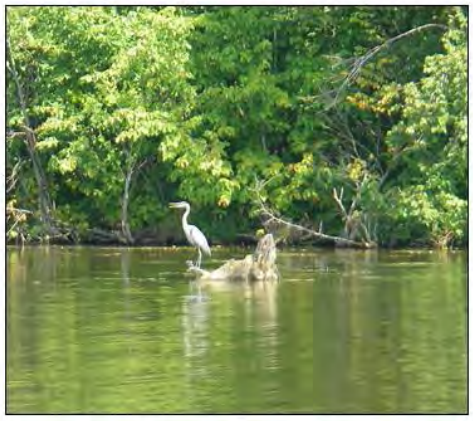
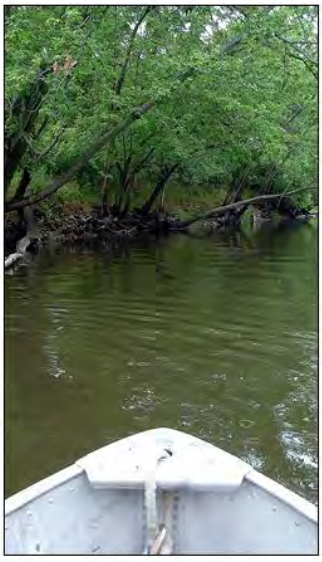
State of Illinois
Pat Quinn, Governor

Illinois Environmental Protection Agency
Lisa Bonnett, Director


ILLINOIS WATER MONITORING STRATEGY 2015 - 2020






Illinois Environmental Protection Agency
Bureau of Water

September 2014

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ILLINOIS WATER MONITORING STRATEGY

2015-2020

Illinois Environmental Protection Agency
Bureau of Water
Springfield, Illinois

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OVERVIEW OF MONITORING STRATEGY

Monitoring the environmental conditions of the surface waters (e.g., lakes, streams, wetlands) and groundwater of Illinois provides vital information for achieving the natural-resource goals of the Illinois Environmental Protection Agency (Illinois EPA). The monitoring performed by Illinois EPA Bureau of Water (BOW) and its partner organizations provides the basis for ensuring that Illinois waters are suitable and safe for human consumption and recreation while supporting other beneficial uses, such as supporting healthy aquatic life, contributing to aesthetic enjoyment, and providing for various agricultural and industrial uses.

This document, *Illinois Water Monitoring Strategy 2015-2020*, describes how and why Illinois EPA will monitor the environmental conditions in Illinois surface waters and groundwater during the years 2015 through 2020. This document is divided into the following sections:

1. **Introduction** describes the purposes of this document, including a brief history of precursor documents and a summary of Illinois water resources.

2. **Monitoring Objectives** defines the primary reasons why Illinois EPA BOW monitors Illinois waters.

3. **Monitoring Design** describes Illinois EPA BOW monitoring with specific reference to how and to what extent this monitoring serves the purposes of various programs and activities. This section also addresses specific monitoring efforts planned for 2015 through 2020 and how each effort is expected to advance the primary monitoring objectives of Illinois EPA BOW.

4. **Environmental Indicators** describes the types of data and information obtained via monitoring and how this information contributes to the resource-management and pollution-control activities performed by Illinois EPA BOW.

5. **Quality Assurance** and **Data Management** address how Illinois EPA BOW ensures the quality and availability of monitoring data and related information for those who rely regularly on it.

6. **Data Analysis and Assessment** describes how Illinois EPA BOW interprets and uses monitoring data and associated environmental indicators to support its primary resource-management and pollution-control activities.

7. **Reporting** provides a brief description of reports produced by Illinois EPA BOW. Other state-agency reports that contain environmental information provided by Illinois EPA BOW are also included.

8. **Programmatic Evaluation** describes how Illinois EPA BOW evaluates its primary resource-management and pollution-control activities.

9. **General Support and Infrastructure Planning** describes the current status and projected needs for advancing Illinois EPA BOW primary monitoring objectives.

Throughout this monitoring strategy, Illinois EPA BOW provides recommendations and strategies for improving its monitoring programs. These recommendations include specific efforts already planned for 2015-2020, as well as estimates of staffing necessary to maintain current programs and to accomplish all elements of the strategy.

INTRODUCTION

This current monitoring strategy represents a fourth comprehensive review of Illinois EPA BOW surface waters and groundwater monitoring activities. The content and design of this strategy closely follow United States Environmental Protection Agency (USEPA) guidance, *Elements of a State Water Monitoring and Assessment Program* (USEPA-2003a) and thereby is intended to fulfill the monitoring-strategy requirements of the Clean Water Act and associated regulations.

To track environmental conditions and to evaluate the efficacy of water-pollution-control programs, as required by state and federal regulations, Illinois EPA BOW has been monitoring Illinois surface water since 1970. Over this 44-year period, Illinois EPA BOW has refined this monitoring to incorporate technological advances, to address broadening environmental concerns, and to improve collaboration with other agencies and public partners.

This strategy defines what Illinois EPA requires to maintain current programs, as well as projected resources necessary to expand into new critical program areas such as tiered aquatic-life uses, fish-contaminant monitoring in lakes, development of biological indicators for headwater and large rivers, biological monitoring on Lake Michigan, and participation in national aquatic resource surveys.

Water Resources of Illinois

Illinois has abundant water resources (Figures 1 and 2). Three large rivers form much (about 911 miles) of the state's borders: Mississippi River on the west, Wabash River on the east, and Ohio River to the south (U.S. Geological Survey 2014). About 64 miles of Lake Michigan shoreline borders the northeast. Within Illinois borders are 106,940 miles of streams. Of these "interior" streams, 25,019 miles are perennial, 78,245 miles are intermittent, and 3,676 miles are ditches or canals (U.S. Geological Survey 2014). Illinois also has more than 91,400 lakes and ponds of which 1,279 are publicly owned (154,333 acres) (Illinois Department of Natural Resources 2000).

Figure 1. Summary of Illinois Water Resources

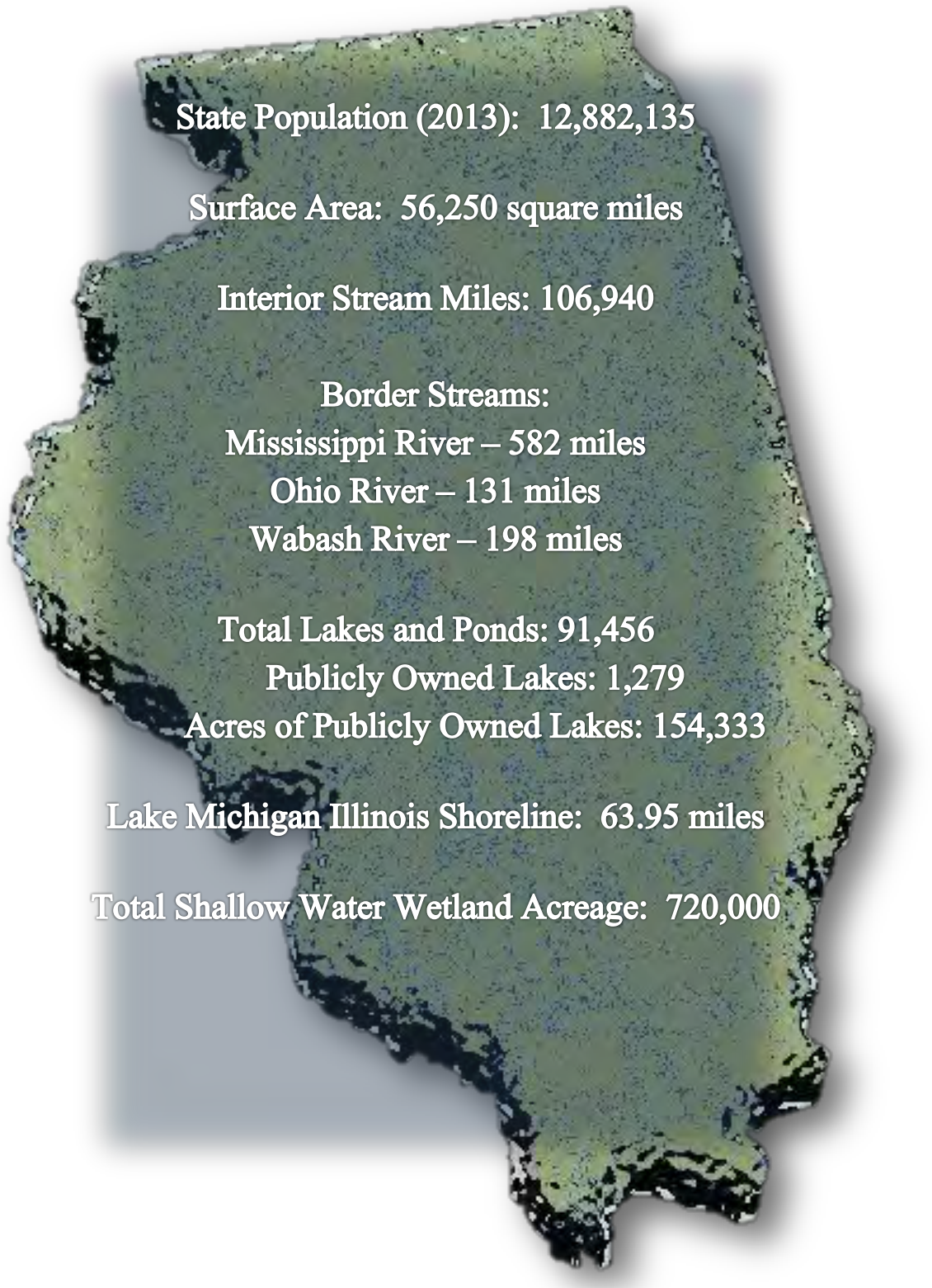
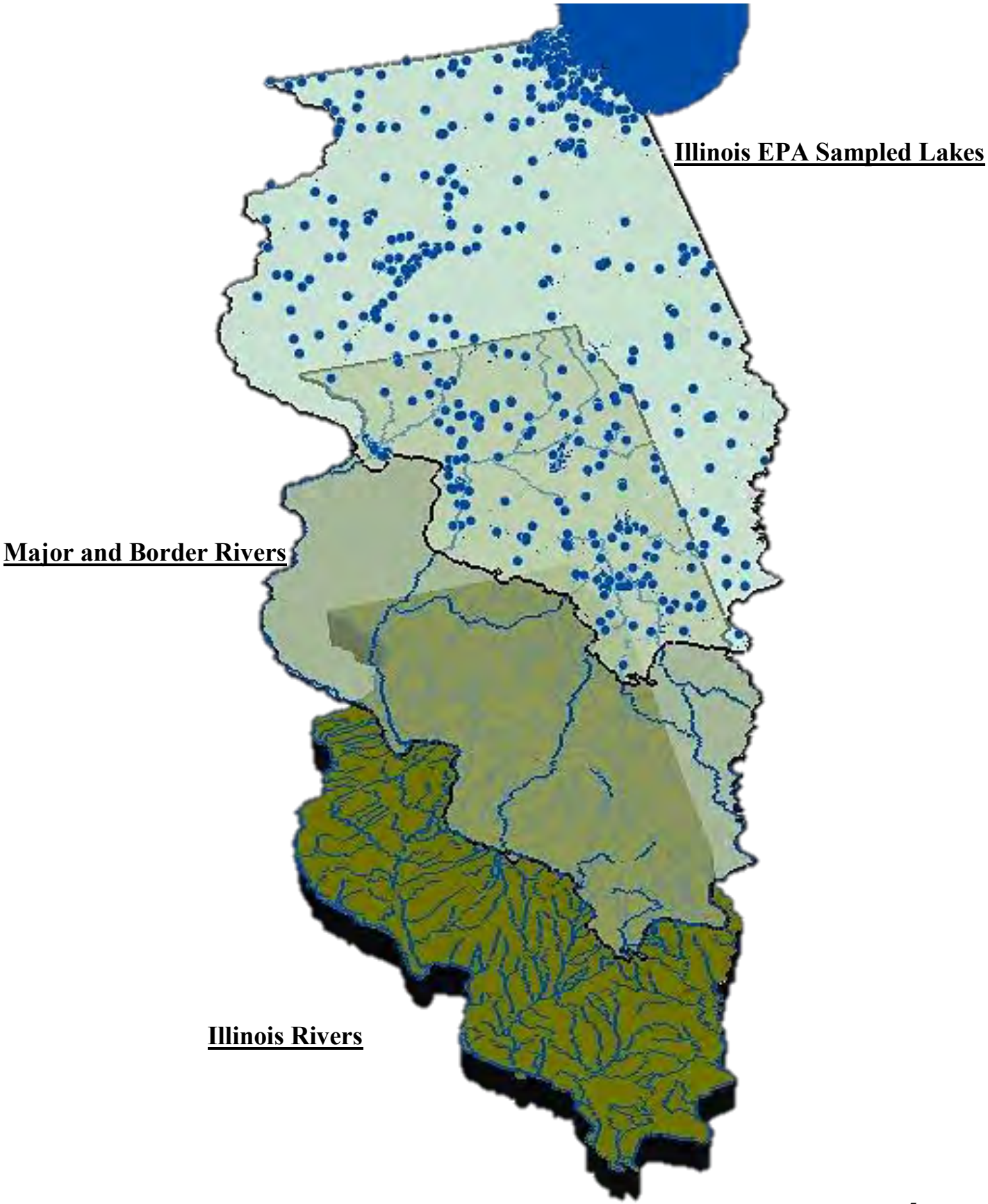


Figure 2. Lakes sampled by Illinois EPA, and Rivers of Illinois



MONITORING OBJECTIVES

Illinois EPA BOW primary monitoring objectives are identified and discussed below. The USEPA (2003a) requests that each state describe how it achieves the monitoring element called "Monitoring Objectives." Specifically, USEPA (2003a) requests that each state identify:

> *... monitoring objectives critical to the design of a monitoring program that is efficient and effective in generating data that serve its management decision needs. EPA expects the State to develop a strategy and implement a monitoring program that reflects a full range of State water-quality management objectives, including, but not limited to, Clean Water Act goals.*

Moreover, Title 40, Section 130.4 of the Code of Federal Regulations requires:

> *The State's water monitoring program shall include collection and analysis of physical, chemical, and biological data and quality assurance and control programs to assure scientifically valid data. The uses of these data include determining abatement and control priorities; developing and reviewing water quality standards, TMDLs, wasteload allocations, and load allocations; assessing compliance with NPDES permits by dischargers; and reporting information to the public through the section 305(b) report and reviewing station-specific monitoring efforts.*

Illinois EPA's monitoring objectives for surface water and groundwater are:

1a. Determine attainment of designated uses, and identify impaired waters.

