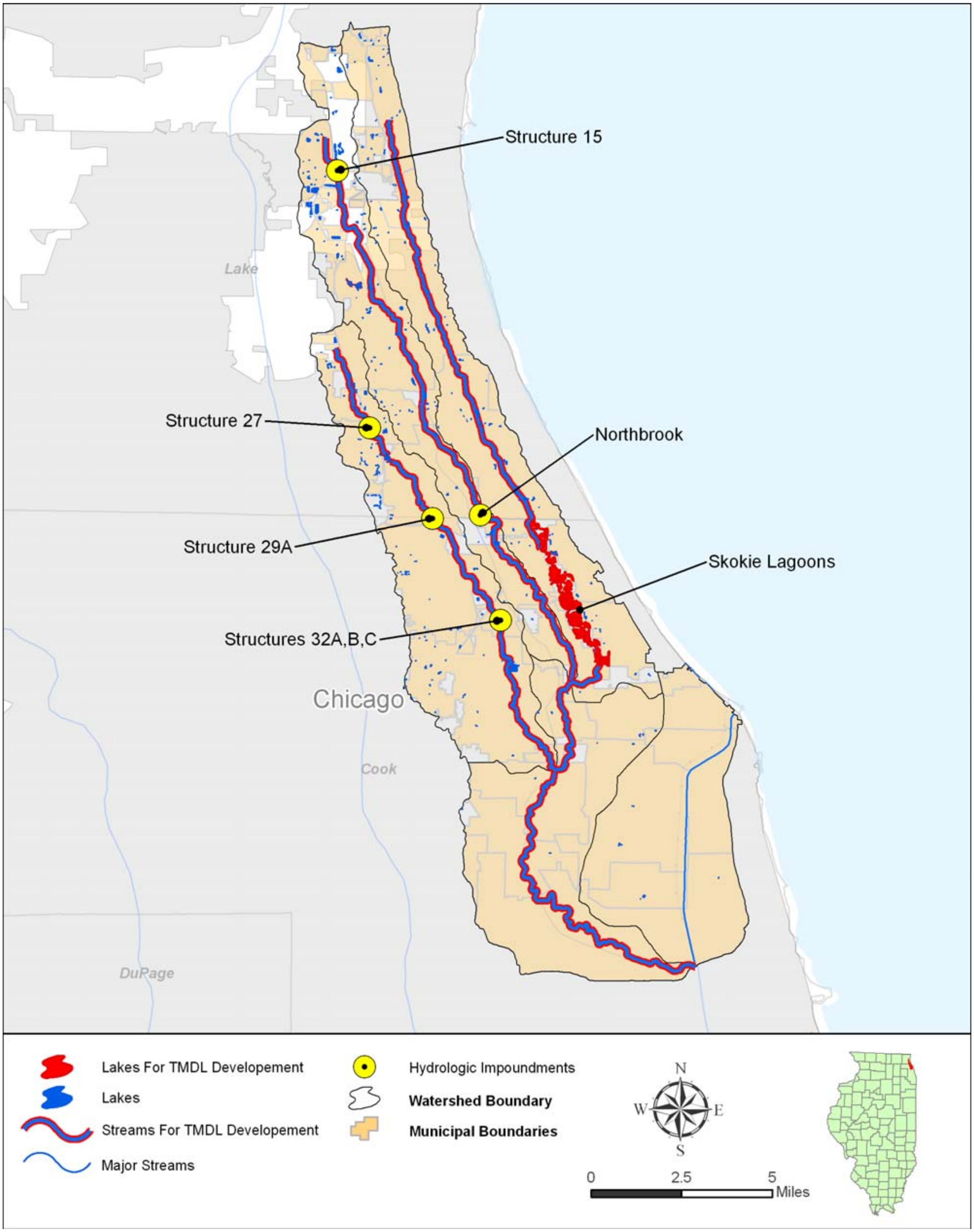
Middle Fork:

- Structure 15 – Atkinson Road Reservoir (Green Oaks)
- Middle Fork of the North Branch Reservoir (Northbrook)

Three of these reservoirs provide flood protection to Lake County. They are designed to store floodwater in excess of a bypass rate until river stages have decreased, and then the stored water is pumped back to the river. While these reservoirs have provided downstream flood protection, all three have caused backwater flooding to varying degrees. A recent US Army Corps of Engineers (USACE) study found that design modifications for Reservoirs 27 and 29A would remedy this problem. A brief description of each of the Lake County reservoirs follows:

- Structure 15 is a 500-acre-foot reservoir constructed on the Middle Fork at Atkinson Road on the eastside of the Tri-State Toll way (I-94). This structure provides downstream flood relief to unincorporated Lake County, Lake Forest and Cook County. According to the engineer for the Village of Green Oaks (located west of Toll way), some residential flooding persists upstream of the reservoir along a tributary. This area requires further assessment for flood mitigation opportunities, one of which could include improved drainage system maintenance. The assessment should include as-built conditions to determine potential structural improvements to reduce backwater flooding from the reservoir.
- Structure 27 is a 525-acre-foot reservoir constructed on the West Fork just east of I-94 and south of Duffy Lane. This structure provides downstream flood relief to Lincolnshire, Bannockburn and Deerfield, but has created backwater flood damage in Riverwoods. Lowering of the emergency spillway is the modification proposed to remedy backwater flood damage.
- Structure 29A is a 575-acre-foot reservoir constructed on the West Fork at Lake–Cook Road. This structure provides flood relief to Deerfield, Northbrook and Glenview, but has also created backwater flood damage in Deerfield. Modifications to this reservoir include opening up the second by-pass culvert to increase stream flow, and lowering the inlet and emergency overflow spillways (SMC 2007).

Figure 2-13: North Branch Chicago River Hydrologic Structures



3.0 Public Participation and Involvement

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

Illinois EPA, along with ENSR/AECOM, will hold up to four public meetings within the North Branch Chicago River Watershed throughout the course of TMDL development. This section will be updated after public meetings have occurred.

General information regarding the process of TMDL development in Illinois can be found at http://www.epa.state.il.us/water/tmdl. This link also contains paths to public meetings and other TMDL related watershed information for the entire state of Illinois.

Background learning about watersheds, watershed management, best management practices and the Clean Water Act (CWA) can be found on the EPA's water website at http://www.epa.gov/watertrain/.

4.0 Water Quality Standard and TMDL Targets

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

4.1 Illinois Pollution Control Program

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

Illinois EPA is also responsible for developing scientifically based water quality criteria and proposing them to the IPCB for adoption into state rules and regulations. These responsibilities were subsequently assumed by the Illinois Department of Energy and Natural Resources who, in July 1995, became part of the Illinois Department of Natural Resources. The Illinois WQS are established in the Illinois Administrative Rules Title 35, Environmental Protection; Subtitle C, Water Pollution; Chapter I, Pollution Control Board; Part 302, Water Quality Standards.

Water resource management activities involving interstate waters are also coordinated with various interstate committees and commissions. The Illinois EPA participates in water-resource management activities of the Association of State and Interstate Water Pollution Control Administrators, International Joint Commission of the Great Lakes Water Quality Board, Ohio River Valley Water Sanitation Commission, Upper Mississippi River Conservation Committee, Upper Mississippi River Basin Association, Council of Great Lakes Governors, and other interstate committees and commissions.

4.2 Designated Uses

The waters of Illinois are classified by designated uses assessed in 2008 as shown in Table 4-1. Designated uses applicable to the North Branch Chicago River Watershed include: aesthetic quality, aquatic life, primary contact, and fish consumption. The corresponding water quality standard classification for these designated uses is the General Use Standard.

Table 4-1: Illinois Designated Uses and Applicable Water Quality Standards

Illinois EPA Designated Uses	Illinois Waters where Designated Use and Standards Apply	Applicable Illinois Water Quality Standards
Aquatic Life	Streams, Inland Lakes	General Use Standards
	Lake Michigan Basin waters	Lake Michigan Basin Standards
Aesthetic Quality	Inland Lakes	General Use Standards
	Lake Michigan Basin Waters	Lake Michigan Basin Standards
Indigenous Aquatic Life	Specific Chicago area Waters	Secondary Contact and Indigenous Aquatic Life Standards

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

The General Use classification is defined by IPCB as: The General Use standards will protect the state's water for aquatic life, wildlife, agricultural use, secondary contact use and most industrial uses and ensure the aesthetic quality of the state's aquatic environment. Primary contact uses are protected for all General Use waters whose physical configuration permits such use.

4.3 Applicable Illinois Water Quality Standards

To make 303(d) listing determinations for aquatic life uses, Illinois EPA first collects biological data and if these data suggest that impairment to aquatic life exists, then a comparison of available water quality data with WQS occurs. Tables 4-2 and 4-3 summarize the potential impairments and standards that apply to streams and lakes within the North Branch Chicago River Watershed.

Table 4-2: Summary of Water Quality Standards for Potential Impairments of Stream Segments in the North Branch Chicago River Watershed

Parameter	Units	General Use Water Quality Standard
Chloride	mg/L	500
Dissolved Oxygen	mg/L	**For most waters[1]:** March-July > 5.0 min. & > 6.0- 7-day mean[1] Aug-Feb > 3.5 min, > 4.0- 7-day mean[1], & > 5.5- 30-day mean[1]. **For waters with enhanced protection[1]:** March-July > 5.0 min & > 6.25- 7-day mean[1] Aug-Feb > 4.0 min, > 4.5- 7-day mean[1], & > 6.0- 30-day mean[1].
Fecal Coliform	count/100 mL	May – October 200[2], 400[3]
Manganese	mg/L	1.0
pH	none	within the range of 6.5 – 9.0 except for natural causes
Phosphorus – Total[5]	mg/L	0.05
Temperature	Deg Celsius	December – March 16[4] April – November 32[4]

1. Applies to the dissolved oxygen concentration in the main body of all streams, in the water above the thermocline of thermally stratified lakes and reservoirs, and in the entire water column of unstratified lakes and reservoirs. Additional dissolved oxygen criteria are found in 35 Ill Adm. Code 302.206, including the list of waters with enhanced dissolved oxygen protection and methods for assessing attainment of dissolved oxygen minimum and mean values.
2. Geometric mean based on a minimum of 5 samples taken over not more than a 30 day period.
3. Standard shall not be exceeded by more than 10% of the samples collected during any 30 day period.
4. Standard shall not be exceeded by more than 1% of the hours in the 12-month period ending with any month. Moreover, at no time shall the standard be exceeded by more than 1.7 Deg C.
5. Standard applies in particular inland lakes and reservoirs (greater than 20 acres) and in any stream at the point where it enters any such lake or reservoir.

Due to limited state resources, fecal coliform bacteria is not normally sampled at a frequency necessary to apply the General Use standard, i.e., at least five times per month during May through October, and very little data available from others are collected at the required frequency. Therefore, assessment guidelines are based on application of the standard when sufficient data is available to determine standard exceedances; but, in most cases, attainment of *primary contact* use is based on a broader methodology intended to assess the likelihood that the General Use standard is being attained. To assess *primary contact* use, Illinois EPA uses all fecal coliform bacteria from water samples collected in May through October, over the most recent five-year period (i.e., 2002 through 2006). Based on these water samples, geometric means and individual measurements of fecal coliform bacteria are compared to the concentration thresholds in Table C-16. To apply the guidelines, the geometric mean of fecal coliform bacteria concentration is calculated from the entire set of May through October water samples, across the five years. No more than 10% of all the samples may exceed 400/100 ml for a water body to be considered Fully Supporting.

Table C-16. Guidelines for Assessing *Primary Contact* Use in Illinois Streams and Inland Lakes.