1b. Identify causes and sources of impairment to water quality.

1c. Identify trends in water quality, and maintain the flexibility to address emerging threats to water quality.

2. Establish, review, and revise water-quality standards, including use designations and use attainability.

3. Implement water-management programs.

4. Evaluate the effectiveness of water-management programs.

Objectives 1a through 1c: Determine attainment of designated uses, identify impaired waters, identify causes and sources of water-quality impairment, and identify trends in water quality while maintaining the flexibility to address emerging threats to water quality.

Via several programs, Illinois EPA regularly monitors streams, lakes (including Lake Michigan), and groundwater throughout Illinois for various chemical, physical, and biological conditions. For each use designated in a waterbody, Illinois EPA interprets the relevant monitoring

information to assess attainment of the use. When at least one designated use is not attained in a waterbody, the waterbody is impaired. In these cases, the relevant monitoring information also is used to identify potential causes and sources of the impairment. This regular monitoring and assessment allows Illinois EPA to identify how environmental conditions change through time in Illinois waters. Illinois EPA tracks statewide changes in these conditions by regularly reporting, in the biannual *Illinois Integrated Water Quality Report and Section 303(d) List* (e.g., Illinois EPA 2014), the percentages of stream miles, lake acres, and groundwater wells that are attaining each of several applicable designated uses. As resources and expertise allow and as the need arises, Illinois EPA may perform formal statistical trends analysis on specific waters.

In accordance with 40 CFR 130.8(b)(1), Illinois EPA monitoring and assessment of *Aquatic Life Use* in Illinois surface waters address the extent to which conditions in Illinois lakes and streams "*provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife.*" Also, in accordance with 40 CFR 130.8(b)(1), via assessments of *Primary Contact Use* and *Secondary Contact Use*, Illinois EPA uses the monitoring information to determine the extent to which conditions in Illinois lakes and streams "*allow recreational activities in and on the water*". Via identification and tracking of waters with impaired uses and via identification of potential causes of impairment, Illinois EPA also uses monitoring information for "*identification and priority setting for water quality-limited segments still requiring total maximum daily loads,*" in accordance with 40 CFR 130.7(b), and for reporting "*an estimate of the extent to which Clean Water Act control programs have improved water quality or will improve water quality . . . and recommendations for future actions necessary and identifications of waters needing action*" in accordance with 40 CFR 130.8(b)(2).

Objective 2: Establish, review, and revise water-quality standards, including use designations and use attainability.

All stream, lake, and groundwater-monitoring information is available to help establish, review, or revise water-quality standards. Specific applications include: (a) defining and designating uses in Illinois waters, (b) determining numeric thresholds for assessing use attainment, and (c) determining numeric thresholds for effluent limits.

Illinois EPA recognizes the ultimate Clean Water Act (Section 101(a)) goal to "*restore and maintain the chemical, physical, and biological integrity of the Nation's waters*". The objective of protecting (i.e., "*maintain*"ing) Illinois least-impacted waters that are currently the closest to achieving this goal is encompassed in our **Objective 2**. Designating uses for each waterbody includes the responsibility to determine each waterbody's potential in terms of each beneficial use. For Illinois waters, designating the appropriate uses requires recognizing that current conditions must be maintained (protected), if such conditions already represent (as much as reasonably possible) progress toward achieving the ultimate Clean Water Act goal. For example, for the period covered by this monitoring strategy, Illinois EPA's intention to address tiered aquatic-life uses for Illinois streams includes designating the aquatic-life use that represents the most-natural biological condition that is reasonably possible in the stream. This aspect of use designation provides a mechanism to maintain (protect) streams that currently represent the most-natural conditions in Illinois. Such protection is thereby encompassed in this **Objective 2**.

Development of water-quality standards for Illinois often requires information on ancillary water-quality parameters related to or influencing the parameter for which a standard is being developed, as well as for the parameter itself. For example, development of the sulfate standard required analyses of hardness and chloride data. Additionally, data from the waters of the state are important to gauge impact of the proposed standard and to answer important questions such as: What natural or anthropogenic factors affect attainability of the proposed standard? Such analysis helps to determine whether a national criterion suits the Illinois environment or the criterion needs regional modifications.

As part of the process for establishing new or revised groundwater-quality standards, Section 8(b)(1) of the Illinois Groundwater Protection Act [415 ILCS 55/8(b)(1) (1998)], states that the Illinois Pollution Control Board shall consider the following, in addition to the factors set forth in Title VII of the Environmental Protection Act, in promulgating water quality standards for groundwater:

1. Recognition that groundwater differs in many important respects from surface water, including water quality, rate of movement, direction of flow, accessibility, susceptibility to pollution, and use.

2. Classification of groundwater on an appropriate basis, such as its utility as a resource or susceptibility to contamination.

3. Preference for numerical water-quality standards, where possible, over narrative standards, especially where specific contaminants have been commonly detected in groundwater or where federal drinking-water levels or advisories are available.

4. Application of nondegradation provisions for appropriate groundwaters, including notification limitations to trigger preventive response activities.

5. Relevant experiences from other states where groundwater-protection programs have been implemented.

6. Existing methods of detecting and quantifying contaminants with reasonable analytical certainty.

Objective 3: Implement water-management programs.

Illinois EPA BOW uses water-quality-monitoring data from streams, lakes, and groundwater to support implementation of various water-management programs and associated projects. These applications include, but are not limited to, the following:

1. Implement lake-restoration projects through the Illinois Clean Lakes Program.

2. Determine the extent of use impairment and identify potential causes and sources of use impairment for the purpose of developing and prioritizing Total Maximum Daily Loads.

3. Develop watershed plans, determine Best Management Practices, and implement restoration projects through adaptive management for the control of nonpoint-source pollution through the Section 319 Program.

4. Prioritize inspections of permitted point-source discharges and other regulated facilities via the National Pollutant Discharge Elimination System Permit Program.

5. Implement statewide groundwater- and wellhead-protection programs.

When using water-quality data to implement programs and projects, Illinois EPA BOW maintains flexibility by annually reviewing and revising monitoring priorities based on availability of resources or competing needs for monitoring information.

Objective 4: Evaluate the effectiveness of water-management programs.

Illinois EPA BOW uses water-quality data from streams, lakes, and groundwater to evaluate the effectiveness of various water-management programs and associated projects. These applications include, but are not limited to, the following:

1. Evaluate effectiveness of restoration activities in lakes through the Illinois Clean Lakes Program.

2. Estimate the extent to which water-pollution-control programs have improved water quality or will improve water quality for *Aquatic Life Use, Primary Contact Use,* and *Secondary Contact Use*, in accordance with 40 CFR 130.8(b)(2), through regular assessments of use attainment in waters statewide.

3. Determine the effectiveness of watershed-management actions (i.e., best-management practices) and evaluate "*to the extent that appropriate information is available, reductions in nonpoint source pollutant loading and improvements in water quality . . . resulting from implementation of the management program*" in accordance with Clean Water Act Section 319(h)(11).

4. Evaluate impacts on aquatic life of National Pollutant Discharge Elimination System permitted discharges, and evaluate the effectiveness of inspection and compliance-assurance activities of dischargers.

5. Use wastewater-discharge data and other facility data to generally assess the performance of treatment facilities.

6. Evaluate statewide groundwater-protection programs.

MONITORING DESIGN

Water Quality Monitoring Programs

Illinois EPA BOW has developed and currently conducts various monitoring programs and efforts to assess the quality of the state's surface and ground waters and to evaluate the effectiveness of policies and activities related to water-pollution control, drinking-water protection, and groundwater protection. Aspects of these programs are required by the federal Clean Water Act, the Illinois Environmental Protection Act, and the Illinois Groundwater Protection Act. For example, in 1986, the Illinois Environmental Protection Act was amended to require an ambient-groundwater-monitoring program. Also, the Illinois Groundwater Protection Act, adopted in 1987, requires implementation of an ambient-monitoring network that includes community-water-supply wells.

These monitoring programs range from comprehensive ambient monitoring of lakes and streams, to fixed-station groundwater monitoring, to specialized wastewater monitoring that assesses compliance or facility performance, to groundwater testing for herbicide-transformation products. The monitoring design of each program is based on waterbody type (e.g., lake, stream, groundwater) and specific primary objectives. Consequently, each program has a unique combination of sampling design, stations, sampling frequency, and parameters monitored (Appendix A).

Table 1 shows each of BOW's aforementioned primary monitoring objectives (rows) and each BOW monitoring program or effort (columns) currently operating or expected to be in operation during the next six years, 2015 through 2020. An assessment of the extent to which each program or effort meets its primary objectives is included. Overall, Illinois EPA places highest priority on the monitoring programs or efforts that contribute critical information toward meeting objectives 1a. and 1b: determining attainment of designated uses and identifying causes and sources of use impairment. Accordingly, Illinois EPA gives high priority to every monitoring program or effort indicated in the first four rows of Table 1 as being currently sufficient (dark circles) or partially sufficient with improvements planned for 2015–2020 (circle with crosshairs). Illinois EPA recognizes that currently projected availability of resources can change in unforeseen ways. Therefore, during the 2015-2020 period addressed by this monitoring strategy, Illinois EPA acknowledges the potential need to further discuss and reassess these general priorities.

Table 2 includes an overview of each BOW monitoring program. The Illinois EPA BOW Quality Assurance Project Plan (Illinois EPA 1994) and various currently approved standard operating procedures contain more detailed information about the field, laboratory, and data-management procedures typically used in these programs.

Table 1. Primary objectives of Illinois EPA Bureau of Water monitoring and the extent to which each program or effort meets primary objectives.

Not every program or effort is designed to meet every objective. Illinois EPA participates in various monitoring activities not directly associated with a primary agency program or effort; such activities are not included[1,2]. "●" = objective is sufficiently supported; room for improvement, but not a priority. "⊕" = objective is partially supported; improvement efforts planned for 2015-2020. "○" = objective is partially supported; potential improvements beyond 2020.

Primary Monitoring Objective	Surface Water Section							Surface Water & Field Operations Sections	Watershed Manage-ment Section	Division of Water Pollution Control/Field Operations, Permits, & Compliance Assurance Sections		Toxicity Assess-ment Unit	Groundwater Section
	Ambient Water Quality Monitoring Network	Intensive Basin Surveys	Facility Related Stream Surveys	Ambient Lake Monitoring Program	Illinois Clean Lakes Program	Volunteer Lake Monitoring Program – Tier 3	Lake Michigan Monitoring Program	Harmful Algal Bloom & Algal Toxin Monitoring Program	Nonpoint Source/BMP, TMDL Monitoring	NPDES Permittee Self-Monitoring	Municipal/ Industrial-Effluent Monitoring	Fish Contaminant Monitoring Program	Groundwater Monitoring
1a. Determine attainment of designated uses & identify impaired waters	⊕	⊕	⊕	⊕	○	○	●	⊕	⊕			●	⊕
1b. Identify causes & sources of impairment	⊕	⊕	⊕	⊕	○	○	○		⊕	○	○	●	⊕
1c. Identify trends in water quality & maintain the flexibility to address emerging threats	⊕	⊕	⊕	⊕	○	○	○		⊕			●	⊕
2. Develop water-quality standards	⊕	○	○	⊕	○	○	○	○		○	○		⊕
3. Implement water-management program(s)	⊕	⊕	●	⊕	○	○	○	○	⊕	●	○	○	⊕
4. Evaluate the effectiveness of water-management programs	⊕	○	⊕	⊕	○	○	○		⊕	●	○	○	⊕

[1] Illinois EPA continues to participate in USEPA's National Aquatic Resource Surveys: National Lakes Assessment, National Rivers and Streams Assessment, National Wetland Condition Assessment, and National Coastal Condition Assessment. Although not directly intended to meet state-scale objectives, these surveys can provide useful context for state-based monitoring activities.

[2] Although not yet an established state-based monitoring program, efforts to monitor the condition of Illinois wetlands are planned for 2015–2020. Illinois EPA, with USEPA Region 5 and the Illinois Natural History Survey, expects to address how to define and designate appropriate beneficial uses for Illinois wetlands and how to assess attainment of those uses for purposes of Clean Water Act 305(b)/303(d) integrated reporting.

Table 2. Overview of Illinois EPA water-monitoring programs

Monitoring Program or Activity	Parameters or Features Monitored (Appendix A)	Summary and Comments
Ambient Water Quality Monitoring Network	Chemical and physical properties of water	Sampling sites in each of three regions: south (51), central (44), and north (51). Except for Mississippi River sites, each site is sampled once every 6 weeks (9 times per year). Mississippi River sites are sampled once every three months.
Intensive Basin Surveys	Water and sediment chemistry, habitat quality, fish assemblage, and macroinvertebrate assemblage	Surveys conducted using a 5-year basin rotation approach cooperatively with the Illinois Department of Natural Resources; each basin survey comprises about 10 to 35 sites. Six to eight basin surveys annually; one to three surveys per each of three regions (north, central, south) per year.
Facility-Related Stream Surveys	Water and effluent chemistry, habitat quality, macroinvertebrate assemblage	3 - 5 surveys per year, each survey consists of sampling upstream and incrementally downstream of wastewater-treatment discharges. Sampling may be conducted in response to legal, Combined Sewage Overflow, Total Maximum Daily Load, water quality standard issues; plant performance; or toxicity issues.
Ambient Lake Monitoring Program	Physical and chemical surface water data; Field conditions and observations data; Limited chemical sediment, biological, macrophyte, habitat, fish tissue contaminant data, and Harmful Algal Bloom samples.	14 to 19 lakes sampled annually in each of the three regions (north, central, south). Water samples are collected 5 times per year at each site : once in April or May, and once in each of June, July, August, and October. Sediment samples are collected once annually at new lakes, lakes near power plant or mining areas, lakes where sampling has not been conducted for a long period of time, or as necessary. Biological, habitat, and fish-tissue data, as well as Harmful Algal Bloom samples, may also be collected by Illinois EPA or other designated entities.
Harmful Algal Bloom (HAB) and Algal Toxin Monitoring	Field observations, microcystins, dissolved oxygen, water temperature, and pH when available.	Sampling consists of two primary components: routine and bloom sampling. Routine samples are collected at a subset of Lake Co. inland lake beaches bi-weekly Memorial Day through Labor Day by the Lake County Health Department. Illinois EPA collects samples at 1 to 2 public access points on a subset of ambient lakes and at source water intakes four times June through Oct.. Bloom samples are collected as one-time samples as resources allow.
Illinois Clean Lakes Program Phase I and Phase II Monitoring	Water and sediment chemistry, temperature & dissolved oxygen profiles, fish tissue contaminants, lake level, bathymetry, macrophyte survey, phytoplankton composition, and shoreline erosion survey	Phase 1 and Phase 2 projects include physical observations and in-lake water chemistry sampling twice-monthly April through Oct., and once monthly Nov. through March for a one year period. Phytoplankton samples are collected five times during April through Oct., for identification and enumeration. Sediment samples are typically collected once annually. Bathymetric, shoreline, and macrophyte surveys are conducted once per study. Additionally, Phase 1 studies include tributary water chemistry monitoring during low and high flow periods.
Volunteer Lake Monitoring Program	Secchi disk transparency, water chemistry, temperature and dissolved oxygen profiles, and phytoplankton (occasionally)	Tier 1: Secchi Disk transparency only, twice per month from May through October at all stations, approximately 85 Tier 1 lakes. Tier 2: Tier 1 monitoring requirements and frequency + water chemistry sampling once per month from May – August at Station 1 only. There are approximately 75 Tier 2 lakes. Tier 3: Tier 1 monitoring requirements and frequency + water chemistry taken at Station 1, surface and bottom, and may have additional stations added on a site specific basis, sampling once per month from May – August and October. Dissolved oxygen and temperature profiles collected at all stations covered by Tier 1, as well. There are approximately 15 Tier 3 lakes.
Lake Michigan Monitoring Program	Water chemistry, sediment chemistry (harbors), and fish tissue contaminants	Three program components: Nearshore (25 probabilistic sites), Harbor (fixed sites, 1-3 harbors), and Public Water Supply (3-5 fixed sites) monitoring, sampled for water chemistry three rounds during the sampling season (May through October), typically June, August, and October. Sediment chemistry is sampled in harbors, once during the sampling season.
Nonpoint Source/BMP, TMDL Monitoring	Metric/parameter coverage as necessary	Includes monitoring at the watershed scale to address causes and sources of use impairment, watershed planning needs, defining critical areas, Best Management Practice (BMP) effectiveness, Total Maximum Daily Load effectiveness, and other project-specific needs.
Fish Contaminant Monitoring Program	Fish-tissue contaminants	Typically, about 250 fish tissue samples are collected per year statewide by the Illinois Department of Natural Resources. Fish tissue analysis is conducted by the Illinois EPA laboratory. For current Fish Advisory information, please visit: http://www.idph.state.il.us/envhealth/fishadvisory/index.htm
Special Surveys	Various as necessary for survey objectives	Surveys may consist of mini-intensive surveys, sediment chemistry or fish contaminant surveys, lake quality assessments, livestock waste sampling, toxic contaminants, or monitoring to satisfy conditions of grant-funded projects.
Groundwater -Ambient Network of Community Water Supply Wells -Rotating Monitoring Network	Water chemistry	Sampling is conducted out of the Rockford Regional Office and Springfield Central Office. There are 356 fixed stations for the Ambient Network, sampled one time per year on a biennial rotation with the Rotating Monitoring Network.

Ambient Water Quality Monitoring Network

1. Relationship to Monitoring Objectives.

	Primary Monitoring Objective "●" = objective is sufficiently supported; room for improvement, but not a priority. "⊕" = objective is partially supported; improvement efforts planned for 2015-2020. "○" = objective is partially supported; potential improvements beyond 2020					
	1a. Determine attainment of designated uses & identify impaired waters	1b. Identify causes & sources of impairment	1c. Identify trends in water quality & maintain the flexibility to address emerging threats	2. Develop water-quality standards	3. Implement water-management program(s)	4. Evaluate the effectiveness of water-management programs
Ambient Water Quality Monitoring Network	⊕	⊕	⊕	⊕	⊕	⊕

2. Program Summary. The Ambient Water Quality Monitoring Network comprises 146 stations. At each station, water samples are collected once every six weeks and analyzed for a minimum of 56 physicochemical properties including pH, temperature, specific conductance, dissolved oxygen, suspended solids, nutrients, fecal-coliform bacteria, and total and dissolved metals. Additional parameters specific to the station or watershed are also analyzed. Appendix B provides a comprehensive description of the Ambient Water Quality Monitoring Network. Additional information can also be found on our website http://www.epa.state.il.us/water/surface-water/river-stream-mon.html.

The Illinois EPA has been routinely monitoring pesticides in water at a subset of ambient-network stations since October 1985. These pesticides include common herbicides and insecticides currently in use. In addition, the samples are also analyzed for organochlorine pesticides, such as DDT, and polychlorinated biphenyls. Since 2006, the number of sites sampled for pesticides has been set at 20 and reflect an emphasis on monitoring near public- water-supply intakes while continuing to monitor at some of the original stations for long-term trends. At these locations, pesticide samples are collected once every six weeks.

As part of ambient-network monitoring, Illinois EPA has collected chlorophyll samples since October 2000. A subset of 32 stations was originally selected to provide information potentially useful for developing nutrient criteria. This subset has expanded to 50 stations across the state. At these locations, chlorophyll samples are collected once every six weeks.

Intensive Basin Surveys

1. Relationship to Monitoring Objectives.

	Primary Monitoring Objective "●" = objective is sufficiently supported; room for improvement, but not a priority. "⌖" = objective is partially supported; improvement efforts planned for 2015-2020. "○" = objective is partially supported; potential improvements beyond 2020					
	1a. Determine attainment of designated uses & identify impaired waters	1b. Identify causes & sources of impairment	1c. Identify trends in water quality & maintain the flexibility to address emerging threats	2. Develop water-quality standards	3. Implement water-management program(s)	4. Evaluate the effectiveness of water-management programs
Intensive Basin Surveys	⌖	⌖	⌖	○	⌖	○

2. Program Summary. Surveys are conducted in selected basins each year by Illinois EPA BOW in cooperation with the Illinois Department of Natural Resources. Each Intensive Basin Survey is designed to meet several objectives, some of which apply only to one of the two cooperating entities. Basins are selected each year so that statewide coverage is achieved once every five years. Each year, more than 100 stations are monitored for biological, chemical, and physical indicators of aquatic-resource condition.

Intensive Basin Surveys are a major source of information for assessing attainment of Aquatic Life Use in Illinois streams. At each station, fish and macroinvertebrate assemblages, physical habitat (including stream discharge), and water chemistry are measured or otherwise characterized to determine resource conditions. Continuous monitoring of water temperature, pH, dissolved oxygen, and conductivity is conducted at each station for two seven-day periods (June 1 – July 31 and August 1 – October 15). Sampling for fish-tissue contaminants and sediment chemistry also is conducted to screen for the accumulation of toxic substances. For Intensive Basin Survey sites that occur near a site in the Ambient Water Quality Monitoring Network, water-chemistry information from the ambient-network site is used. Appendix C provides a comprehensive description of the Intensive Basin Survey program. Additional information can also be found on our website http://www.epa.state.il.us/water/surface-water/river-stream-mon.html.

Facility-Related Stream Surveys

1. Relationship to Monitoring Objectives.

	Primary Monitoring Objective "●" = objective is sufficiently supported; room for improvement, but not a priority. "⌖" = objective is partially supported; improvement efforts planned for 2015-2020. "○" = objective is partially supported; potential improvements beyond 2020					
	1a. Determine attainment of designated uses & identify impaired waters	1b. Identify causes & sources of impairment	1c. Identify trends in water quality & maintain the flexibility to address emerging threats	2. Develop water-quality standards	3. Implement water-management program(s)	4. Evaluate the effectiveness of water-management programs
Facility Related Stream Surveys	⌖	⌖	⌖	○	●	⌖

2. Program Summary. Illinois EPA conducts Facility Related Stream Surveys primarily on wadeable streams. These surveys involve the collection of macroinvertebrate, water chemistry, stream flow, and habitat data upstream and incrementally downstream from discharges of municipal or industrial wastewater-treatment facilities. Continuous monitoring of water temperature, pH, dissolved oxygen, and conductivity may also be done at selected stations. The monitoring information is used to evaluate water-quality impacts and the need for additional wastewater-treatment controls. Data are also used to (a) characterize the existing and potential aquatic resource of each receiving stream; (b) determine whether there is a significant impact on aquatic life in the receiving stream; and (c) support NPDES permitting activities.

Criteria for selecting discharge facilities at which to conduct a Facility Related Stream Survey are based on several factors including requests from Illinois EPA BOW field staff to document federal Clean Water Act 303(d) listings, water-quality-standards issues, NPDES permit-expiration dates, and identification of effluent toxicity. Facility Related Stream Surveys are also frequently linked with Intensive Basin Surveys (i.e., conducted in the same time frame and watershed). Depending on staff resources, three to five facility-related surveys may be conducted annually, usually during July through September. Additional information can be found on our website http://www.epa.state.il.us/water/surface-water/river-stream-mon.html.

Ambient Lake Monitoring Program

1. Relationship to Monitoring Objectives.

	Primary Monitoring Objective "●" = objective is sufficiently supported; room for improvement, but not a priority. "⊕" = objective is partially supported; improvement efforts planned for 2015-2020. "○" = objective is partially supported; potential improvements beyond 2020					
	1a. Determine attainment of designated uses & identify impaired waters	1b. Identify causes & sources of impairment	1c. Identify trends in water quality & maintain the flexibility to address emerging threats	2. Develop water-quality standards	3. Implement water-management program(s)	4. Evaluate the effectiveness of water-management programs
Ambient Lake Monitoring Program	⊕	⊕	⊕	⊕	⊕	⊕

2. Program Summary. Illinois EPA conducts the Ambient Lake Monitoring Program (ALMP) at approximately 40 – 50 inland lakes annually to determine attainment of various designated uses (e.g., Aquatic Life Use, Aesthetic Quality Use, Public and Food Processing Water Supply Use); to identify impaired waters and causes and sources of impairments; to encourage development of management plans; and to evaluate the effectiveness of programs implemented. In 2008, the ALMP three-year lake sampling rotation was modified to more closely resemble the Intensive Basin Survey stream-monitoring schedule, where surveys are conducted in selected basins each year in cooperation with the Illinois Department of Natural Resources. Basins are selected each year so that statewide coverage is achieved once every five years. This allows more lakes to be sampled and more data collected in the same watershed, which results in better assessments and watershed-management decisions. The shift to a basin approach allows Illinois EPA BOW the ability to continue assessing lake trends. Lakes that serve as a source of drinking water are also sampled every five years. Other lakes in the basin may be included as part of the current year's sampling schedule, but may not necessarily be sampled again in five years.