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

4.4 TMDL Targets

In order for a water body to be listed as Full Support, it must meet all of its applicable designated uses. Because WQS are designed to protect those designated uses a pollutant's numeric WQS is therefore used as the endpoint for establishing a TMDL. Table 4-2 summarizes the endpoints that will be used in the TMDL development for the North Branch Chicago River Watershed.

Table 4-3: TMDL Targets for Impaired Waterbodies in the North Branch Chicago River Watershed

Segment ID	Waterbody Name	Impairment	TMDL Target	Units
IL_HCC-07	N. Br. Chicago R.	Chloride	<500	mg/L
		Fecal Coliform	<200	cfu/100 ml
		Dissolved Oxygen	*	mg/L
		pH	6.5-9	s.u.
IL_HCCB-05	W. Fk. N. Br. Chicago R.	Chloride	<500	mg/L
		Fecal Coliform	<200	cfu/100 ml
		Dissolved Oxygen	*	mg/L
IL_HCCC-02	Mid. Fk. N. Br. Chicago r.	Chloride	<500	mg/L
		Fecal Coliform	<200	cfu/100 ml
		Dissolved Oxygen	*	mg/L
		Manganese	<1.0	mg/L
IL_HCCC-04	Mid. Fk. N. Br. Chicago R.	Chloride	<500	mg/L
		Fecal Coliform	<200	cfu/100 ml
		Dissolved Oxygen	*	mg/L
		pH	6.5-9	s.u.
		Temperature	Dec – Mar <17.7 Apr – Nov <33.7	Deg C
IL_HCCD-01	Skokie R.	Fecal Coliform	<200	cfu/100 ml
		Dissolved Oxygen	*	mg/L
		pH	6.5-9	s.u.
IL_HCCD-09	Skokie R.	Fecal Coliform	<200	cfu/100 ml
		pH	6.5-9	s.u.
IL_RHJ	Skokie Lagoons	Total Phosphorus	<0.05	mg/L
IL_RHJA	Chicago Botanical Gardens	Total Phosphorus	<0.05	mg/L
IL_UHH	Eagle Lake	Total Phosphorus	<0.05	mg/L

*Please refer to Table 4-2 for the dissolved oxygen standard

5.0 Water Quality Assessment

This section discusses the pollutants of concern for the North Branch Chicago River Watershed. The available water quality data were analyzed, assessed, and compared with WQS to verify the impairments of the 6 stream segments and 3 lakes. The water quality conditions in the watershed were evaluated by sampling location and time variation. Available point and non-point source data were also assessed and discussed in more detail in the remainder of the section

5.1 Water Quality Data

The North Branch Chicago River Watershed has 9 impaired waters within its drainage area. Figure 5-1 shows the water quality data stations within the watershed that contain data relevant to the impaired segments. The following sections address both stream and lake impairments.

Data analysis was focused on all available data collected since the year 2000. The information presented in this section is a combination of both legacy and modernized USEPA Storage and Retrieval (STORET) database and data from the Illinois EPA database, Metropolitan Water Reclamation District of Greater Chicago (MWRDGC), and Lake County. Table 5-1 contains the monitoring entities for each water segment.

Data relevant to impairments were compiled for each impaired waterbody and summarized. The following parameters were grouped by impairment and discussed in relation to the relevant Illinois numeric WQS. For all assessments, compliance was determined at the surface of a stream or at the one-foot depth from the lake surface.

Table 5-1: Monitoring Station Information

Segment	Parameter	Entity
HCC-07	Chloride	IEPA, MWRDGC
HCC-07	DO	IEPA, MWRDGC
HCC-07	Fecal	IEPA, MWRDGC
HCC-07	pH	IEPA, MWRDGC
HCCCB-05	Chloride	IEPA, MWRDGC
HCCCB-05	DO	IEPA, MWRDGC
HCCCB-05	Fecal	IEPA, MWRDGC
HCCC-02	Chloride, Mn	IEPA, MWRDGC
HCCC-02	DO	IEPA, MWRDGC
HCCC-02	Fecal	IEPA, MWRDGC
HCCC-04	Chloride	IEPA, MWRDGC
HCCC-04	DO	IEPA, MWRDGC
HCCC-04	Fecal	IEPA, MWRDGC
HCCC-04	pH	IEPA, MWRDGC
HCCC-04	Temperature	IEPA, MWRDGC

Segment	Parameter	Entity
HCCD-01	DO	IEPA, MWRDGC
HCCD-01	Fecal	IEPA, MWRDGC
HCCD-01	pH	IEPA, MWRDGC
HCCD-09	Fecal	IEPA, MWRDGC
HCCD-09	pH	IEPA, MWRDGC
RHJ	Phosphorus	IEPA
RHJA	Phosphorus	IEPA
UHH	Phosphorus	Lake County

Figure 5-1: Monitoring Stations Used for Assessing Impairments

5.1.1 Fecal Coliform

Data summarized in Table 5-2 is the most recent data, ranging from 1999 to 2007. The distribution of fecal coliform for each impaired segment in the North Branch Chicago River Watershed, including all historic data, is presented in Figures 5-2 to 5-4. The WQS for fecal coliform is a 200 cfu/100ml geometric mean based on a minimum of five samples taken over any 30 day period or a 400 cfu/100ml maximum not to be exceeded in more than 10% of samples taken during any 30 day period. Considering that the frequency of available data does not meet five samples in a 30 day period, the 200 cfu/100ml geometric mean will by used as the target as it is a more conservative value.

Table 5-2: Recent Fecal Coliform Data Summary

Segment	Stations	Data Years	No. of Samples	Violations >200	Violations >400	Min	Max	Average
NB Chicago R HCC-07	HCC-07 WW_34, 96	1999-2007	196	186	166	88	100000	3536
WF NB Chicago R HCCB-05	WW_106	2001-2007	49	47	41	140	21000	2476
MF NB Chicago R HCCC-02	HCC-02 WW_31	1999-2007	115	107	92	90	728000	9154
MF NB Chicago R HCCC-04	WW_103, 104	2001-2007	131	119	100	60	54000	2219
Skokie R HCCD-01	HCCD-01 WW_32	2001-2007	67	58	49	40	26000	2317
Skokie R HCCD-09	WW_105	2001-2007	74	36	20	9	21000	653

Figure 5-2: Fecal Coliform Distribution 1970 to 2007

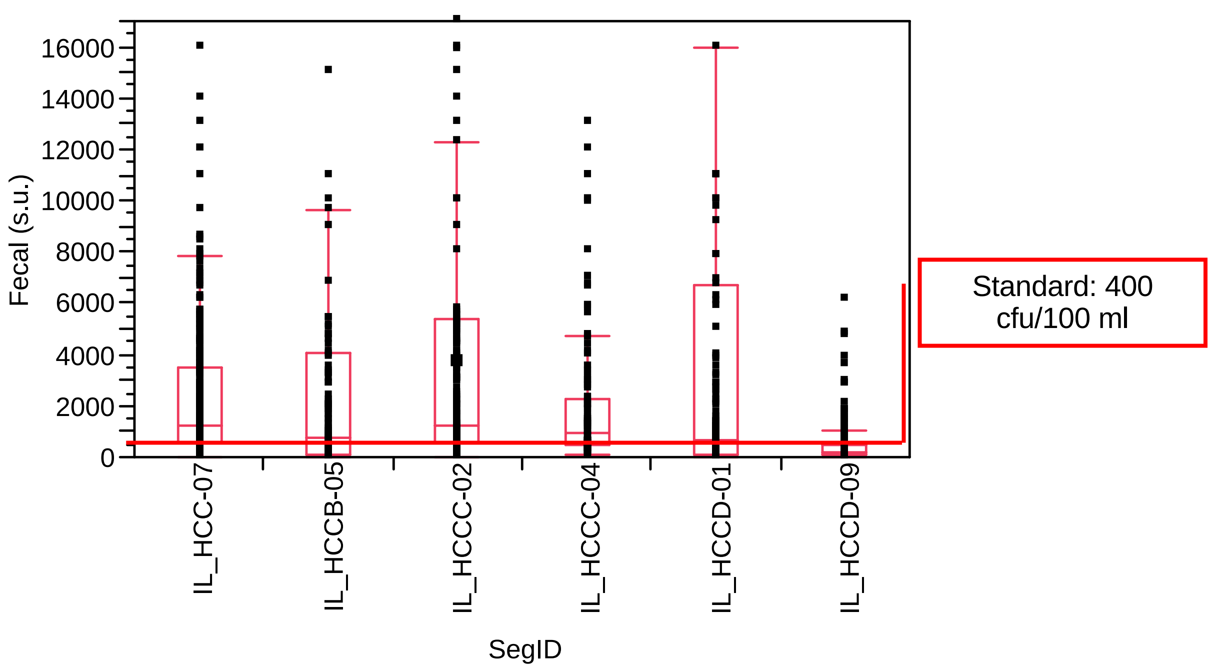


Figure 5-3: Fecal Coliform Time Series for HCCB-05, HCCC-02 and HCCD-01

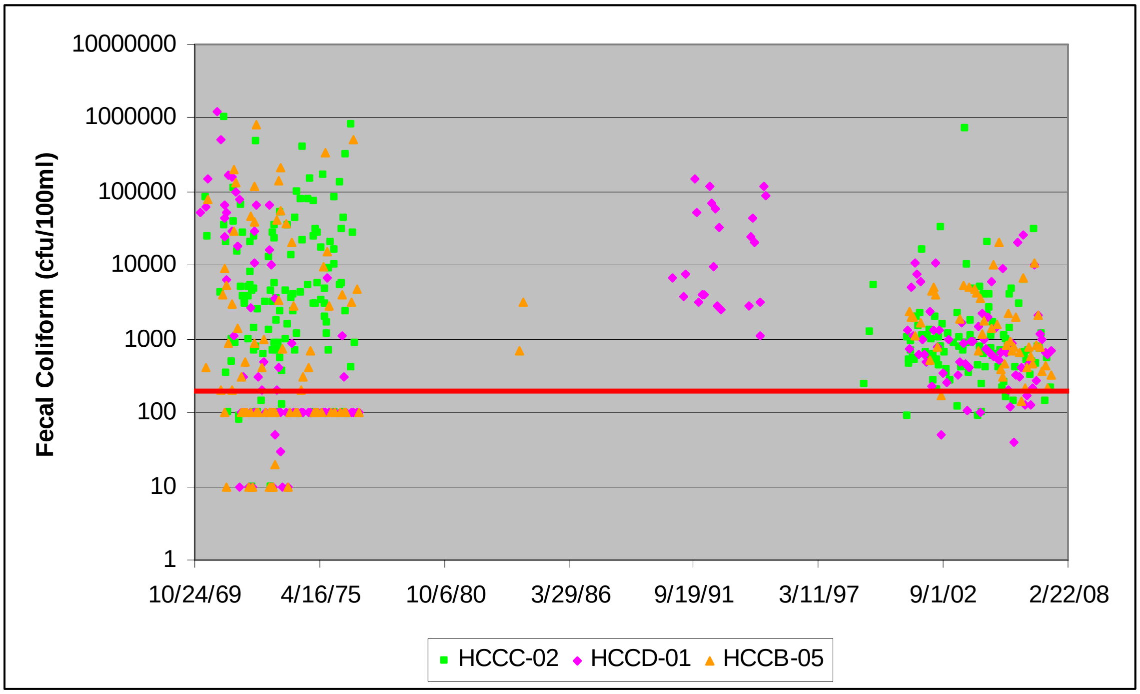
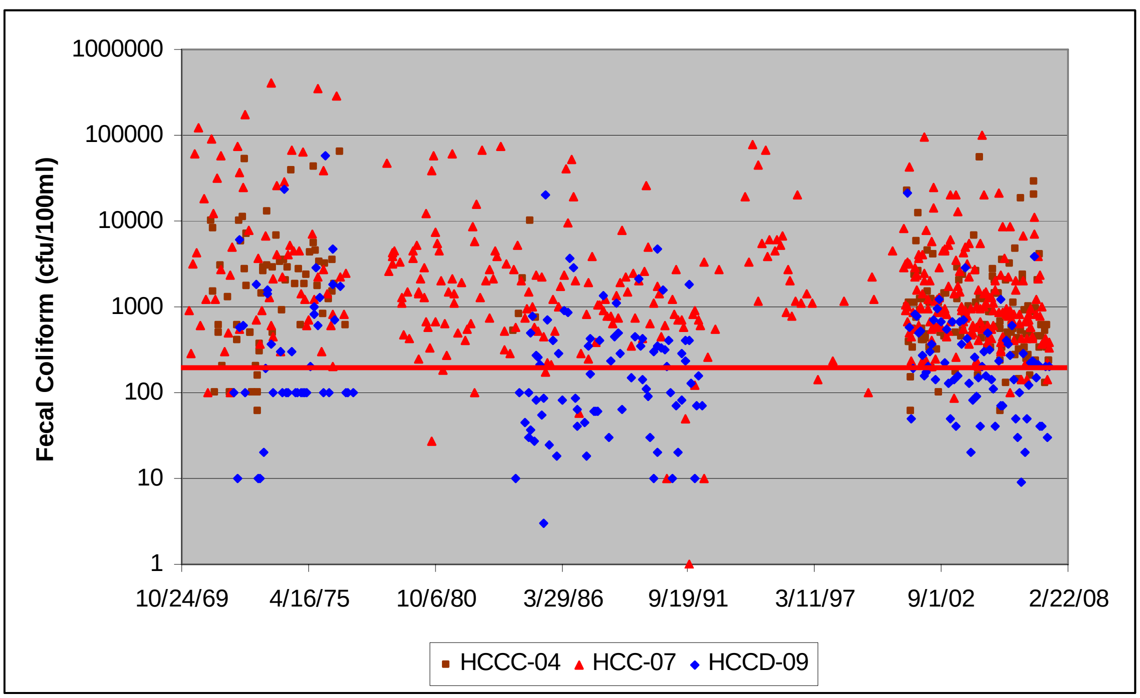