Lakes in the ALMP are monitored five times during the sampling season: once during the spring runoff and turnover period in April or May; once in June, July, and August; and once during fall turnover in October. Data are routinely collected from three distinct lake stations. A near-surface and a near-bottom water sample are collected at Station 1, which is the deep lake station (usually near the dam in reservoirs). Station 2 is generally at mid-lake and Station 3 is typically located in the headwater area of the lake. Near-surface-only water samples are collected at Stations 2 and 3. Water-quality parameters analyzed include; pH, temperature, specific conductivity, dissolved oxygen, suspended solids, nutrients, chlorophyll, and phytoplankton. A sediment grab sample is collected once annually at a representative site at: new lakes, lakes near a power plant or mining areas, lakes where sampling has not been conducted for a long period of time, or as

determined necessary. Sediment samples are analyzed for organic and inorganic constituents. As part of the Source Water Protection Program, lakes that serve as a source for drinking water are also sampled for organic and inorganic compounds at a designated site near the intake.

In addition to water and sediment chemical data, ALMP monitoring includes the collection of physical data (e.g., temperature, Secchi disk transparency, turbidity), and field observations, (e.g., weather conditions, presence of algae, macrophyte density, lake/management activities).

Every year a subset of ALMP lakes (maximum 15) are chosen for expanded monitoring. The expanded monitoring includes additional surveys to be completed once each during the growing season. The macrophyte surveys, shoreline habitat, and macroinvertebrate surveys make up the expanded monitoring. These surveys are conducted to determine floristic quality and invasive-plant distribution, quantify the development and quality of in-lake and riparian habitat, and develop a Lake Macroinvertebrate Index of Biological Integrity. Illinois EPA intends to use these expanded surveys for assessing Aquatic Life Use. Additional information on the ALMP can be found on our website http://www.epa.state.il.us/water/conservation/almp.html.

Illinois Clean Lakes Program

1. Relationship to Monitoring Objectives.

	Primary Monitoring Objective "●" = objective is sufficiently supported; room for improvement, but not a priority. "⊕" = objective is partially supported; improvement efforts planned for 2015-2020. "○" = objective is partially supported; potential improvements beyond 2020					
	1a. Determine attainment of designated uses & identify impaired waters	1b. Identify causes & sources of impairment	1c. Identify trends in water quality & maintain the flexibility to address emerging threats	2. Develop water-quality standards	3. Implement water-management program(s)	4. Evaluate the effectiveness of water-management programs
Illinois Clean Lakes Program	○	○	○	○	○	○

2. Program Summary. The Illinois Clean Lakes Program is a financial assistance grant program that fosters lake owners' interest and commitment to long-term, comprehensive lake management. Grant availability, and therefore number of projects implemented, in any given year depends on the level of Partners for Conservation funding appropriated by the state legislature. The allocation of funding for the Illinois Clean Lakes Program is uncertain at this time. However, if future support becomes available, Illinois EPA

intends to re-engage the program. Additional information can be found on our website http://www.epa.state.il.us/water/conservation/.

The monitoring design of the Illinois Clean Lakes Program is similar to that of the Ambient Lake Monitoring Program, with enhanced sampling frequency. For Phase I and II projects of the Clean-Lakes Program, lake monitoring is generally conducted twice a month from April to October and monthly from November to March for a one-year period. Water quality samples are collected from one foot below the lake surface, at intake depth (for lakes with a public-water-supply intake), and two feet above the lake bottom at the deepest station. For most lakes, a sample one-foot below the lake surface is also collected at two other in-lake stations. In addition, Phase I monitoring includes flow and chemical data collections at major inflows and outflows for development of nutrient, sediment, and hydrologic budgets. Phase I monitoring and mapping activities also include: major biological resources (e.g., phytoplankton, fish populations, and aquatic vegetation), bathymetric (water depth) maps, shoreline and sedimentation surveys, fish-contaminant monitoring conducted pursuant to the Fish Contaminant Monitoring Program, and surficial or core sediment sampling and analyses.

Detailed diagnostic/feasibility studies (Phase I) scientifically document causes, sources, and magnitude of lake impairment. Data generated from these monitoring studies are used to make recommendations for lake protection and restoration practices for future implementation. Final monitoring conducted at the conclusion of the Phase II project is intended to assess the effectiveness of the practices implemented during the Phase II portion of the project.

Volunteer Lake Monitoring Program

1. Relationship to Monitoring Objectives.

	Primary Monitoring Objective "●" = objective is sufficiently supported; room for improvement, but not a priority. "⊕" = objective is partially supported; improvement efforts planned for 2015-2020. "○" = objective is partially supported; potential improvements beyond 2020					
	1a. Determine attainment of designated uses & identify impaired waters	1b. Identify causes & sources of impairment	1c. Identify trends in water quality & maintain the flexibility to address emerging threats	2. Develop water-quality standards	3. Implement water-management program(s)	4. Evaluate the effectiveness of water-management programs
Volunteer Lake Monitoring Program – Tier 3	○	○	○	○	○	○

2. Program Summary. The Volunteer Lake Monitoring Program (VLMP) serves as an educational program that teaches Illinois citizens about lake ecosystems, contributing to understanding lake/watershed relationships and promoting informed decision-making. It also provides a cost-effective method of gathering fundamental information about inland lakes.

About 175 lakes statewide participate annually in the VLMP. To accommodate the varying needs of volunteers and Illinois EPA, a three-tiered approach for the collection and use of volunteer data was developed. Each tier requires a different level of effort, experience, and time commitment as described below.

Tier 1 volunteers collect Secchi transparency depth data at all established inland lake stations on their lake. In addition to Secchi data, Tier 2 volunteers collect water quality samples (nutrients and suspended solid parameters) at the lake's representative station (typically Site 1). Chlorophyll may be added as a parameter for Tier 2 sampling if the Tier 2 volunteer meets certain criteria determined by the Volunteer Lake Monitoring Regional or Statewide Coordinator. Tier 3 volunteers collect Secchi transparency depth, dissolved oxygen, and water temperature data at up to three established inland lake stations. Water quality and chlorophyll samples are also collected at each of these stations. Each year, approximately 10 -15 Illinois inland lakes are monitored by Tier 3 volunteers. In addition to lake monitoring, volunteers are trained to identify a suite of aquatic invasive species.

Illinois EPA continues to examine the role volunteer-collected data plays in environmental decision-making. Currently, Tier 1 and Tier 2 data are used for public education or for lake management purposes. Tier 3 data are used by Illinois EPA to make specific use-support decisions, which are incorporated into the Integrated Report for 303(d) purposes. Other uses of Tier 3 data include: diagnosing lake problems, encouraging development of management plans, and evaluating the effectiveness of programs implemented. More detailed information on the VLMP can be found at www.epa.state.il.us/water/conservation/vlmp and www.epa.state.il.us/water/conservation/vlmp/online-lake-database.html.

Lake Michigan Monitoring Program

1. Relationship to Monitoring Objectives.

	Primary Monitoring Objective "●" = objective is sufficiently supported; room for improvement, but not a priority. "⊕" = objective is partially supported; improvement efforts planned for 2015-2020. "○" = objective is partially supported; potential improvements beyond 2020					
	1a. Determine attainment of designated uses & identify impaired waters	1b. Identify causes & sources of impairment	1c. Identify trends in water quality & maintain the flexibility to address emerging threats	2. Develop water-quality standards	3. Implement water-management program(s)	4. Evaluate the effectiveness of water-management programs
Lake Michigan Monitoring Program	●	○	○	○	○	○

2. Program Summary. Recognizing the great importance of Lake Michigan as a natural asset, the 75th Illinois General Assembly authorized Illinois EPA, through 615 ILCS 5/14a, to "*regularly conduct water quality and lake bed surveys to evaluate the ecology and quality of water in Lake Michigan*." Additional information can be found on our website http://www.epa.state.il.us/water/surface-water/lake-michigan-mon.html.

Illinois EPA began implementation of its current Lake Michigan Monitoring Program in 2010. This program includes three components: Nearshore Monitoring, Harbor Monitoring, and Public Water Supply/Fixed Station Monitoring. A comprehensive description, including monitored parameters, of the Lake Michigan Monitoring Program is provided in Appendix D.

a. Nearshore Monitoring. This component is designed to describe Lake Michigan water quality within Illinois state boundaries from the shoreline to an offshore distance of 5 km, or a depth of 30 m, whichever comes first. The design is probability-based, consisting of 50 randomly selected stations, sampled over a period of two years (25 stations/year). Near-surface (0.5 m depth) water-quality samples are collected by Illinois EPA staff three times throughout the year; generally in June, August, and October. Ten of the 50 stations are randomly selected as "expanded stations," which, in addition to a near-surface water-quality sample, a sample is also collected 1 m off the lake bottom.

b. Harbor Monitoring. There are currently thirteen harbors along the Illinois coastline of Lake Michigan. Illinois EPA samples two to three harbors per year. Each harbor has one to four fixed stations based on harbor size. Water samples are collected three times throughout the year; generally in June, August, and October. Near-surface water samples are collected at 0.5 m below the water surface, and an additional bottom water sample (1.0 m off the bottom) is collected at one station per harbor. Sediment samples are collected at all harbor stations one time during the sampling season.

c. Public Water Supply / Fixed Station Monitoring. The Illinois portion of the Lake Michigan watershed is home to half of the total population of Illinois; the lake serves as the largest source of drinking water in the state, serving nearly 8.5 million people (of a total of over 10 million lake-wide). Public Water Supply stations are at fixed water-intake locations, sampled three times throughout the year. At each station, samples are collected 1 m off the lake bottom (or at intake depth), and an additional sample is taken 0.5 m below the water surface.

Harmful Algal Bloom and Algal Toxin Monitoring Program

1. Relationship to Monitoring Objectives.

	Primary Monitoring Objective "●" = objective is sufficiently supported; room for improvement, but not a priority. "⊕" = objective is partially supported; improvement efforts planned for 2015-2020. "○" = objective is partially supported; potential improvements beyond 2020					
	1a. Determine attainment of designated uses & identify impaired waters	1b. Identify causes & sources of impairment	1c. Identify trends in water quality & maintain the flexibility to address emerging threats	2. Develop water-quality standards	3. Implement water-management program(s)	4. Evaluate the effectiveness of water-management programs
Harmful Algal Bloom & Algal Toxin Monitoring Program	⊕			○	○	

2. Program Summary. Illinois EPA initiated a statewide monitoring program for Harmful Algal Blooms (HABs) and algal toxins in 2013 for the purpose of protecting Illinois citizens from adverse health effects due to recreational exposure to microcystin. The HAB Program is a collaborative effort between Illinois EPA and the Lake County Health Department Environmental Services. The Illinois HAB Program consists of two main components: a routine Pilot Survey component and an Event Response component. The routine Pilot Survey component is further divided into lake and beach components.

a. Routine Pilot Surveys. To help support monitoring objectives 1a, 1b, 1c, 2 and 3, the main sampling protocol will focus on routine sampling at public-access sites in Illinois lakes (e.g., beaches, boat ramps, and docks). Routine samples are collected at public-access sites at a subset of Illinois EPA's Ambient Lake Monitoring Program (ALMP) lakes and at intake locations (intake depth) at lakes serving as a source of public drinking water. Routine samples are also collected at a subset of Lake County inland lake beaches. The routine surveys are designed to obtain background levels of microcystin in Illinois inland lakes and to track trends in microcystin concentration across the state.

Routine samples collected as part of the ALMP are collected four times a year during the months of June through October. Samples collected at Lake County inland lake beaches are collected on a bi-weekly schedule during the period of Memorial Day through Labor Day. All samples are sent to the Illinois EPA laboratory in Springfield, IL for quantitative analysis of microcystins ADDA using the ELISA method.

b. *Event Response*. Illinois EPA staff, Lake County Health Department Environmental Services staff or other Illinois EPA-approved designated party will collect a one-time sample for microcystin as soon as possible after a direct observation of a cyanobacterial bloom by professional monitoring staff or when the information provided in the Bloom Report form submitted to Illinois EPA indicates a potentially harmful algal bloom.

The microcystin sample is screened within 24 hours of collection using a qualitative strip test for microcystin When strip test results indicates a microcystin concentration greater than 20 µg/l, the lake owner is promptly notified. Illinois EPA does not issue advisories or lake closures based on high levels of microcystin. However, Illinois EPA will provide information to lake owners so that they can assess the relative risk to their constituents and make appropriate public safety decisions. All Event Response samples will be sent to the Illinois EPA laboratory in Springfield, IL for quantitative analysis of microcystins ADDA using the ELISA method. Resampling will be conducted at lakes with confirmed microcystin concentrations above 20 µg/l as available resources allow.

Additional information can be found at the following Illinois EPA web address http://www.epa.state.il.us/water/algal-bloom/index.html.