Figure 5-4: Fecal Coliform Time Series for HCC-07, HCCC-04, and HCCD-09



5.1.2 Dissolved Oxygen

The WQS for DO is a 5.0 mg/L instantaneous minimum for March through July and 3.5 mg/L for August through February. Five waterbody segments were determined to be impaired for low DO based on this criterion. Table 5-3 summarizes recent DO data since 1999. Data used for assessments and Figures 5-5 to 5-7 ranged from 1964 to 2007. DO concentration time series for impaired segments HCCB-05, HCCC-02 and HCCD-01 in the North Branch Chicago River Watershed are presented in Figure 5-6. Segments HCC-07 and HCCC-04 are shown in Figure 5-7.

Table 5-3: Recent Dissolved Oxygen Data Summary

Segment	Stations	Data Years	No. of Samples	Violations	Min	Max	Average
NB Chicago R HCC-07	HCC-07 WW_34, 96	2001-2007	173	6	1.0	14.9	8.1
WF NB Chicago R HCCB-05	HCCB-05 WW_106	2001-2007	33	1	1.4	13.0	8.6
MF NB Chicago R HCCC-02	HCC-02 WW_31	1999-2007	113	34	0.0	14.4	6.6
MF NB Chicago R HCCC-04	HCCC-04 WW_103, 104	2001-2007	130	8	3.6	13.0	7.8
Skokie R HCCD-01	HCCD-01 WW_32	2001-2007	67	8	2.2	14.0	7.6

Figure 5-5: Dissolved Oxygen Distribution 1964 to 2007

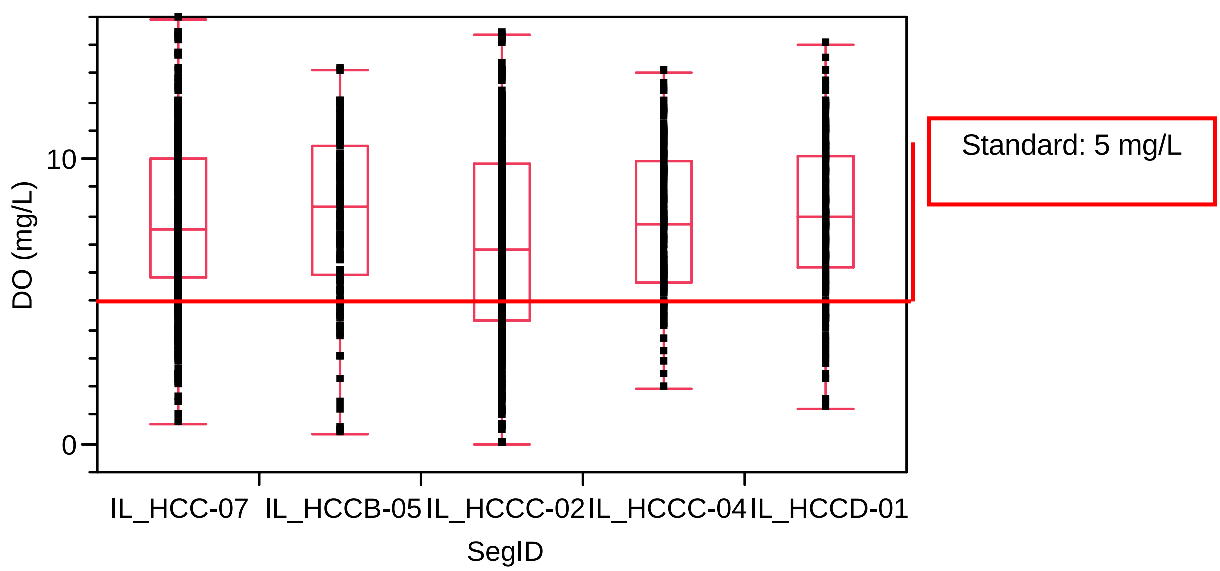


Figure 5-6: Dissolved Oxygen Time Series for HCCB-05, HCCC-02, and HCCD-01

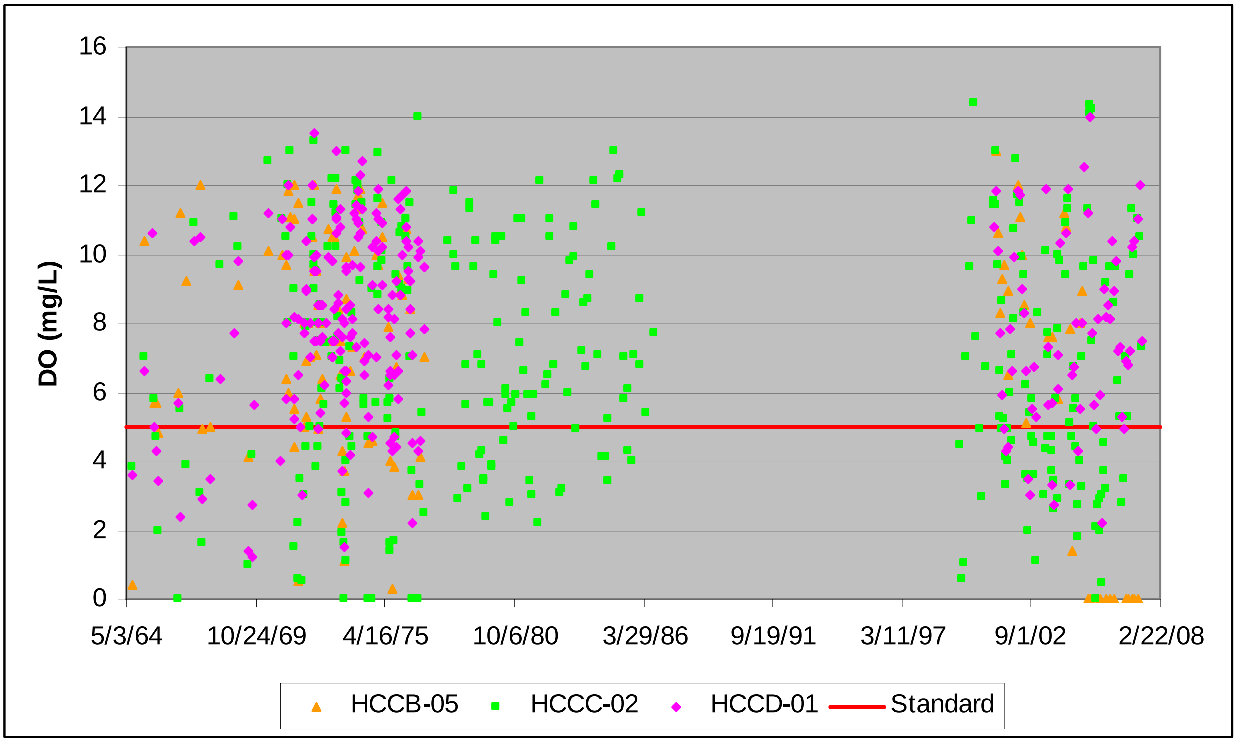
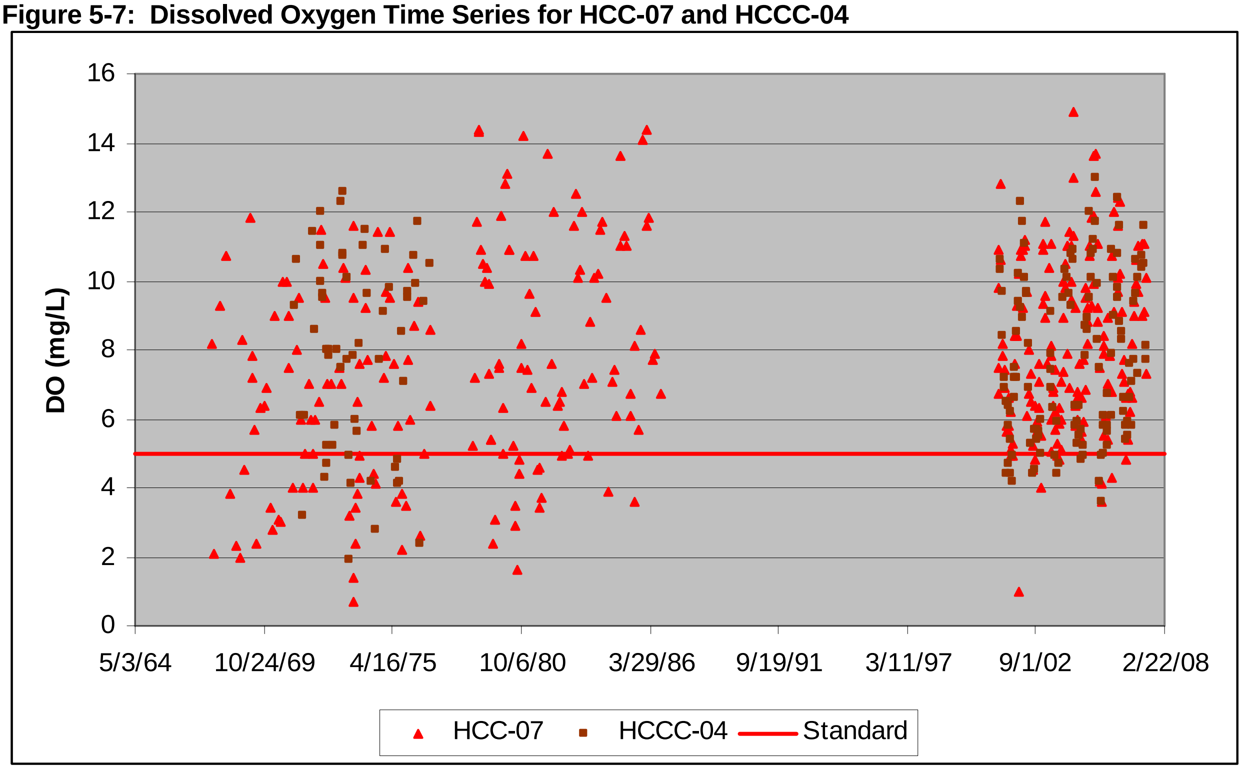


Figure 5-7: Dissolved Oxygen Time Series for HCC-07 and HCCC-04



5.1.3 pH

The WQS dictates an acceptable pH range between 6.5 and 9 s.u. Four segments were identified to have this impairment within the North Branch Chicago River Watershed. Table 5-4 contains recent summary information since 1999 for pH. Historic data are presented in Figures 5-8 and 5-9, ranging from 1964 to 2007. Available data indicates that all segments have at least one violation, except HCCC-04.