Nonpoint Source Monitoring

1. Relationship to Monitoring Objectives.

	Primary Monitoring Objective "●" = objective is sufficiently supported; room for improvement, but not a priority. "⊕" = objective is partially supported; improvement efforts planned for 2015-2020. "○" = objective is partially supported; potential improvements beyond 2020					
	1a. Determine attainment of designated uses & identify impaired waters	1b. Identify causes & sources of impairment	1c. Identify trends in water quality & maintain the flexibility to address emerging threats	2. Develop water-quality standards	3. Implement water-management program(s)	4. Evaluate the effectiveness of water-management programs
Nonpoint Source/ BMP, TMDL Monitoring	⊕	⊕	⊕		⊕	⊕

2. Program Summary. There is a need to evaluate reductions in non-point source pollutant loading and improvements in water quality resulting from projects implemented under the Clean Water Act Section 319 program, Total Maximum Daily Loads, Illinois Green Infrastructure Grants program, Illinois Clean Lakes and other programs/studies. Monitoring at the watershed scale is best suited for this purpose. In addition, relevant data from various Agency monitoring programs or contractual efforts are used by Illinois EPA to develop watershed-based plans, develop TMDLs and their associated implementation plans, track implementation success, and do adaptive management. The overall goal is to assess success in improving or maintaining water quality. Additional information can be found on the Illinois EPA website: http://www.epa.state.il.us/water/watershed/nonpoint-source.html

National Pollutant Discharge Elimination System Permittee Self-Monitoring

1. Relationship to Monitoring Objectives.

	Primary Monitoring Objective "●" = objective is sufficiently supported; room for improvement, but not a priority. "⊕" = objective is partially supported; improvement efforts planned for 2015-2020. "○" = objective is partially supported; potential improvements beyond 2020					
	1a. Determine attainment of designated uses & identify impaired waters	1b. Identify causes & sources of impairment	1c. Identify trends in water quality & maintain the flexibility to address emerging threats	2. Develop water-quality standards	3. Implement water-management program(s)	4. Evaluate the effectiveness of water-management programs
NPDES Permittee Self-Monitoring		○		○	●	●

2. Program Summary. All permittees whose permits contain numerical effluent limits are required to perform effluent self-monitoring for the parameters regulated by their permit. Facilities designated as "major dischargers" are also required to perform whole effluent toxicity testing prior to renewal of their permits. The monitoring may be completed by Illinois EPA staff or by using a contract laboratory. Monitoring results are regularly reviewed by staff in the BOW Compliance Assurance and Field Operations Sections, and when results indicate permit limits are being exceeded, compliance or enforcement action may be initiated. The monitoring results are also considered when reviewing permit applications, developing water quality standards, and making use impairment decisions.

Municipal and Industrial Effluent Monitoring Program

1. Relationship to Monitoring Objectives.

	Primary Monitoring Objective "●" = objective is sufficiently supported; room for improvement, but not a priority. "⊕" = objective is partially supported; improvement efforts planned for 2015-2020. "○" = objective is partially supported; potential improvements beyond 2020					
	1a. Determine attainment of designated uses & identify impaired waters	1b. Identify causes & sources of impairment	1c. Identify trends in water quality & maintain the flexibility to address emerging threats	2. Develop water-quality standards	3. Implement water-management program(s)	4. Evaluate the effectiveness of water-management programs
Municipal/ Industrial-Effluent Monitoring		○		○	○	○

2. Program Summary. Monitoring of municipal and industrial wastewater treatment facilities in Illinois is the responsibility of BOW's Division of Water Pollution Control, Field Operations Section. Illinois EPA BOW's wastewater monitoring programs are conducted from seven regional offices located throughout the state: Des Plaines, Rockford, Peoria, Champaign, Springfield, Collinsville, and Marion.

Illinois EPA BOW's municipal and industrial effluent monitoring provides inspections and monitoring of NPDES discharges and other wastewater sources (e.g., livestock, stormwater) to verify compliance with applicable permit limits and water-pollution-control laws and regulations.

An annual strategy for the Division of Water Pollution Control's inspection program is prepared and provided to USEPA Region 5 pursuant to the annual Performance Partnership Agreement. Procedures for routine wastewater effluent monitoring are provided in a *Facility Inspection Manual for Reconnaissance Technicians* (IEPA 1992). A *Field Procedures Manual* has also been developed and recently revised to provide program and training guidance to Field Operations Section staff (IEPA 2013).

Fish Contaminant Monitoring Program

1. Relationship to Monitoring Objectives.

	Primary Monitoring Objective "●" = objective is sufficiently supported; room for improvement, but not a priority. "⊕" = objective is partially supported; improvement efforts planned for 2015-2020. "○" = objective is partially supported; potential improvements beyond 2020					
	1a. Determine attainment of designated uses & identify impaired waters	1b. Identify causes & sources of impairment	1c. Identify trends in water quality & maintain the flexibility to address emerging threats	2. Develop water-quality standards	3. Implement water-management program(s)	4. Evaluate the effectiveness of water-management programs
Fish Contaminant Monitoring Program	●	●	●		○	○

2. Program Summary. Illinois EPA participates in the Fish Contaminant Monitoring Program in accordance with a memorandum of agreement with Illinois Department of Natural Resources, Illinois Department of Public Health, and Illinois Department of Agriculture. Fish-tissue samples are analyzed for approximately 17 or 18 parameters (not all samples are routinely analyzed for mercury). For 2009-2013, 220-290 fish-tissue samples were collected per year from about 200 Illinois inland lakes and streams. A total of 130 fish samples were also collected from the Illinois waters of Lake Michigan and four harbors. Additional information can be found on our website http://www.epa.state.il.us/water/surface-water/fish-contaminant-mon.html.

The statewide monitoring network consists of the following components.

a. Intensive Basin Survey Samples. A minimum of one routine fish-tissue sample (i.e., two bottom feeders, one omnivore, and one predator species) is collected from each basin scheduled for an intensive survey each year. Additional routine samples may be collected at the discretion of the field sampling team where it is known or anticipated that the public regularly fishes in the waterbody (e.g., presence of a boat launch, evidence of fishing activity such as discarded bait containers). Such samples focus on the species and sizes of fish known or anticipated to be sought by anglers. Fish-tissue samples may also be collected from specific waterbodies within basins scheduled for an intensive survey, or in response to requests from the public or local officials.

b. Follow-up Samples. Specific numbers and sizes of one or more species (often two sizes of bottom feeders, omnivores, and predators, plus one panfish and any other species regularly targeted by anglers) may be requested by the Fish Contaminant Monitoring Program to follow up on bodies of water where previous samples have indicated one or more species exhibit contaminants above a level of concern—either risk-based or U.S. Food and Drug Administration criteria. Such samples are also

requested on a regular basis to evaluate the continued need for an existing advisory on a species or modifications of the existing advisory.

c. Lower Priority Samples. Bodies of water from which no species have been found with contaminants above a level of concern—either risk-based or U.S. Food and Drug Administration criteria—are assigned a lower priority for sampling frequency. Such bodies shall be resampled on a recurring basis (e.g., every five to ten years), as permitted by budgetary and laboratory capacity constraints.

d. Lake Michigan Samples. Samples of Chinook salmon, coho salmon, lake trout, rainbow trout, brown trout, yellow perch, rainbow smelt, bloaters, or alewives are collected annually from the open waters of Lake Michigan according to specific size ranges for salmon and trout and as available for other species. In addition, selected harbors and tributaries are sampled for representative predators, omnivores, and bottom feeders, as needed.

e. Special Samples. As necessitated by special circumstances (e.g., investigations of spills, fish kills, and toxic chemical cleanup stations) the Fish Contaminant Monitoring Program may request specific numbers and sizes of selected fish or other aquatic species be collected by field sampling teams or other personnel. Such samples may be designated as high priority for analysis by Illinois EPA or another designated laboratory. Costs for collection and analysis of such samples shall be paid, to the extent possible, by the party or parties responsible for the special circumstance.

Groundwater Monitoring Program

1. Relationship to Monitoring Objectives.

	Primary Monitoring Objective "●" = objective is sufficiently supported; room for improvement, but not a priority. "⌖" = objective is partially supported; improvement efforts planned for 2015-2020. "○" = objective is partially supported; potential improvements beyond 2020					
	1a. Determine attainment of designated uses & identify impaired waters	1b. Identify causes & sources of impairment	1c. Identify trends in water quality & maintain the flexibility to address emerging threats	2. Develop water-quality standards	3. Implement water-management program(s)	4. Evaluate the effectiveness of water-management programs
Ground-water Monitoring	⌖	⌖	⌖	⌖	⌖	⌖

2. Program Summary. Groundwater in Illinois is routinely monitored for biological and chemical contaminants and, to some degree, withdrawal rates. Currently, the Groundwater Monitoring program operates an ambient network of Community Water Supply (CWS) wells and a special rotating network. Illinois EPA has operated an

ambient network of CWS wells via a rotating approach since 1997. The random stratified probabilistic network consisting of 356 fixed stations is sampled every other year to allow the flexibility to conduct special/intensive monitoring during the second year cycle.

Components of the Rotating/Special/Intensive Groundwater Monitoring Network include, but may not be limited to, the following:

a. *Highly Susceptible Community Water Supply Monitoring Network*
b. *New Community Water Supply Well Monitoring Network*
c. *Inorganic Chemical Trend Monitoring Network of Community Water Supply Wells*

The purpose of the Rotating/Special/Intensive monitoring network is to maximize resources and increase monitoring coverage of groundwater quality at CWS wells. It was determined that the primary purposes of the probabilistic network referred to above, could be realized by reducing the monitoring frequency to a biennial basis. As a result, Illinois EPA is currently able to concentrate on specialized monitoring programs at high priority areas during alternative years. The rotation between the probabilistic network and the rotating monitoring network/special intensive monitoring program has been carried forth to the current day, and will be maintained in the future, pending available resources. Appendix E provides a comprehensive description of the Groundwater Monitoring Program. Additional information can be found on our website http://www.epa.state.il.us/water/groundwater/index.html

Overview of Major Monitoring Gaps and Weaknesses and Improvement Efforts Planned for 2015 through 2020

The different monitoring programs and efforts described in this Strategy are designed to focus on varying temporal and spatial scales. This makes it challenging to determine the degree to which each of the primary monitoring objectives (i.e., each row in Table 1) is being supported holistically rather than on a program-specific basis. As Table 1 implies, the ultimate goal is to advance every monitoring program or effort to "*sufficiently supported*" status (black circle) for every relevant monitoring objective.

Current practical limits on time, expertise, and supporting funds prevent achievement of this ideal. To meet our varied monitoring needs, Illinois EPA BOW believes that the best strategy for improvement is to first address programs and efforts individually. As program-specific advances are realized, Illinois EPA will try to capitalize as much as possible on incorporating improvements that can benefit multiple programs simultaneously. In the meantime, Illinois EPA BOW will review and coordinate current monitoring programs and efforts to maximize their BOW-wide benefits as much as reasonably possible.

Planned Monitoring Efforts for 2015–2020

In 2015 through 2020, Illinois EPA BOW will initiate several monitoring efforts intended to advance the primary objectives of BOW monitoring (Table 3). These planned efforts respond to the need to address gaps and weaknesses that currently prevent Illinois EPA BOW from fully meeting the primary objectives of each program (Table 1). Where applicable, some of the planned effort includes a preliminary development and implementation schedule. During the 2015 – 2020 period, each schedule may change based on various factors such as changes in priorities or in available staffing or other resources. While we will endeavor to do so, Illinois EPA cannot guarantee that each schedule will be adhered to as indicated herein.

By necessity, each implementation schedule, represented as a table at the end of the description of each planned effort, is general. In order to provide more specificity, each table entry is defined as:

Research:	Learn about and define the monitoring component, and justify the need for it.
Design:	Define the objective of the monitoring component and determine how to incorporate it in the existing monitoring program or activity.
Field:	Collection of data.
Lab:	Laboratory analysis of collected field data.
Report:	Compile laboratory results into a report to be used as a tool in the evaluation process.
Evaluate:	Assess how the monitoring component is contributing to its intended objective and redesign the component as necessary.
Implement:	Apply the monitoring component and maintain its operation.
Ongoing:	Monitoring component has been successfully implemented.

Table 3. Bureau of Water planned monitoring efforts for 2015 through 2020

The monitoring objectives expected to be advanced by each effort are indicated by number. All planned monitoring efforts are scheduled to be completed by 2020, assuming necessary funds and resources are available. Some planned efforts do not pertain directly to an existing monitoring program or effort; these are indicated as a blank (grey) table cell.

Primary monitoring objectives:

1a. Determine attainment of designated uses and identify impaired waters.
1b. Identify causes and sources of impairments to water quality.
1c. Identify trends in water quality and maintain the flexibility to address emerging threats to water quality.
2. Establish, review, and revise water-quality standards, including use designations and use attainability.
3. Support implementing water-management programs.
4. Support evaluating the effectiveness of water-management programs.

Monitoring Programs:

ALMP = Ambient Lake Monitoring Program
FRSS = Facility Related Stream Surveys
HAB = Harmful Algal Bloom & Algal Toxin Monitoring Program
IBS = Intensive Basin Surveys (streams)
AWQMN = Ambient Water Quality Monitoring Network (streams)

Surface Water Monitoring Efforts	Monitoring Program(s) or Effort	Relevant Monitoring Objectives
1. Expand monitoring of algal toxins in selected lakes.	HAB, ALMP	1a, 1b, 1c, 2, 3
2. Continue to conduct expanded monitoring surveys (macrophyte, shoreline, and macroinvertebrate) on inland lakes to develop a Lake Macroinvertebrate IBI.	ALMP	1a, 1b, 1c, 2, 3, 4
3. Address monitoring needs for supporting biological assessment based on tiered aquatic-life uses and corresponding biological criteria.		1a, 1b, 1c, 3, 4
4. Continue to incorporate probability-based monitoring.		1a, 1c
5. Monitor potential mining impacts on surface waters.	IBS, FRSS	1a, 1b, 1c, 3, 4
6. Monitor success of watershed-based restoration efforts in selected waters.	Watershed-based	3, 4
7. Monitor watersheds for stakeholder-driven watershed-plan development.	Watershed-based	1a, 1b, 3
8. Monitor effectiveness of BMP implementation at selected sites.	Watershed-based	3, 4
9. Implement a Statewide Nutrient Export Loadings Network	AWQMN	1a, 1b, 1c, 2, 3, 4
Groundwater Monitoring Efforts		
10. Evaluate VOC trend data from 1990 to the present and compare to probabilistic results.	Groundwater	1a, 1b, 4
11. Evaluate causal data to determine the potential source of VOC trends.	Groundwater	1c, 4
12. Continue discussion of groundwater-quality-standards development with the Groundwater Advisory Council and stakeholders; prepare Illinois Pollution Control Board proposal.	Groundwater	2
13. Continue to implement probabilistic and rotating groundwater-monitoring networks (fixed/special/intensive).	Groundwater	1b, 1c, 3
14. Conduct surveillance monitoring of potential hydraulic-fracturing impacts on groundwater resources.	Groundwater	1a, 1b

1. Expand monitoring of algal toxins in selected Illinois lakes. A new statewide monitoring effort for harmful algal blooms and algal toxins was initiated in Illinois during the 2013 monitoring season. Initial efforts included the analysis of total microcystins. Illinois EPA plans to continue collecting microcystin data for potential standard development and continue working with other state and local government agencies toward the goal of establishing a human-health-advisory program for microcystin. Illinois EPA plans to eventually revise assessment methodologies to include data collected in the Harmful Algal Bloom Program for assessing attainment of primary- and secondary-contact uses. Because 2013 was the first year of the Harmful Algal Bloom Program, Illinois EPA is still investigating potential expansion of the program to include collection of multiple algal toxins (e.g., anatoxin a, saxitoxin, cylindrospermopsin) and algal samples for identification and enumeration. As changes are made to the program, Illinois EPA will update its website to reflect those changes and to improve the educational component of the program for the public. Furthermore, Illinois EPA is investigating development of a database to house data from the Harmful Algal Bloom Program (e.g., algal toxin analyses, algal identification and cell counts, physicochemical data). This effort will advance monitoring objectives 1a, 1b, 1c, 2 and 3 (Table 1). Below is a schedule for plan implementation, contingent on continued and enhanced support outlined in Table 8.

Monitoring Component	2015	2016	2017	2018	2019	2020
Monitor microcystin for potential standards development	Ongoing					
Establish human-health-advisory program for microcystin, with other state and local agencies	Research	Design	Implement			
Revise methods for how to assess attainment of primary- and secondary-contact uses	Research	Research	Design	Implement		
Expand Harmful Algal Bloom Program by monitoring multiple algal toxins and defining/examining composition of the algal community	Design	Field	Lab	Report	Evaluate	
Develop database for Harmful Algal Bloom-related data	Design	Implement				

2. Continue to conduct expanded monitoring surveys (macrophyte, shoreline, and macroinvertebrate) on inland lakes to develop a Lake Macroinvertebrate Index of Biological Integrity. Illinois EPA began collecting macroinvertebrate data from Illinois inland lakes in 2008 for the purpose of developing a macroinvertebrate Index of Biological Integrity for lakes. In late 2013, Illinois EPA, via a contract between USEPA Region 5 and Tetra Tech, is working with Tetra Tech to develop the index. Illinois EPA plans to continue to conduct expanded surveys on a maximum of 15 Ambient Lake Monitoring Program lakes yearly. The expanded monitoring includes macrophyte

surveys, shoreline habitat, and macroinvertebrate surveys completed once during the growing season. These surveys are conducted to determine floristic quality and invasive plant distribution, to quantify the development and quality of in-lake and riparian habitat, and to develop the macroinvertebrate index. Illinois EPA intends to use these expanded surveys and macroinvertebrate IBI's to update the assessment methodology for determining attainment of Aquatic Life Use in Illinois inland lakes. This effort will advance monitoring objectives 1a, 1b, 1c, 2, 3, and 4 (Table 1). Below is a schedule for plan implementation, contingent on continued and enhanced support outlined in Table 8.

Monitoring Component	2015	2016	2017	2018	2019	2020
Continued collection of macrophyte, shoreline, and macroinvertebrate data on ambient lakes	Ongoing					
Update assessment methodologies to include expanded surveys and new IBI to assess attainment of Aquatic Life Use in Lakes	Research	Design	Implement			

3. Address monitoring needs for supporting biological assessment based on tiered aquatic-life uses and corresponding biological criteria. Illinois EPA recently assessed the technical and resource needs to support future biological assessment of aquatic-life uses based on a regulatory framework of tiered aquatic-life uses and corresponding biological criteria. For Illinois EPA to achieve the technical rigor required to support such a program, several aspects of stream monitoring will require reevaluation and refocusing or refinement. These aspects include: increasing the spatial density of monitoring sites; selecting the chemical, physical, and biological attributes to monitor; determining the monitoring frequency for each attribute; and changing the spatial focus from the current approach – which achieves statewide coverage of monitored sites at a frequency of once per every five years – to the watershed approach, which would require ten years or even more to achieve statewide coverage of monitored sites. Illinois EPA anticipates beginning to address these monitoring needs in 2015. Below is a schedule for plan implementation, contingent on continued and enhanced support outlined in Table 8.

Monitoring Component	2015	2016	2017	2018	2019	2020
Evaluate stream monitoring aspects for supporting biological assessment based on tiered aquatic-life uses & corresponding biological criteria	Research	Design	Field	Lab	Report	Evaluate

4. Continue to incorporate probability-based monitoring. Illinois EPA participates in probability-based monitoring at larger regional or national scales, as well as at the state scale. At regional/national scales, Illinois EPA has routinely participated either directly or indirectly in USEPA's National Aquatic Resource Surveys using Clean Water Act Section 106 monitoring-initiative-grant funding. These surveys provide an ongoing five-

year snapshot of the chemical, physical, or biological condition of the nation's waters. These national surveys include the National Lakes Assessment, the National Rivers and Streams Assessment, the National Wetland Condition Assessment, and the National Coastal Condition Assessment. At the state scale, the Lake Michigan Monitoring Program and the Groundwater Monitoring Program are both based on probability designs.

The following information summarizes, by waterbody type, the past and potential future probability-based monitoring activities for 2015-2020.

a. Lake Michigan. To address Clean Water Act reporting requirements at the state scale, Illinois EPA currently uses a probability-based design to monitor the condition of the Illinois portion of Lake Michigan. Illinois EPA expects to continue Lake Michigan probability-based monitoring at the state scale into the foreseeable future. For more information on this monitoring, see the section, Lake Michigan Monitoring Program, earlier in this chapter. At regional/national scales, Illinois EPA participated directly in the 2010 National Coastal Condition Assessment by monitoring conditions at three sites in Illinois' jurisdiction of Lake Michigan, as well as two sites located in Indiana's jurisdiction of the lake. Illinois EPA will not participate in the 2015 National Coastal Condition Assessment because the probabilistic selection of Lake Michigan sites did not include any sites in the Illinois portion of the lake. As resources allow, Illinois expects to directly participate in future National Coastal Condition Assessment monitoring at sites identified in the Illinois portion of Lake Michigan and remains open to monitoring sites in Indiana waters as well. Below is a schedule for plan implementation, contingent on continued and enhanced support outlined in Table 8.

Monitoring Component	2015	2016	2017	2018	2019	2020
Continue Lake Michigan Probability-based monitoring at the State scale	Ongoing					
Continue to Participate in the National Coastal Condition Assessment*					Design	Field

*From: http://water.epa.gov/type/watersheds/monitoring/aquaticsurvey_index.cfm

b. Inland Lakes. Illinois EPA participated in the 2007 National Lakes Assessment by monitoring conditions at 17 lakes per the national/regional scale probability-based survey draw. The final report of the 2007 national survey can be found at *http://water.epa.gov/type/lakes/upload/nla_newlowres_fullrpt.pdf*. Thirty-seven lakes were additionally drawn and monitored to contribute to a state-scale survey, and a statewide assessment of mercury in water. In 2012, Illinois EPA participated only in the national/regional scale National Lakes Assessment. For this survey, Illinois EPA contracted with the United States Geological Survey (USGS) to sample 13 lakes across the state. Illinois EPA expects to continue direct or indirect participation in national/regional scale National Lakes Assessments, and as resources allow, remains

open to considering the addition of sites to achieve a state-scale lakes assessment. Below is a schedule for plan implementation, contingent on continued and enhanced support outlined in Table 8.

Monitoring Component	2015	2016	2017	2018	2019	2020
Continue to Participate in the National Lakes Assessment*	Research	Design	Field	Lab	Report	Research

*From: http://water.epa.gov/type/watersheds/monitoring/aquaticsurvey_index.cfm

c. Wetlands. Most recently, Illinois EPA participated in the 2011 National Wetland Condition Assessment by entering into agreement with the Illinois Natural History Survey to monitor conditions at 12 Illinois sites (including revisits at two sites) and at 11 Indiana sites (with two revisits). For regional/national-scale purposes, Illinois EPA expects to continue direct or indirect participation in the National Wetland Condition Assessment. In 2015–2020, Illinois EPA, with USEPA Region 5 and the Illinois Natural History Survey, expects to discuss the potential for incorporating the use of the new wetland index of biotic integrity into a statewide assessment of wetland condition. Illinois EPA anticipates that future data used for these purposes will be collected based on the Illinois Natural History Survey's existing probability-based monitoring design of their Critical Trends Assessment Program. This design covers the entire state once every five years. Below is a schedule for plan implementation, contingent on continued and enhanced support outlined in Table 8.

Monitoring Component	2015	2016	2017	2018	2019	2020
Continue Participation in the National Wetland Condition Assessment*	Design	Field	Lab	Report	Research	Design
Investigate the use of the Wetland Index of Biotic Integrity into a Statewide Assessment of Wetland Condition.	Develop					

*From: http://water.epa.gov/type/watersheds/monitoring/aquaticsurvey_index.cfm

d. Streams. Most recently, Illinois EPA participated in the 2013-2014 National Rivers and Streams Assessment by entering into agreement with the USGS/Illinois Water Science Center to monitor conditions at 44 Illinois sites (including revisits at four sites) and at 30 Indiana sites (with four revisits). For regional/national-scale purposes, Illinois EPA expects to continue direct or indirect participation in the National Rivers and Streams Assessment. At the state scale, to address Clean Water Act reporting requirements across a larger proportion of Illinois waters than has been typically reported on in the recent past, Illinois EPA anticipates working with USEPA Region 5 to develop a statewide probability-based design for stream monitoring. Below is a schedule for plan implementation, contingent on continued and enhanced support outlined in Table 8.

Monitoring Component	2015	2016	2017	2018	2019	2020
Continue Participation in the National Rivers and Streams Assessment*	Lab	Lab	Report / Design	Field	Field	Lab
Partner with USEPA Region 5 to develop statewide probability-based design for Illinois streams	Research	Design	Field	Lab	Report	Evaluate

*From: http://water.epa.gov/type/watersheds/monitoring/aquaticsurvey_index.cfm

e. Groundwater. At the state scale, Illinois EPA currently uses a probability-based design to monitor the condition of groundwater. Illinois EPA expects to continue groundwater monitoring that is based on this design. For more information on this monitoring, see the section, Groundwater Monitoring Program, earlier in this chapter.

Monitoring Component	2015	2016	2017	2018	2019	2020
Continue probabilistic-based design for Groundwater Monitoring	Ongoing					

5. Monitor potential mining impacts on surface waters. Historically, Illinois EPA has monitored surface waters potentially impacted by mines in a general way as part of existing programs. Beginning in 2012, coordinated efforts were initiated to better understand and monitor impacts and potential impacts of operating mines to Illinois waters. During 2015 – 2020, Illinois EPA will expand this monitoring effort through increased coordination and communication to better use resources in existing programs. Sampling and monitoring efforts will focus on contaminants of concern typically associated with mining (e.g., chlorides, metals) with a primary goal of documenting and tracking changes in surface-water quality as a result of mining activities. This monitoring effort will help meet primary monitoring objectives 1a, 1b, 1c, 3, and 4.

Monitoring Component	2015	2016	2017	2018	2019	2020
Develop mechanism to increase coordination and communication with existing programs	Design	Implement				
Define sampling frequency and parameters monitored	Research	Design	Field	Lab	Report	Evaluate

6. Monitor success of watershed restoration efforts in selected waters.

National Water Quality Initiative

In FY2012, the USDA Natural Resource Conservation Service announced a new program, National Water Quality Initiative (NWQI). During 2012 and into 2013 the Illinois NRCS office selected three watersheds to be included in this program. Although Illinois EPA was included in the selection process, NRCS ultimately selected watersheds that were not a priority for implementation or monitoring activities by Illinois EPA. In

2013, two additional watersheds were added to the NRCS NWQI program and guidance was released by USEPA directing state water quality agencies to monitor one or more of the NWQI watersheds. Illinois EPA Watershed Management (WM) staff along with NRCS staff selected one watershed to meet the monitoring requirement of USEPA. The watershed selected is the Lake DeRevey Watershed in the North Fork Vermilion River Basin (HUC051201090804). Monitoring will be conducted by the WM staff once the Monitoring Strategy is completed for this project (October 2014). Illinois EPA has committed to 10 years of monitoring this watershed for water quality. Illinois EPA had hoped to partner with NRCS on this monitoring effort and conversations continue, but monitoring will begin without a Memorandum of Understanding between our Agencies.