Table 5-4: Recent pH Data Summary

Segment	Stations	Data Years	No. of Samples	Violations	Min	Max	Average
NB Chicago R HCC-07	HCC-07 WW_34, 96	1999-2007	197	4	6.2	8.6	7.6
MF NB Chicago R HCCC-04	HCCC-04 WW_103, 104	2001-2007	126	2	6.4	8.8	7.6
Skokie R HCCD-01	HCCD-01 WW_32	2001-2007	61	2	6.1	8.5	7.5
Skokie R HCCD-09	HCCD-09 WW_105	2001-2007	74	2	6.3	8.7	7.6

Figure 5-8: pH Distribution 1964 to 2007

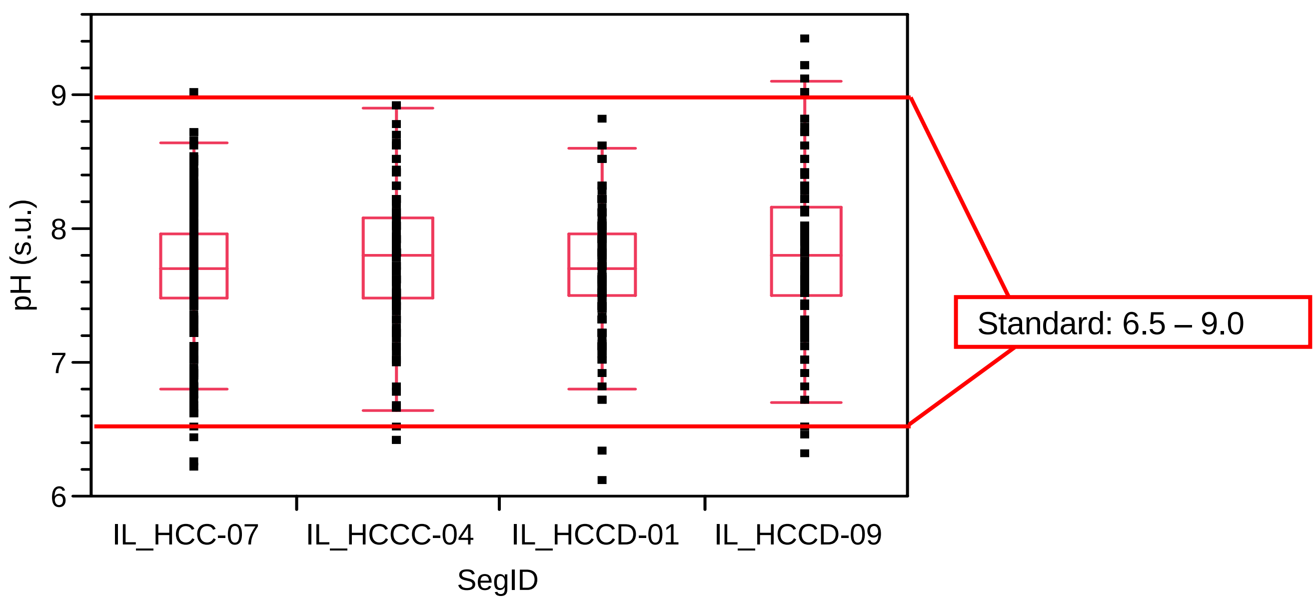
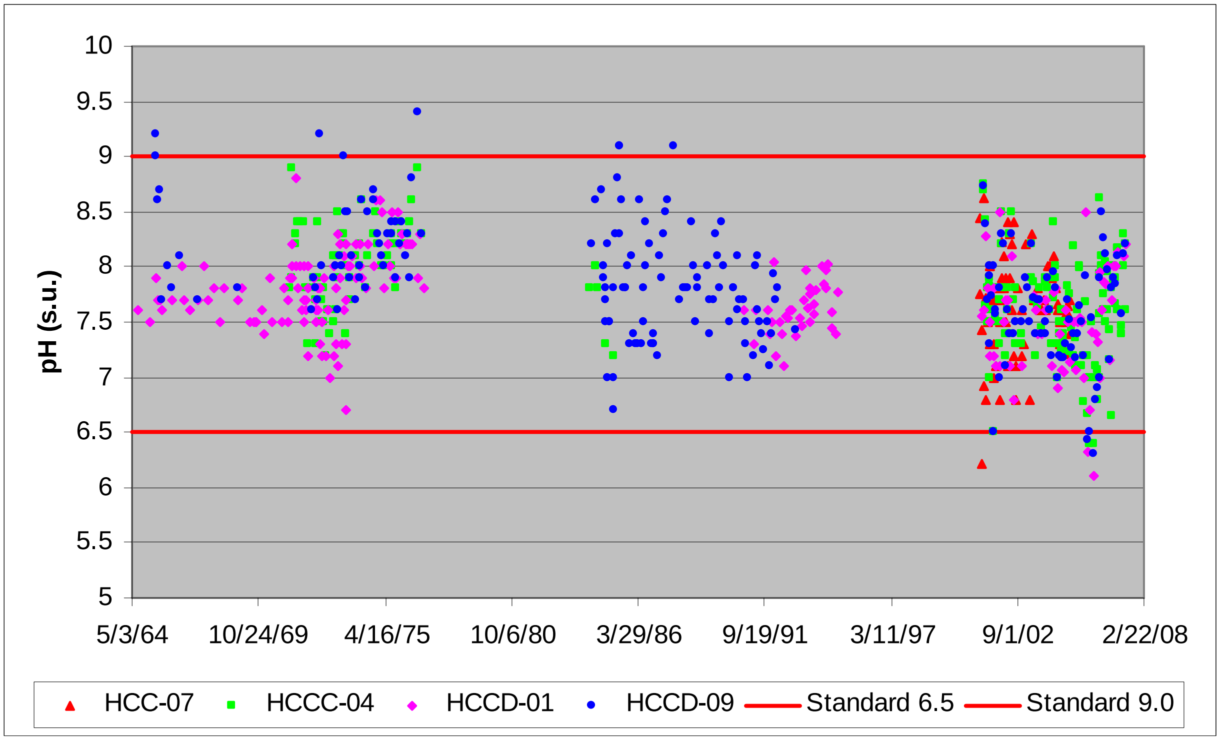


Figure 5-9: pH Time Series for HCC-07, HCCC-04, HCCD-01, and HCCD-09



5.1.4 Chloride

The general use WQS for chloride is 500 mg/L and four stream segments indicated exceedances within the North Branch Chicago River Watershed, resulting in chloride impairment listing. Table 5-5 summarizes recent data from 1999 to 2005. Available data used for assessment ranged from 1964 to 2007. Figures 5-10 and 5-11 present the available chloride data distribution and time series throughout the impaired segments.

Table 5-5: Recent Chloride Data Summary

Segment	Stations	Data Years	No. of Samples	Violations	Min	Max	Average
NB Chicago R HCC-07	HCC-07 WW_34, 96	1999-2007	187	58	1.0	1272.0	227.0
WF NB Chicago R HCCB-05	HCCB-05 WW_106	2001-2007	34	8	89.0	1563.0	381.1
MF NB Chicago R HCCC-02	HCCC-02 WW_31	1999-2007	104	2	56.8	707	228.1
MF NB Chicago R HCCC-04	HCCC-04 WW_103, 104	2001-2007	129	14	31.6	1346.3	271.6

Figure 5-10: Chloride Distribution 1964 to 2007

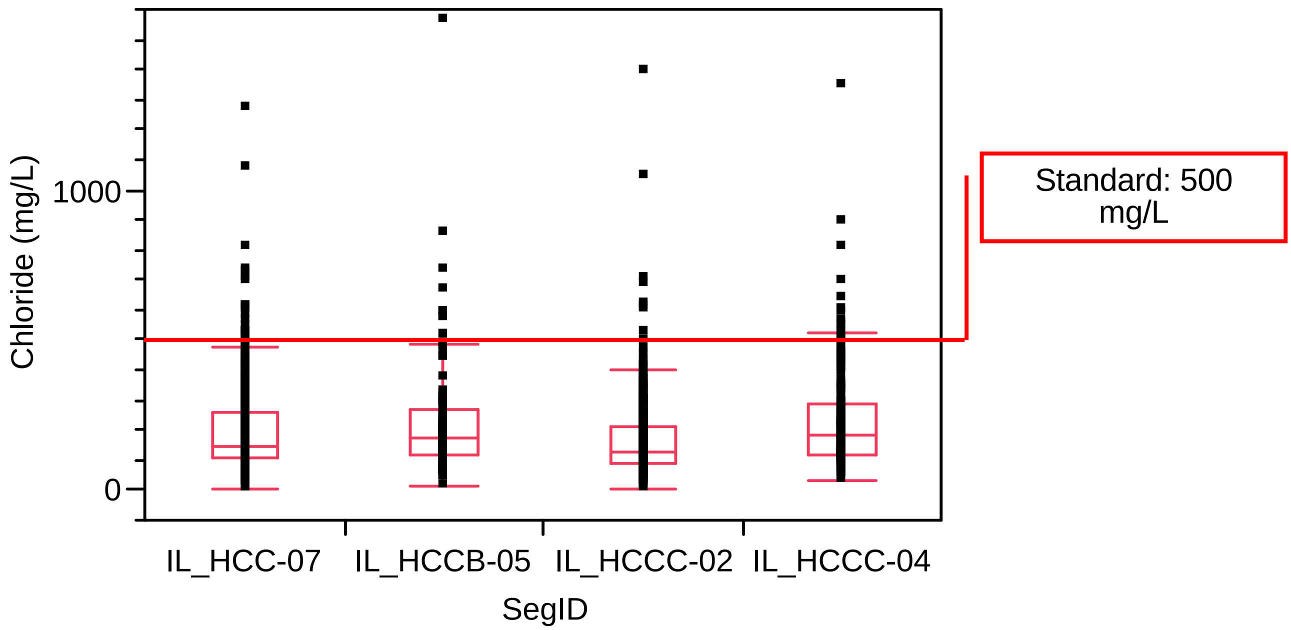
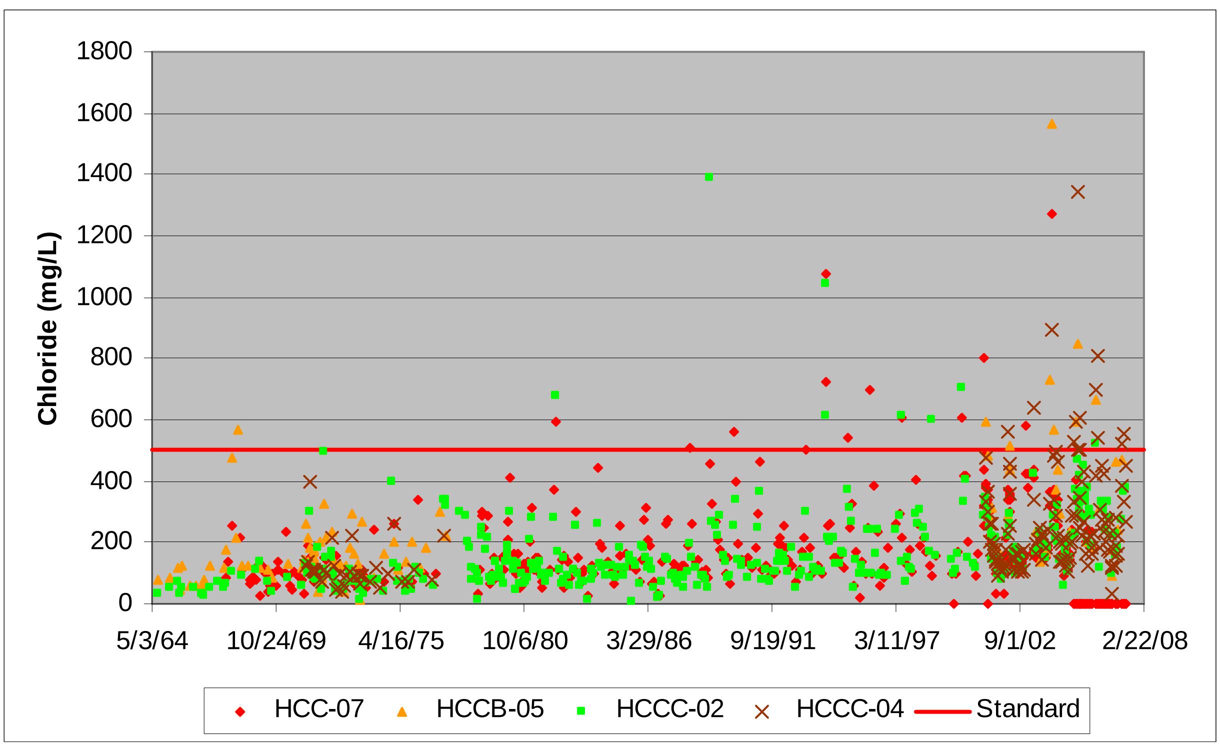


Figure 5-11: Chloride Time Series for HCC-07, HCCB-05, HCCC-02, and HCCC-04



5.1.5 Total Phosphorus

The WQS for total phosphorus is a maximum concentration of 0.05 mg/L and is applicable only to lakes with a surface area of 20 acres or greater. Within the North Branch Chicago River Watershed, three lakes are impaired. Recent data are summarized in Table 5-6 from 1999-2006. The time series distribution of phosphorus concentrations for each impaired segment in the North Branch Chicago River Watershed is presented in Figures 5-12 and 5-13. Data used for the assessments ranged from 1970 to 2006.

Table 5-6: Recent Phosphorus Data Summary

Segment	Stations	Data Years	No. of Samples	Violations	Min	Max	Average
Skokie Lagoons RHJ	RHJ-1, 2, 3	1998-2006	46	40	0.028	1.810	0.209
Chicago Botanic Garden RHJA	RHJA-1, 2, 3	1998-2006	151	35	0.000	0.365	0.043
Eagle Lake UHH	UHH-1, 2	2002	10	9	0.038	0.124	0.085

Figure 5-12: Phosphorus Time Series for RHJ, RHJA, and UHH

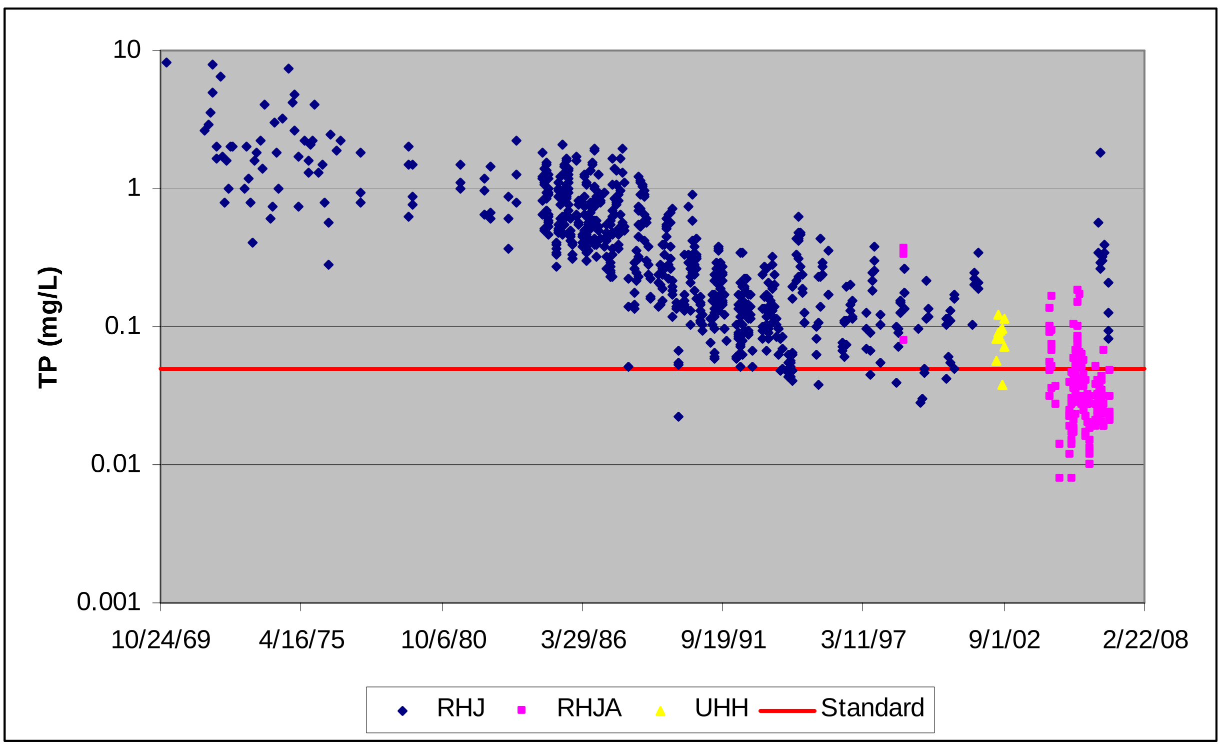
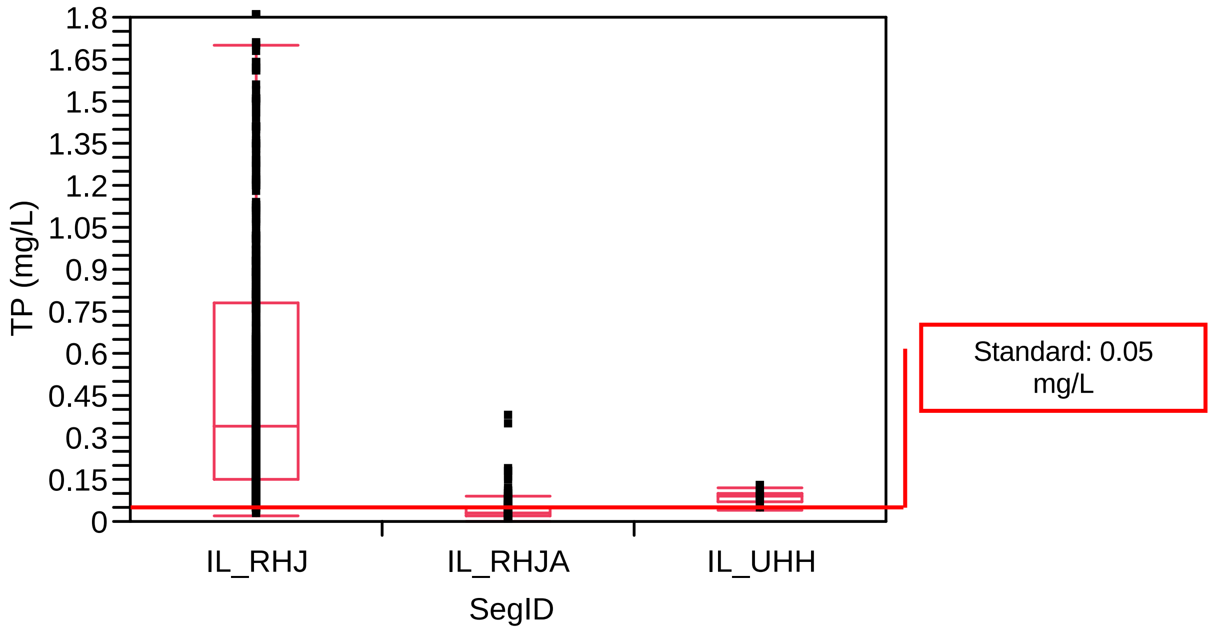


Figure 5-13: Total Phosphorus Distribution 1970 to 2006



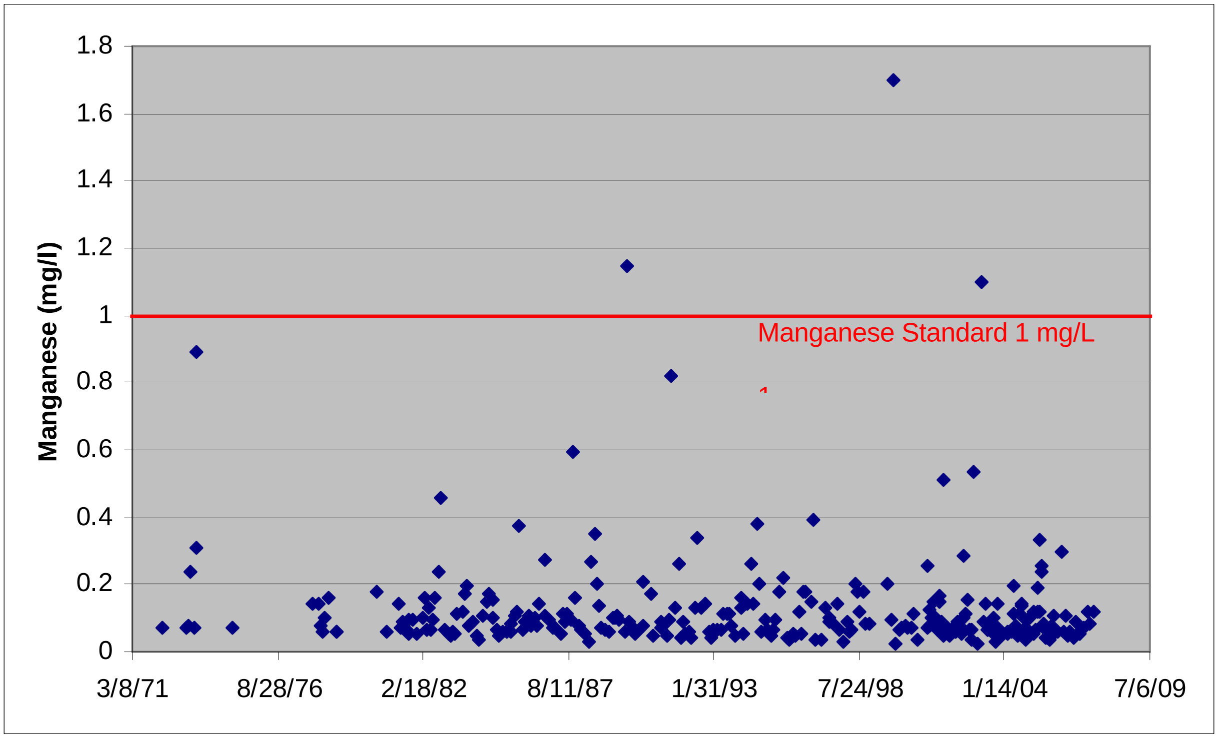
5.1.6 Manganese

The applicable water quality standard for manganese is 1 mg/L for general use. Table 5-7 and Figure 5-14 summarizes available manganese data for a segment on the Middle Fork of the North Branch of the Chicago River (IL_HCCC-02), the only waterbody with manganese impairment. Analysis was based on recent available total manganese data that ranged from 2001 to 2007.