Measure W (http://earth1.epa.gov/region9/water/watershed/measurew.html):
In response to Fiscal Year 2014 – 2018 EPA Strategic Plan: Charting Our Course (http://nepis.epa.gov/Adobe/PDF/P1001IPK.PDF) submitted to the U.S. Congress in September 2006, Illinois EPA plans to monitor water quality in selected impaired waters to identify problems and evaluate the effectiveness of watershed-based improvement efforts. Surveys will be linked whenever possible with stream Intensive Basin Surveys (e.g., conducted in the same time frame and watershed) and will focus on measuring the success of implemented Total Maximum Daily Load plans or Clean Water Act Section 319 projects (e.g., application of Best Management Practices). Surface Water Section staff will coordinate with Nonpoint Source and Total Maximum Daily Load staff to accomplish this linkage. Illinois EPA is working with USEPA Region 5 to plan appropriate management and monitoring efforts to affect improvement by 2020. This effort will advance monitoring objectives 3 and 4 (Table 1). These plans are contingent on enhanced funding and resource support outlined in Table 8. These ongoing efforts do not require an implementation schedule.

Kickapoo Creek National Nonpoint Source Pollution Monitoring Program: Through the use of Clean Water Act Section 319 funds, the Agency is supporting monitoring of this small tributary watershed, with Illinois EPA and Illinois Department of Natural Resources support. Stream restoration converted two miles (3 km) of agricultural drainage ditches in the east and west branches of Kickapoo Creek into meandering stream channels within an 80-acre (32-hectare) park. New wetland basins were created within the meander bends throughout the park to reduce stormwater runoff rates. The park landscape maximizes the enhancement of native wetland, riparian, and aquatic species for the parks trail system. Past sediment transport capacity in the restored stream segments has been maintained in order to prevent the loss of wetland plant communities and instream habitat resulting from excessive sediment deposition.

Monitoring is conducted according to an upstream/downstream design. Fish and macroinvertebrates are monitored in the restored reach and in an upstream control reach. Sediment and nutrient concentrations and loads are at stations upstream and downstream of the development area and at a third control station on the west branch of Kickapoo Creek. Effectiveness of created wetlands is being assessed by monitoring the concentration and loads of nutrients entering the wetland vegetation and the concentrations and loads entering the stream. Detailed monitoring of the vegetation

community in the riparian plantings within the restoration area will contribute to better understanding of vegetation management in river restoration elsewhere in the state and region.

The National Monitoring Program project is expected to continue through 2015.

Total Maximum Daily Load and watershed-based plan implementation monitoring: The Surface Water Section is working with the Watershed Management Section to determine which watersheds have significantly implemented a Total Maximum Daily Load Implementation Plan or the Watershed-based Plan. Once these are identified, these watersheds will be placed on a high priority for sub-watershed site selection within the Intensive Basin Survey program. For those watersheds with the expertise and an approved Quality Assurance Project Plan, they will be given consideration for Clean Water Act Section 319 funding to implement follow up monitoring. In all cases, these monitoring protocols will be looking at use attainment for the sub-watersheds receiving Best Management Practices as identified in either the Total Maximum Daily Load Implementation Plan or the Watershed-based Plan.

Kickapoo Creek in Coles County: Through the use of Section 319 funds, partnership organizations including Eastern Illinois University, United States Geological Survey, and Illinois Department of Natural Resources will conduct upstream/downstream monitoring on Kickapoo Creek to determine best management practice effectiveness (2000 feet of streambed and streambank stabilization) and to supplement the Embarras River Watershed-Based Plan. Monitoring will begin in 2014 and extend into 2016.

Indian Creek- MRBI: Monitoring of this watershed began in May 2010 using Illinois EPA Watershed Management staff to track water quality improvements associated with the Natural Resources Conservation Services' Mississippi River Basin Initiative. Samples are collected at three tributary sites and the final "pour" site for evaluation. Monitoring is expected to continue through 2016.

7. Monitor watersheds for stakeholder-driven watershed-plan development. As time and resources allow, the collection of nonpoint source data to support watershed plan development will be conducted via increased coordination and collaboration between Illinois EPA Watershed Management Section and Surface Water Section staffs. Pre-watershed plan development monitoring can aid in plan development and subsequent tracking of implementation success. This goal can be accomplished with the addition of staffing resources outlined in Table 8. These monitoring efforts do not require an implementation schedule.

Currently, several watershed groups throughout Illinois have undertaken watershed monitoring to supplement watershed plan, Total Maximum Daily Load, or implementation plan development. These include:

- DuPage River/Salt Creek Workgroup, stakeholder funded. Best Management Practice implementation selection and effectiveness monitoring.

- Fox River Study Group, stakeholder funded. Development of the Fox River Implementation Plan monitoring.
- Hickory Creek Watershed Planning Workgroup, stakeholder funded. Potential third party Total Maximum Daily Load monitoring and monitoring of current Best Management Practice implementation activities.
- Lake Springfield Watershed Resource Planning Committee, stakeholder funded. Supplemental information for Total Maximum Daily Load development and watershed planning purposes.
- Apple Canyon Lake Watershed, stakeholder and Clean Water Act 319 funded. Information to be used for watershed plan development.
- Flint and Spring Creek Watersheds, stakeholder and Clean Water Act 319 funded Quality Assurance Project Plan development and monitoring strategy, with the expectation of implementing the monitoring strategy to determine effectiveness of Best Management Practices implemented and provide information to update the current watershed plan.

8. Monitor effectiveness of Best Management Practice implementation at selected sites. Currently all Best Management Practices funded with Section 319 funds are monitored for practice effectiveness. Effectiveness monitoring is conducted through Illinois EPA's Ambient Water Quality Monitoring Network, Ambient Lake Monitoring, and Intensive Basin Survey programs. However, it is appropriate to monitor site specific Best Management Practices implemented to address site specific problems. Consideration will be given to conducting site specific project monitoring as appropriate and as resources allow. This ongoing effort does not require an implementation schedule.

9. Implement a Statewide Nutrient Export Loadings Network. Continuous real-time monitoring of nitrate, phosphate, turbidity, dissolved oxygen, stream flow, and several other parameters, is occurring at the "superstation" located on the Illinois River at Florence, Illinois. This superstation is operated by the US Geological Survey (USGS). It is also one of Illinois EPA's Ambient Water Quality Monitoring Network stations. Data collected by USGS at Florence over the past several years show that nutrient and sediment loads that pass this site vary over short time scales at various times of the year. Monitoring the loadings, and changes in loadings, exported from large rivers can help determine if employed management strategies are working. Thus, establishment of a "Statewide Nutrient Export Loadings Network" was recommended in "Illinois' Statewide Nutrient Loss Reduction Strategy," recently completed in September 2014. The development and implementation of that network is being funded for a five-year period by the Illinois EPA under agreement with USGS's Illinois Water Science Center in Urbana. The loadings network will consist of eight-superstations similar to the one located at Florence, Illinois. In addition to the Illinois River, superstation sites will be located on the Rock, Green, Kaskaskia, Embarras, Vermilion, Big Muddy, and Little Wabash rivers. Automated, real-time continuously-recorded sediment, phosphorus, nitrogen, and flow data will be collected so that statewide sediment and nutrient exports to the Mississippi River from Illinois can be estimated, and evaluation of the state's point and nonpoint source reduction strategy efforts to reduce sediment and nutrient losses can be achieved.

10. Evaluate Volatile Organic Compounds (VOC) trend data from 1990 to the present and compare to probabilistic results. Year-to-year evaluation of the Illinois EPA ambient network of Community Water Supply (CWS) wells have shown fluctuations of VOCs; however, analyses of data collected from 1990 to the present shows a statistically significant increasing trend of CWS wells with VOC detections. Analytical detection levels and sampling frequencies have not changed significantly during this time frame. The results show the importance of doing long-term monitoring such that trend analysis can be performed. More importantly, these show an increasing trend of groundwater degradation. Illinois EPA will continue to evaluate these groundwater monitoring data to determine the causes and potential sources of this trend. This ongoing effort will advance monitoring objectives 1a, 1b, and 4, and does not require an implementation schedule.

11. Evaluate causal data to determine the potential source of Volatile Organic Compounds (VOC) trends. Illinois EPA continues to evaluate the potential causes and sources of VOC contamination to determine what might be causing this trend. Spatial analyses will be conducted, taking into account multiple variables including: VOC detects, Community Water Supply wells with delineated contributing recharge areas or wellhead protection areas (WHPA), well depth, principal aquifers being utilized, potential for aquifer recharge, and the proximity of cleanup sites. Statistical analyses will be conducted to determine if the well detection points are coincident with clean-up sites within the WHPA. This ongoing effort will advance monitoring objectives 1c, and 4, and does not require an implementation schedule.

12. Continue discussion of groundwater quality standards development with the Groundwater Advisory Council stakeholders, and prepare Illinois Pollution Control Board proposal. On October 4, 2012, the Illinois Pollution Control Board adopted amendments for 39 new numerical groundwater quality contaminant standards. The new standards were proposed for contaminants based on their common occurrence in Illinois groundwater pursuant to the requirement outlined in the Illinois Groundwater Protection Act (415 ILCS 55/8). Updates on the adopted amendments to the Illinois Pollution Control Board's groundwater quality standards were discussed with the Groundwater Advisory Council stakeholders. The adopted regulations include wellhead protection areas under the compliance determination section and definitions. Illinois EPA testimony provided the technical basis of the modeling used to delineate wellhead protection areas and incorporates by reference the Groundwater Protection Needs Assessment Guidance Document and Illinois' approved Wellhead Protection Plan. The next steps of incorporating wellhead protection areas in the groundwater classification section of groundwater standards regulation were also discussed with stakeholders. This ongoing effort will advance monitoring objective 2, and does not require an implementation schedule.

13. Continue to implement probabilistic and rotating groundwater-monitoring networks (fixed/special/intensive). As previously described in the Groundwater Monitoring Design section of this report, Illinois EPA will continue to maintain a Rotating/Special/Intensive Groundwater Monitoring Network. Sampling is conducted during alternate years from

the Probabilistic Network. The Rotating Monitoring Network has concentrated on the sampling of new Community Water Supply wells and those with detections of Volatile Organic Compounds or other contaminants. This on-going network will continue to be implemented in alternate years as staffing and resources allow. This ongoing effort will advance monitoring objectives 1b, and 1c, and does not require an implementation schedule.

14. Conduct surveillance monitoring of potential hydraulic-fracturing impacts on groundwater resources. The Hydraulic Fracturing Regulatory Act was signed into law in May 2013. This Act establishes the Illinois Department of Natural Resources as the lead state agency in developing administrative rules to permit and regulate high-volume horizontal hydraulic fracturing in Illinois. As part of the draft rules, Illinois EPA must be notified when violations of the Environmental Protection Act are being alleged. Surveillance monitoring would consist of collecting samples from Community Water Supply well(s) located within a one mile radius of these sites. Illinois EPA would evaluate the samples for contaminants that might be indicative of brine, crude oil, or other hydraulic fracturing related contaminants. If sample evaluation of the initial or subsequent resamples indicates the presence of hydraulic fracturing related contaminants, Illinois EPA would further investigate as appropriate pursuant to the Environmental Protection Act and the Hydraulic Fracturing Act. If the groundwater monitoring results do not indicate the presence of brine, crude oil, or other hydraulic fracturing related contaminants, the community well(s) within one mile of the site or a subset of those wells could be resampled as part of the rotating groundwater monitoring network. This ongoing effort does not require an implementation schedule.

Potential Monitoring Efforts for 2015–2020

This section describes several potential monitoring activities that are neither specifically planned nor funded for 2015 through 2020. As time and resources allow, Illinois EPA would like to pursue these additional activities. These efforts represent potential advancement of the primary monitoring objectives addressed in Table 1.

Continue to collect phytoplankton data for potential use in assessing attainment of aquatic life use. Although Illinois EPA was unsuccessful at developing a phytoplankton Index of Biological Integrity for reservoirs and lakes, we have not ruled out the possibility of using phytoplankton data to help assess attainment of Aquatic Life Use in inland lakes. Illinois EPA would like to renew efforts to investigate using phytoplankton data at some level to assist in determining attainment of Aquatic Life Use in lakes.

Begin collecting human-pathogen indicator data in inland lakes. Illinois EPA recognizes the lack of human-pathogen indicator data required for the assessment of Primary Contact Use for inland lakes as a gap in our monitoring strategy. During the period of 2015 through 2020, Illinois EPA plans to renew efforts to develop a methodology for assessing attainment of primary- and secondary-contact uses in lakes and to investigate collecting human-pathogen-indicator data as part of the Ambient Lake Monitoring Program, potentially at licensed inland lake beaches. Because Illinois EPA is currently in the process of changing the Illinois General Use water-quality standard for fecal-coliform bacteria (35 Ill. Adm. Code 302.209) to *E. coli*, it is not likely that this effort will be completed until the new water-quality standard for *E. coli* has been approved by the Illinois Pollution Control Board and USEPA, and that all current monitoring contracts for fecal-coliform bacteria have expired.