Table 5-7: Recent Manganese Data Summary 2001-2007

Segment	Units	# Observations	# Violations	Min	Max	Average	Median	Standard Deviation
NB Chicago R IL_HCCC-02	mg/L	295	3	0.02	1.70	0.13	0.08	0.16

Figure 5-14: Manganese Time Series for IL_HCCC-02



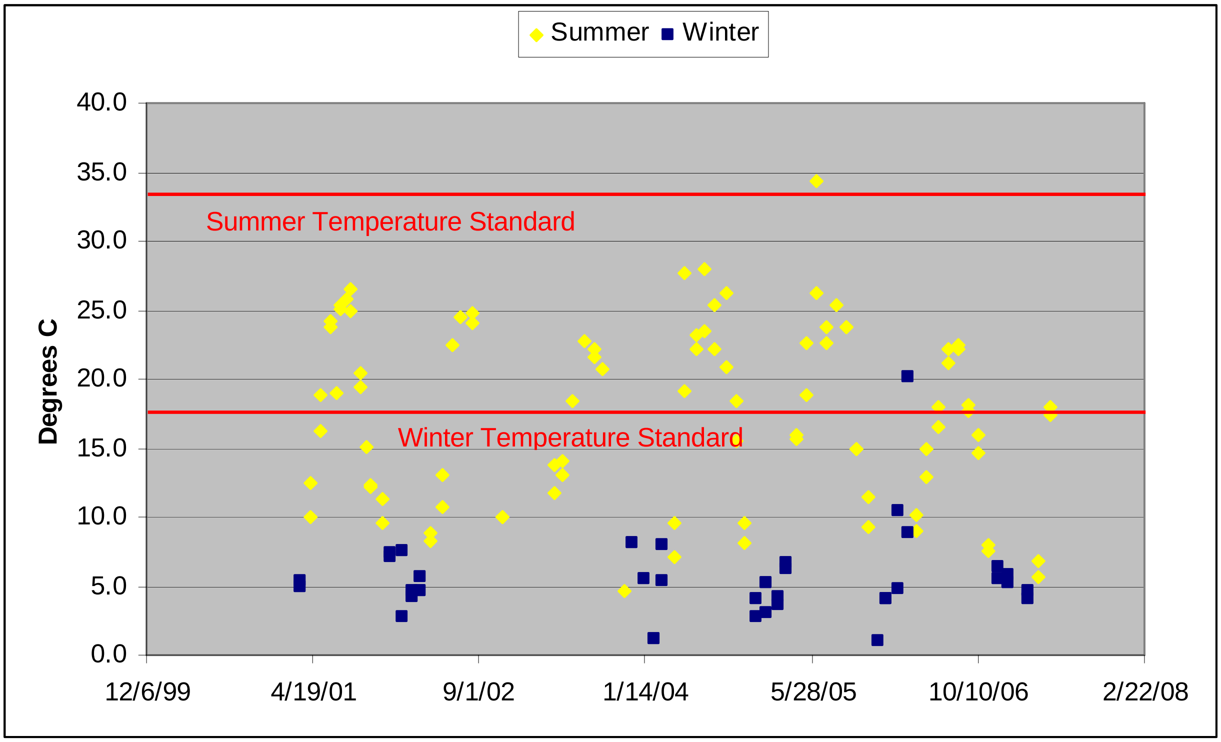
5.1.7 Temperature

IL_HCCC-04 on the Middle Fork of the North Branch of the Chicago River is the segment listed for temperature impairment within the North Branch Chicago River Watershed. Table 5-8 and Figure 5-15 summarize available temperature data. The applicable water quality standard for temperature limits an increase of 2.8 degrees Celsius above natural background temperature. In addition, the water temperature in the main river shall not exceed 32 degrees Celsius in the summer (April to November) or 16 degrees Celsius in the winter (December to March) more than one percent of the hours in a 12 month period ending with any month. Moreover, at no time shall the water temperature exceed 33.7 degrees Celsius in the summer nor 17.7 degrees Celsius in the winter. Due to the unlikelihood of having natural temperature data and sufficient hourly data during any 12 month period, the winter and summer maximums are often used to determine a violation. Ambient data indicate that the temperature maximums of 33.7 and 17.7 degrees Celsius were violated on 2 occasions. Data used for analysis ranged from 2001 to 2007.

Table 5-8: Recent Temperature Data Summary 2001-2007

Segment	Units	# Observations	# Violations	Min	Max	Average	Median	Standard Deviation
MF NB Chicago R IL_HCCC-04	Deg C	126	2	1	34.4	14.2	13.5	7.9

Figure 5-15: Temperature Time Series for IL_HCCC-04



5.2 Potential Point Sources

A number of point source dischargers actively maintain National Pollutant Discharge Elimination System (NPDES) permits within the North Branch Chicago River Watershed. Discharge Monitoring Reports (DMRs) for each discharger will be required for the Stage 3 analysis of the TMDL, as available data will be quantified and analyzed to determine the point source loading for each receiving water. Table 5-9 lists the existing NPDES permits as provided by EPA's Enforcement Compliance History Online (ECHO) database. Geographic locations are provided in Figure 5-16.

Phase I of the NPDES Storm Water program began in 1990 and required medium and large municipal separate storm sewer systems (MS4s) to obtain NPDES coverage. The expanded Phase II program began March 2003 and requires small MS4s in urbanized areas to obtain NPDES permits and implement six (6) minimum control measures. An urbanized area as delineated by the Bureau of Census is defined as a central place or places and the adjacent densely settled surrounding area that together have a residential population of at least 50,000 people and an overall population density of at least 500 people per square miles. Table 5-10 lists the MS4s within the North Branch Chicago River Watershed and Figure 5-17 indicates the location.

MS4 Permit Requirements:

1. Develop a storm water management program comprised of best management practices (BMPs) and measurable goals for each of the following six minimum control measures:
    - Public education and outreach on storm water impacts
    - Public involvement and participation
    - Illicit discharge detection and elimination

- o Construction site storm water runoff control
- o Post construction storm water management in new development and redevelopment
- o Pollution prevention/good housekeeping for municipal operations

2. Submit a completed Notice of Intent. Operators can choose to share responsibilities for meeting the Phase II program requirements. Those entities choosing to do so may submit jointly with other municipalities or governmental entities. The Notice of Intent form is available below.

3. Submit an annual report to IEPA in June of each year starting in 2004. The reports must include:

- o The status of compliance with the permit conditions, including an assessment of the BMPs and progress toward the measurable goals;
- o Results of any information collected and analyzed, including monitoring data;
- o A summary of the storm water activities planned for the next reporting cycle;
- o A change in any identified best management practices or measurable goals;
- o If applicable, notice of relying on another governmental entity to satisfy some of the permit obligations.

Table 5-9: Existing NPDES Dischargers in the North Branch Chicago River Watershed

Facility Name	NPDES ID	Receiving Stream	DAF	DMF
Abbott Laboratories	IL0066435	Middle Fork North Branch Chicago R.	2.21	2.481
Abbott Laboratories	IL0066435	Middle Fork North Branch Chicago R.	1.71	5.447
Central Lake County JAWA PWS	IL0068951	Skokie River	0.014	0.531
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Chicago CSOS	IL0045012	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Deerfield WRF	IL0028347	West Fork North Branch Chicago R.	3.5	8
Deerfield WRF	IL0028347	West Fork North Branch Chicago R.	Intermittent	

Facility Name	NPDES ID	Receiving Stream	DAF	DMF
Deerfield WRF	IL0028347	West Fork North Branch Chicago R.	Intermittent	
Deerfield WRF	IL0028347	Middle Fork North Branch Chicago R.	Intermittent	
Deerfield WRF	IL0028347	West Fork North Branch Chicago R.	Intermittent	
Golf CSOS	IL0072389	TARP/ West Branch North Branch Chicago R.	Intermittent	
Morton Grove CSOs	IL0046175	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Morton Grove CSOs	IL0046175	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Niles CSOs	IL0052477	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Niles CSOs	IL0052477	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Niles CSOs	IL0052477	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Niles CSOs	IL0052477	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Niles CSOs	IL0052477	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Niles CSOs	IL0052477	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Niles CSOs	IL0052477	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
Niles CSOs	IL0052477	TARP/ Middle Fork North Branch Chicago R.	Intermittent	
NSSD Clavey Road STP	IL0030171	Skokie Lagoon	17.8	28
NSSD Clavey Road STP	IL0030171	Skokie River	Intermittent	
Prairie Material Yards 21	IL0066991	West Fork North Branch Chicago R.	Intermittent	
Underwriters Labs- Northbrook	IL0002739	West Fork North Branch Chicago R.	Intermittent	

Table 5-10: Municipal Separate Storm Sewer Systems in the North Branch Chicago River Watershed

Name	2000 Population*	Acres*
Bannockburn	1429	1298.74
Chicago	2896016	146125.84
Deerfield	18420	3464.79
Evanston	74239	4909.47
Glencoe	8762	2431.89
Glenview	41847	7782.35
Golf	451	280.17
Green Oaks	3572	2532.67
Highland Park	31365	7883.27
Highwood	4143	409.97
Kenilworth	2494	384.51
Lake Bluff	6056	2580.3
Lake Forest	20059	10788.94
Lincolnshire	6108	2693.21
Mettawa	367	3379.91
Morton Grove	22451	3221.68
Niles	30068	3680.89
North Chicago	35918	4951.32
Northbrook	33435	8155.02
Northfield	5389	1836.46

Name	2000 Population*	Acres*
Park City	6637	744.64
Park Ridge	37775	4529.36
Riverwoods	3843	2526.48
Skokie	63348	6389.98
Waukegan	87901	14930.44
Wilmette	27651	3397.27
Winnetka	12419	2441.85

*This information is taken from the municipal boundary shapefile provided by Illinois EPA.

Figure 5-16: Existing NPDES Discharges in the North Branch Chicago River Watershed

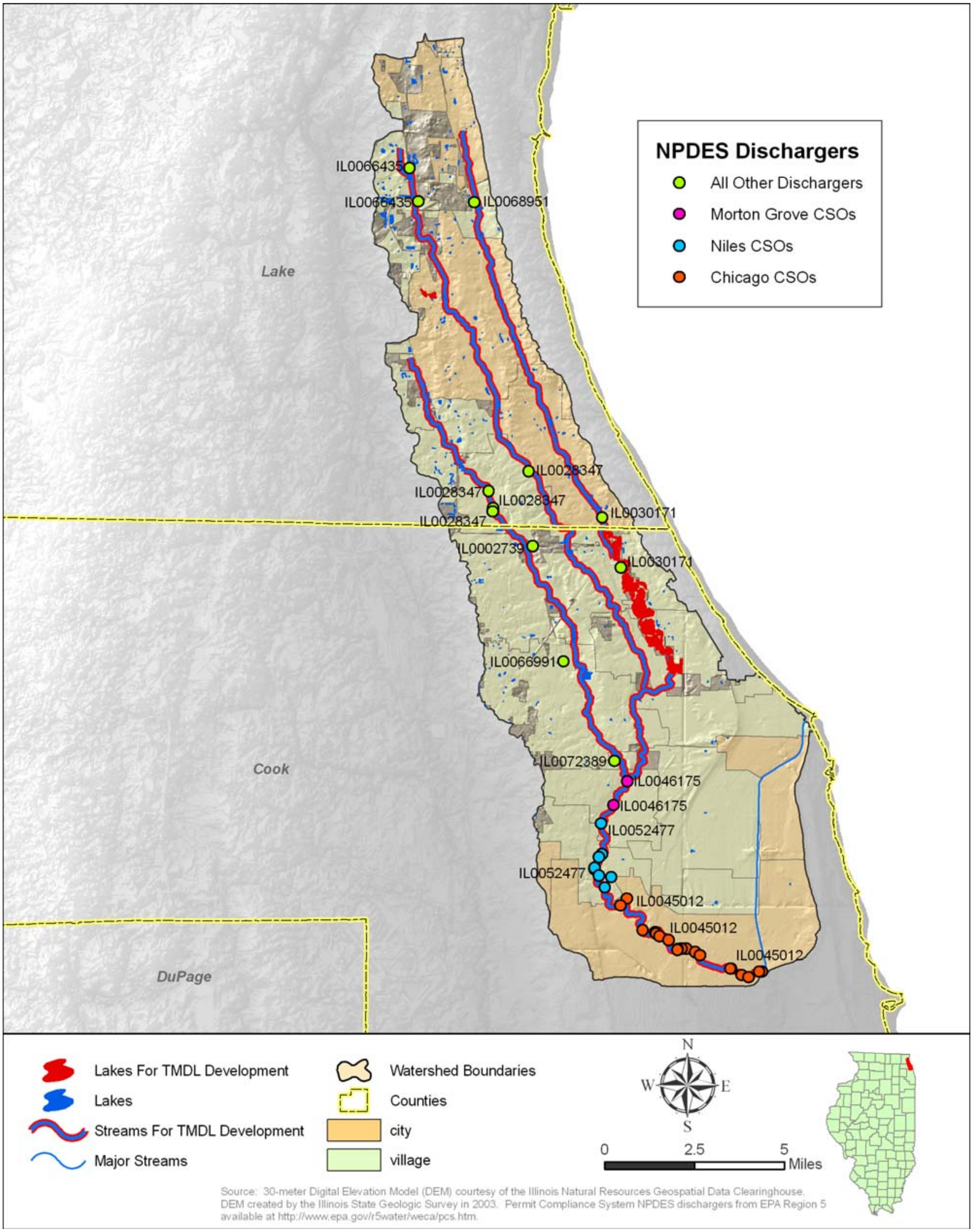
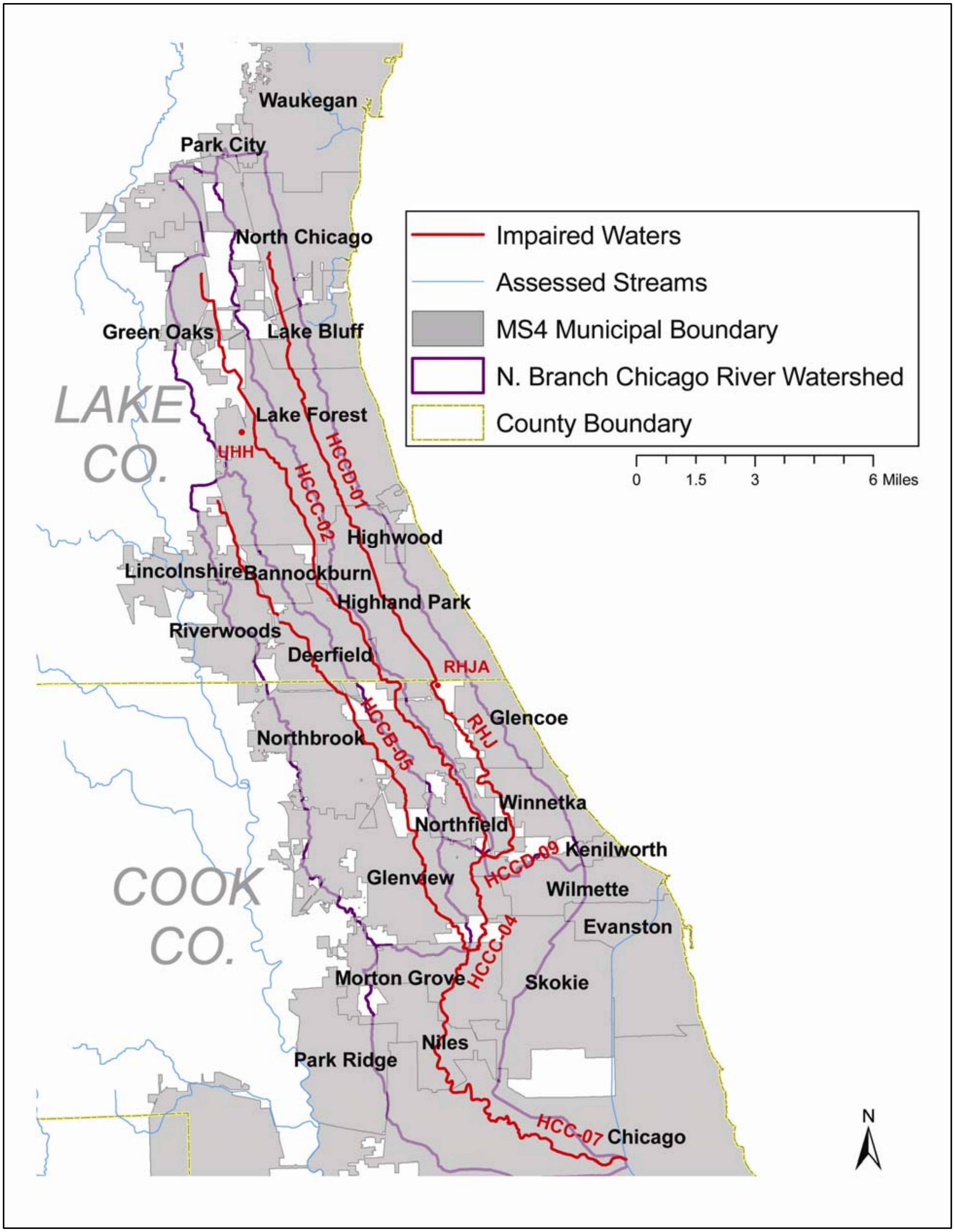


Figure 5-17: Municipal Separate Storm Sewer Systems in the North Branch Chicago River Watershed



5.3 Non-Point Sources

The North Branch Chicago River Watershed is dominated almost entirely by urban growth; current land use is approximately 82% urban. As compared to other watersheds in the region, agriculture has a very limited amount of influence within the watershed, comprising only 0.52% of the area. To properly manage and maintain water quality in the North Branch Chicago River Watershed, the impacts associated with new development must be carefully evaluated.

Urban and suburban development can adversely impact water quality in a number of ways. During the construction phase of development, soils destabilized as a result of clearing, grading, and excavation are subject to increased erosion by wind and water. These eroded soils can be carried offsite and deposited in receiving waters such as lakes, rivers and wetlands. Adverse impacts associated with such sediment loading include increased turbidity and habitat modification, including smothering of invertebrates and covering spawning beds. Typically, the construction phase is relatively short-lived; however, the impacts to receiving waters from poorly managed construction activities may be extremely severe and the effects can endure long after the project is over.

Post-construction receiving water quality impacts may become more pronounced due to potentially dramatic changes to the area's hydrology (reduced baseflow and exaggerated peak flow volumes), and the change in land use compared to predevelopment conditions. The increase in impervious areas, such as roadways and parking lots, can often result in increased runoff rates and volumes. This can result in increased streambank erosion which can lead to increased sediment loading and its associated water quality problems. The increased runoff can also accelerate the transport of land-borne pollutants such as heavy metals, oil and grease, pesticides, fertilizers and other nutrients, and toxic organic contaminants. Increased imperviousness can also cause significant elevations in receiving water temperatures during summer months. Winter road deicing activities can contribute high levels of chlorides or sediment.

Water quality impacts may be evaluated in terms of short-term impacts, and long-term impacts. Individual runoff events can cause short-term impacts to receiving waters, and are typically on a timescale of hours to days. Changes to the dry and wet weather hydrology, stream bank morphology, and water chemistry of the receiving water are considered long-term impacts. Such long-term chemical impacts are most critical for those waters with longer residence times such as lakes and wetlands, and slow-moving stream segments. With regards to urban development and agriculture, pollutant concentrations are best used to evaluate short-term effects, while pollutant loadings are appropriate for assessing long-term impacts. North Branch Chicago River Watershed planners and developers need to understand these impacts and carefully plan in order to mitigate the negative water quality impacts of development and agriculture.

5.4 Watershed Studies and Other Watershed Information

A watershed plan written by the Lake County Stormwater Management Commission is available on-line at http://www.co.lake.il.us/smc/planning/northbranch/default.asp. This plan, written in 2000, contains detailed information and recommendations for the North Branch Chicago River Watershed that will be considered throughout the process of this TMDL. Additionally, the commission has been involved in many other projects like the North Branch Chicago River Watershed Project.

Four drainage districts have fee authority and stream and maintenance responsibility for different sections of the three tributaries of the North Branch. Other parties with jurisdiction in the North Branch include:

- Department of the Navy (Great Lakes and Glenview)
- County Forest Preserve Districts
- Park Districts - In Lake County 6 municipalities have park districts (Deerfield, Highland Park, Lake Bluff, Waukegan, Gurnee and Foss in North Chicago).

- Lake and North Cook County Soil and Water Conservation Districts
- US Congressional Districts
- State Senatorial and Representative Districts.

In addition to these jurisdictions, the Lake County Stormwater Management Commission maintains the authority to administer development permits under the Watershed Development Ordinance throughout the county. Lake County also has a North Branch Watershed Management Board (WMB) that was designed to address inter-jurisdictional issues (SMC 2007).

The Metropolitan Water Reclamation District of Greater Chicago has implemented many management programs within the watershed including the Native Prairie Landscaping Project in 2003. More information about the district's activity can be found at www.mwrdgc.dst.il.us.

Friends of the Chicago River are a very active group involved in policy and planning, education and outreach, and project implementation. More information about the group can be found at www.chicagoriver.org.

The North Branch Restoration Project works to restore native habitat within the watershed. More information can be found at www.northbranchrestoration.org.

6.0 TMDL Approach and Data Needs

This chapter discusses the methodology that may be used for the development of TMDLs for the North Branch Chicago River Watershed. While a detailed watershed modeling approach can be advantageous, a simpler approach is often able to efficiently meet the requirements of a TMDL and yet still support a TMDL-guided and site-specific implementation plan. The final selection of a methodology will be determined with consultation with the Illinois EPA based on following factors:

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

A simpler approach shall be used as long as it adequately supports the development of a defensible TMDL. If it is deemed that this approach will not suffice, a more sophisticated modeling approach will be recommended for analysis to help better establish a scientific link between the pollutant sources and the water quality indicators for the attainment of designated uses. Methodology for estimating daily loads will depend on available data as well as the selected analysis.

6.1 Recommended Modeling Approach for Fecal Coliform

Many states currently use load duration curves for fecal coliform TMDLs for its simplicity and effectiveness. Load duration curves use water quality criteria, ambient concentrations, and observed flows to estimate loading capacities for streams under various flow conditions.

The first step in this process is to obtain an appropriate stream flow record. This is often difficult for streams not monitored by the USGS. There are methods, however, for developing stream flow statistics on ungaged streams. Regional curve numbers and regression equations are typical used in such instances. Alternatively, a gaged reference watershed can be used to obtain a stream flow record. For this watershed, substantial flow data is available as indicated by Figure 2-10 (USGS Gaging Station map) and alternative methods may not be required.

Flow duration curves are developed from stream flow records spanning multiple decades. The flow duration curve is based on flow frequency which provides a probability of meeting or exceeding of a given flow. The duration curve is broken into hydrologic categories where high flows represent a duration interval of 0-10%, moist conditions represent 10-40%, mid-range flows 40-60%, dry conditions 60-90% and low flows 90-100%.

Once the flow duration curve is established, a load duration curve can be generated by multiplying stream flow with the numerical water quality standard and a conversion factor to obtain the load per day for a given stream flow. Individual measurements can be plotted against the load duration curve to evaluate patterns of impairment. Values that fall above the load duration line indicate an exceedance of the daily load and hence, water quality standard. These data can aid in determining whether impairment occurs more frequently in one of the hydrologic categories (wet, moist, mid-range, dry or low).

The margin of safety (MOS) for duration curves can be implicit or explicit. Implicit MOS are derived from the inherent assumptions in establishing the water quality target (conservative assumptions). Explicit MOS include setting the water quality target lower than the WQS or not allocating a portion of the allowable load. For the North Branch Chicago River TMDL, an implicit margin of safety is proposed. The load duration analysis performed for this TMDL will be conservative because the TMDL target (no more than 200 cfu/100 ml at any point in time) is more conservative than the more restrictive component of the fecal coliform water quality standard (geometric mean of 200 cfu/100 ml for all samples collected May through October).

Wasteload allocations (WLA) will be based on NPDES permit limits. Average discharge flow and permit limits will be used to calculate a daily load and serve as the WLA. WLAs for NPDES-permitted stormwater discharges, including current and future Municipal Separate Storm Sewer Systems (MS4s), "Urbanized" areas, construction and industrial discharges and sanitary sewer overflows (SSOs) that do not have numerical effluent limitations will be expressed as a percent reduction instead of a numerical target. The NPDES Phase II Stormwater Regulations require all areas defined as "Urbanized" by the US Census obtain a permit for the discharge of stormwater. Stormwater discharges are required to meet the percentage reduction or the existing instream standard for the pollutant of concern, whichever is less restrictive. The load allocation (LA) for all non-regulated sources, including non-point sources, will also be expressed as a percent reduction. The percent reduction is based on the maximum reduction required to meet WQS plus a margin of safety under critical conditions.

The critical condition for fecal coliform load duration TMDLs is established by hydrologic category. It is defined as the greatest reduction needed to meet WQS among all hydrologic categories. For example, if an 89% reduction is required to meet the TMDL under wet conditions and a 50% reduction is required under dry conditions, an 89% reduction will be required under all hydrologic conditions to ensure that the TMDL is protective under in all hydrologic conditions.

Seasonality of loading will also be evaluated. Flow duration intervals will be plotted by month to determine if there is a strong seasonal component. Although this will not change allocations, this may assist in implementation planning.

6.2 Recommended Modeling Approach for Dissolved Oxygen

QUAL-2K, a spreadsheet model that is based on the fundamental Streeter-Phelps DO sag equation, is recommended for DO TMDL development for impaired waterbodies in the North Branch Chicago River Watershed. QUAL-2K is a one-dimensional, steady-state model that can accommodate point and non-point source loading and is capable of modeling DO in streams and well-mixed lakes. QUAL-2K is an updated version of QUAL-2E and has been developed using a Microsoft Excel interface. QUAL-2K allows for model segmentation, the use of two forms of carbonaceous BOD (both slow and rapid oxidizing forms), and is also capable of accommodating anoxia and sediment – water interactions. While the model is simplistic in nature, it is capable of estimating critical BOD concentrations associated with instream DO concentrations of 5 mg/L.

If sufficient data are available, load duration curves could also be used to adequately simulate BOD loading associated with DO sags in streams. These calculated loads will be the basis for recommending TMDL reductions if necessary.

6.3 Recommended Modeling Approach for Total Phosphorus

An export coefficient model linked to empirical in-lake response models will be used to determine existing loading and load reductions required to bring Eagle Lake, Skokie Lagoons, and the Chicago Botanical Gardens into compliance with current WQS. This model, ENSR-LRM (lake response model), was developed by ENSR and has been used on more than 35 lake TMDLs.

ENSR-LRM uses export coefficients for runoff, groundwater and nutrients to estimate loading as a function of land use. Yields will be assigned to each defined parcel (sub-watershed) in the lake watershed. Loading estimates will be adjusted based on proximity to the lake, soils and major Best Management Practices (BMPs) in place. Model yields will be compared to measured data, where available. Export coefficients and attenuation factors will be adjusted such that model loading accurately reflects actual loading based on sample data and measured in-lake concentrations.

Watershed and subwatershed boundaries will be delineated based topography. Watershed land use will be determined using publically available GIS data layers from the Illinois Natural Resource Geospatial Data Clearinghouse, or similar source. ENSR-LRM will be set-up on a sub-watershed level using available land use and average annual precipitation. The spreadsheet-based export coefficient model allows the user to select watershed yield coefficients and attenuation factors from a range appropriate in the region. The model also includes direct inputs for atmospheric deposition, septic systems, point sources, waterfowl and internal loading from lake sediments.

The generated load to the lake is processed through five empirical models: Kirchner & Dillon 1975, Vollenweider 1975, Larsen & Mercier 1976, Jones & Bachmann 1976 and Reckhow 1977. These empirical models predict in-lake phosphorus concentrations based on loading and lake characteristics such as mean water depth, volume, inflow, flushing and settling rates. Predicted in-lake phosphorus is compared to measured data. An acceptable agreement between measured and predicted concentrations indicates loading estimates are appropriate for use in the preparation of a TMDL. Adjustments to the loading portion of the model are made when necessary based on best professional judgment to ensure acceptable agreement between measured and predicted concentrations. These empirical models also predict chlorophyll concentrations and water clarity (Secchi disk transparency). ENSR-LRM also includes a statistical evaluation of algal bloom probability.

Once the model has been calibrated to existing conditions, adjustments to the model can be made to determine predevelopment conditions and the load reductions necessary to meet WQS. In some instances, waterbodies are naturally eutrophic and may not achieve numerical WQS even under predevelopment conditions. In such instances, site specific criteria or maximum practical reductions have been used for TMDL targets and is proposed.

ENSR-LRM is most effective when calibrated with water quality data for the target system, but can be used with limited data. While it is a spreadsheet model with inherent limitations on applied algorithms and resultant reliability of predictions, it provides a rational means to link actual water quality data and empirical models in an approach that addresses the whole watershed and lake. ENSR-LRM is an easy and efficient method of estimating current loads to lakes as well as providing predictions on lake response under countless loading scenarios.

ENSR-LRM, as well as most simplified lake models, predicts phosphorus concentrations and estimates loading on an average annual basis. As required by the EPA, the TMDL must be expressed on a daily basis. However, there is some flexibility in how the daily loads may be expressed (US EPA, 2006). Several of these options are presented in “Options for Expressing Daily Loads in TMDLs” (US EPA, 2007). For TMDLs based on watershed load and in-lake response models providing predictions on an annual basis, the EPA offers a method for calculating the maximum daily limit based on long-term average and variability. This statistical approach is preferred since long periods of continuous simulation data and extensive flow and loading data are not available. The following expression assumes that loading data are log-normal distributed and is based on a long term average load calculated by the empirical model and an estimation of the variability in loading.

$$MDL = LTA * e^{[z\sigma - 0.5\sigma^2]}$$

Where:
MDL = maximum daily limit
LTA = long-term average
Z = z-statistic of the probability of occurrence
$\sigma^2 = \ln(CV^2 + 1)$
CV= coefficient of variation

Data from similar lakes will be used in situations where there are not enough data to determine probability of occurrence or coefficient of variation for the impaired waterbody.

MOS for phosphorus using this method is implicit. There is substantial uncertainty in concentration inputs to the models related to the timing of sampling and analytical methods, and the empirical equations used to predict in-lake phosphorus concentrations, mean and maximum chlorophyll, Secchi disk transparency, and bloom probability also introduce variability into the predictions.

WLA will be determined based on NPDES permit effluent limitations and average flow. WLAs for NPDES-permitted stormwater discharges, including current and future MS4s, "Urbanized" areas, construction and industrial discharges and SSOs that do not have numerical effluent limitations will be expressed as a percent reduction instead of a numerical target. Stormwater discharges are required to meet the percentage reduction or the existing instream standard for the pollutant of concern, whichever is less restrictive. LAs will also be expressed as a percent reduction. The percent reduction is based on the maximum practical reduction, which is generally 60% of the target load achievable through BMPs (Center for Watershed Protection 2000) including source reduction, transport mitigation and behavior modification.

Critical conditions for lakes typically occur during the summertime, when the potential (both occurrence and frequency) for nuisance algal blooms are greatest. The loading capacity for total phosphorus is set to achieve desired water quality standards during this critical time period and also provide adequate protection for designated uses throughout the year. The target goal is based on average annual values, which is typically higher than summer time values. Therefore a load allocation based on average concentrations will be sufficiently low to protect designated uses in the critical summer period

The ENSR-LRM derived TMDL takes into account seasonal variations because the allowable annual load is developed to be protective of the most sensitive (i.e., biologically responsive) time of year (summer), when conditions most favor the growth of algae. Maximum annual loads are calculated based on an overall annual average concentration. Summer epilimnetic concentrations are typically lower than the average annual concentration, so it is assumed that loads calculated in this manner will be protective of designated uses in the summer season, in which the most sensitive of designated uses (swimming) occurs. It is possible that concentrations of phosphorus will be higher than the annual average during other seasons, most notably in the spring, but higher phosphorus levels at that time does not compromise uses. The proposed TMDL is expected to protect all designated uses of the impaired waterbody.

6.4 Recommended Modeling Approach for pH

QUAL-2K is also capable of estimating instream pH. In the modeling framework, both total inorganic carbon and alkalinity are simulated based on inputs. Using these two quantities, the model then simulates instream pH. These calculated values will then be the basis for recommending TMDL reductions if necessary.

6.5 Recommended Modeling Approach for Chloride and Manganese

Similar to fecal coliform, load duration curves are recommended for the chloride and manganese TMDLs. The duration curve will be used to estimate the percent of time that a water quality standard is exceeded. The wasteload allocations will be based on criteria concentrations which will then be converted into a distribution of allowable loads as a function of daily flow.

6.6 Recommended Modeling Approach for Temperature

QUAL-2K includes a heat budget and temperature analysis. The simulation is based on meteorological data and dynamic inflow boundary conditions of flow and temperature. It can handle point mass and heat inputs and simulates on a function of a diurnal time scale. These calculated values will then be the basis for recommending TMDL reduction s if necessary.

6.7 Data Needs

Effective TMDL development heavily relies on site-specific data. Sufficient flow and water quality data are required for the evaluation of water conditions and for model calibration. In fact, data availability often dictates the modeling approach used for various watersheds. Five types of data are crucial for the North Branch Chicago River Watershed TMDL development:

- Flow data
- Meteorological data
- Water quality data
- Watershed and water body physical parameters
- Source characteristics data

Most necessary data are available for the TMDL with the exception of some ambient water quality data. Impairments based on available data sources indicate exceedance of standard in most of the North Branch Chicago River Watershed. However, available pH data at IL_HCCC-04 indicate that conditions were within applicable WQS. Additionally, the other pH impaired segments and the temperature impaired segment show a very low percentage of violations, recommending that additional sampling be conducted to confirm that impairment exists at these waterbody segments. Available phosphorus data were limited to one year for Eagle Lake (IL_UHH). Ongoing sampling will help to address the Eagle Lake data gaps.

Point source discharge data from all NPDES permittees within the watershed will also be necessary for the Stage 3 analysis. Individual NPDES permits, DMRs, and measured discharge data are all pertinent to TMDL development. Data will be obtained either using EPA's ECHO database or by directly contacting permittees.

7.0 References

Hill, Libby. 2000. The Chicago River: A Natural and Unnatural History. Lake Claremont Press. Chicago, IL.

Appendix A

Water Quality Data
(CD to be inserted)

Appendix B

Site Photographs

Eagle Lake (East) at Lake Forest Academy

Eagle Lake (West) at Lake Forest Academy

Appendix C

Permit Limits
(To be provided in a CD)