Expand scope of monitoring data from the Volunteer Lake Monitoring Program – Tier III Volunteers to include macroinvertebrates. Aquatic insects are found in all lakes and their sensitivity to water quality and habitat impacts make them effective indicators of lake impairment. Protocols for sampling macroinvertebrates, based on those used in the Ambient Lake Monitoring Program, will be considered for use and modified (as necessary) in the VLMP training manual.

Use satellite imagery and collect Secchi transparency data to evaluate and track water clarity in lakes statewide. Illinois EPA would like to further investigate the use of remote satellite imagery (based on Landsat imagery and Secchi transparency data) to develop a statewide assessment of lake water resource condition.

Conduct bathymetric surveys on Ambient Lake Monitoring Program lakes to help identify causes and sources of impairment. Illinois EPA would like to add lake bathymetric surveys to Ambient Lake Monitoring Program lakes. These surveys would help identify such things as siltation rates and best management practice placement to help alleviate siltation problems. The surveys would also help in assessments and identifying causes and sources of impairments to water quality.

Expand fish-contaminant monitoring in lakes. Illinois EPA would like to expand monitoring contaminants in fish tissue at Ambient Lake Monitoring Program lakes (from which such data are currently not available) to help better protect public health in inland lakes.

Add fish-assemblage monitoring in lakes. Illinois EPA would like to expand monitoring fish assemblages in Illinois lakes to consider development of a fish-based indicator. An indicator of fish-assemblage balance would help Illinois EPA better assess attainment of Clean Water Act aquatic-life goals in Illinois lakes.

Incorporate biological monitoring in Lake Michigan. As time and resources allow, Illinois EPA would like to further expand the Lake Michigan Monitoring Program by including biological monitoring. Using such monitoring information to develop indicators of biological condition (e.g., indexes of biological integrity) would help Illinois EPA better assess attainment of Clean Water Act aquatic-life goals in Lake Michigan. Biological-monitoring information to consider may be provided by Illinois DNR Lake Michigan fish surveys, benthic-dredge grabs, plankton-net tows, or artificial substrates. Research is still needed to determine the best collection methods.

Implement new monitoring strategy for the Upper Mississippi River. From 2012 to 2014, Illinois EPA worked with Missouri, Iowa, Wisconsin, and Minnesota via the Upper Mississippi River Basin Association to develop a monitoring strategy and recommended monitoring plan for the upper Mississippi River (www.umrba.org/wq.htm). Although state, federal, and local entities have been monitoring the Mississippi River, these efforts are not designed specifically for Clean Water Act purposes. The new monitoring strategy for the upper Mississippi River is designed to provide comprehensive coverage of the river and to help states improve consistency in how they assess attainment of designated uses. Illinois EPA BOW will continue to work through the Upper Mississippi River Basin Association, as time and resources allow, to develop an assessment methodology and implementation of monitoring activity.

Develop biological indicators of ecological health for large rivers. Illinois has been exploring the use of biological indicators for monitoring large rivers as part of the development of a monitoring strategy for the upper Mississippi River. Some fish-based indicators already exist (i.e., fish indexes of biological integrity). States of the Upper Mississippi River Basin Association have been exploring macroinvertebrate-sampling techniques and indicators as well. Illinois EPA BOW believes it may be possible to adapt these tools to other large rivers in the state, such as the Illinois River. Illinois EPA BOW will continue to evaluate these tools as time and resources allow.

Continue collaboration to study water-quality trends in the Illinois River. A technical publication by Markus et al. (2014) represents recent collaboration between Illinois EPA BOW staff and the Illinois State Water Survey that addresses annual nitrate loads and trends in the lower Illinois River. As time and resources allow, Illinois EPA BOW will continue to collaborate with Illinois State Water Survey staff to explore various methods of trend analysis on the Illinois River and perhaps other rivers in Illinois.

Refine monitoring of physicochemical conditions at public-water-supply intakes in streams. Illinois EPA would like to update location information for all public-water-supply intakes in streams and refine the current monitoring design to improve the ability to determine ambient water-quality conditions at intakes, thereby improving the accuracy and reliability of assessments of Public and Food Processing Water Supply Use.

Monitor for emerging contaminants. Illinois EPA recognizes recent interest in Contaminants of Emerging Concern (CECs) at the state, national, and international level. A growing list of CECs, such as pharmaceuticals; personal-care products; disinfectants; flame retardants; perfluorinated compounds; hormone-mimicking/blocking chemicals; new-age pesticides; and organisms such as the amoeba, *Naegleria fowleri*, and *Legionella* bacteria have been identified in various environmental and biological matrices. Monitoring for these compounds or organisms could provide information about exposures to CECs. However, Illinois EPA is experiencing both analytical and funding-source constraints to monitor CECs. If resources become available, the analytical capability of the Illinois EPA laboratory could be enhanced to characterize CEC presence in surface waters, groundwater, and biota. Another option could be to establish long-term contractual services with qualified external laboratories with appropriate analytical expertise. Either option would provide a first cut to evaluate human and environmental exposures to CECs and to prioritize future actions.

Monitor polycyclic aromatic hydrocarbons in the Illinois environment. Polycyclic aromatic hydrocarbons (PAHs) are an emerging issue in Illinois waters and in urban areas nationwide. PAHs are found in coal tar and coal-tar pitch, compounds used to seal asphalt surfaces (driveways, parking lots, playgrounds) for maintenance of those surfaces. Coal tar and coal-tar pitch are listed as Group 1 (carcinogenic to humans) carcinogens. Preliminary monitoring in the DuPage River and Salt Creek watersheds shows that of the 42 sites sampled (sediment), all 42 sites were found to have PAH concentrations greater than those known to be harmful to aquatic life. House Bill 4599 and a sister Senate Bill have been introduced into the 98th General Assembly that calls for banning sealants containing coal tar on or after January 1, 2015, and the use/application of such sealants on or after July 1, 2016. Illinois EPA would like to begin monitoring PAHs in urban-impacted waters and to track progress in reducing those levels, as needed.

Develop monitoring and assessment of Illinois wetlands. Illinois EPA would like to work with USEPA Region 5 and the Illinois Natural History Survey to address how to best monitor and assess environmental conditions in Illinois wetlands. Efforts could include defining and designating appropriate wetland uses for Illinois; determining use-attainment criteria, including consideration of biological indicators such as the recently developed wetland Index of Biological Integrity for Illinois; and examining the feasibility of cooperating on future wetland assessments for Clean Water Act 305(b)/303(d) reporting.

Participate in an initiative to monitor effects of climate change in upper-Midwest streams. In early 2014, USEPA Region 5 initiated discussions with monitoring staff of Region 5

states and tribes to explore the efficacy of establishing a regional network of streams in which to monitor the effects of climate change in the upper Midwest. Similar to USEPA efforts in the Northeast, Mid-Atlantic, and Southeast portions of the United States, states and tribes in an upper Midwest regional monitoring network would collaboratively monitor reference-condition streams, with a focus on stream biota, thermal and hydrologic regimes, physical habitat, and water chemistry. The purpose of the monitoring is to understand how biological, thermal, and hydrologic conditions interrelate; understand how organisms respond to and recover from extreme events (drought, floods, etc.); test hypotheses about vulnerability to climate change; inform state and federal agencies about how to attribute altered conditions to climate change versus other stressors; and track trends and understand annual variability in reference condition over time. No more than six reference-condition sites per state or tribe would be monitored. Each site would be monitored over at least a 10-year period. Many questions remain unanswered, such as, "What resources are required to support such an effort? Who would store and analyze the data? How can one achieve consistency, across the region, in data collection and processing?" As resources allow, Illinois EPA BOW remains open to discussing and exploring potential participation in this initiative to monitor the effects of climate change in streams of the upper Midwest.

Monitor for pesticides not currently covered by Illinois EPA.
As resources allow, Illinois EPA could partner with USEPA Region 5 to collect water samples for pesticide analysis at ambient water quality monitoring network stations or intensive basin survey sites with the possibility of additional samples from the ground water monitoring networks. Most pesticides lack water quality standards and are not routinely assessed. This project would aim to collect data on those pesticides. Region 5 plans to review available data to help target areas to be sampled, to determine the most effective and efficient timing for samples, and to identify the likely pesticides to be encountered in the areas that Illinois EPA is sampling. Field collected water samples or split samples would be sent to the USEPA Region 5 Central Regional Lab for analysis. Data from this effort would aid in USEPA's review of and re-registration process for these pesticides.

Develop aquatic-life uses and biological indicators of use attainment for frequently intermittent streams. Currently, Illinois EPA does not routinely monitor environmental conditions in frequently intermittent (typically, headwater) streams. Consequently, for these waters, the data needed to define and designate appropriate aquatic-life uses and the indicators needed to directly assess attainment of those uses are lacking. As time and resources allow, Illinois EPA would like to evaluate how to best monitor these streams for the aforementioned purposes.

Incorporation of Selenium as a routine analysis parameter in the Fish Contaminant Monitoring Program. USEPA recently released draft new water quality criteria for selenium that will set both a numeric fish-tissue value as well as a water column measure. While selenium data are collected in water samples as a routine component of both Illinois EPA's Ambient Water Quality and Groundwater Monitoring Networks, selenium is not currently analyzed in fish tissues as part of the Fish Contaminant Monitoring

Program. The efficacy of having Illinois EPA's Division of Laboratories, or a private laboratory, analyze fish tissues for selenium should be explored so that data can be generated to assess against any new selenium fish tissue criteria that might be established.

E. coli water quality standard development to replace Fecal Coliform and associated future monitoring activity. USEPA released its final 2012 Recreational Water Quality Criteria that are designed to protect the public from exposure to harmful levels of pathogens while participating in water-contact activities such as swimming and wading in all waters designated for such recreational uses. Illinois EPA has committed to USEPA and Illinois stakeholders to developing and taking a rulemaking petition to the Illinois Pollution Control Board for adoption of a new *E. coli* water quality standard. Currently, Illinois EPA field staff collects fecal coliform data as the primary pathogen indicator. When adoption of the new *E. coli* standard is passed (or even imminent), Illinois EPA staff will need to make the necessary changes for collection, processing, and management of *E. coli* data as opposed to fecal coliform data.

Collect periphyton data in streams. Nutrient research has indicated that periphyton can be the predominant form of algae in wadeable streams in Illinois. Understanding the interactions among nutrients, primary producers (i.e., periphyton), biological integrity, and the various conditions (e.g., light, turbidity, flow, and dissolved oxygen) that influence or result from these interactions is important for setting appropriate water quality standards for nutrients. In 2006, periphyton samples were collected from nine stream stations and analyzed for chlorophyll *a* and algal biomass. Dissolved oxygen, pH, conductivity, and temperature data were also collected. While that monitoring effort provided non-conclusive results as to the role periphyton played in stream impairment, broader-scale, statewide monitoring and assessment would be beneficial.

Low phosphorus (P) stream identification and assessment. As part of Illinois EPA's overall nutrient standards development efforts, streams low in phosphorus (i.e., <0.04 mg/L) should be identified and targeted for special protection. While some "Low P" streams have already been identified, particularly in southern Illinois in the Shawnee National Forest area, a concerted monitoring effort is needed to identify where other Low P streams exist within the state.

Hydrologic Unit Code (HUC) 8 watershed nutrient export loadings network or export modeling efforts. Nitrate and total phosphorus yields and loads from both point and nonpoint sources were estimated at each Illinois HUC 8 watershed as part of a science assessment conducted pursuant to the development of Illinois' statewide nutrient management strategy. Because of high loading rates, watershed group readiness to implement practices, and other factors, some of those watersheds should be prioritized for targeted point and nonpoint source management strategy implementation. Continuous real-time monitoring for nutrients or nutrient export modeling efforts should be conducted at a group of high priority HUC 8 watersheds.

Offensive Conditions Determinations. Illinois EPA is engaged in a stakeholder process to propose an update to Illinois' narrative "Offensive Conditions" standard found in

Illinois Pollution Control Board regulations at Section 302.203. In part, Section 302.203 states, "*Waters of the State shall be free from sludge or bottom deposits, floating debris, visible oil, odor, plant or algal growth, color or turbidity of other than natural origin*." Some Illinois water conditions can be found that are more than just offensive to the human senses. They actually can be harmful to aquatic organisms, although not truly toxic. For example, having excessive algal or plant growth in a stream can lead to reduced dissolved oxygen levels that impact some aquatic organisms. While harmful, such condition is not easily numerically measured as can a truly toxic substance. The update to Section 302.203 is being designed to establish a criterion for the determination whether either of two conditions prohibited by the regulation, algal growth and plant growth of other than natural origin, have reached amounts harmful to aquatic life. It is currently envisioned that aquatic life will be determined as being harmed by algal or plant growth, and thus phosphorus impacted, if Illinois' dissolved oxygen standard is not achieved *and* dissolved oxygen exceeds 100% saturation within a 24-hour period. Additional monitoring and evaluation may be needed to build consensus amongst stakeholders, USEPA, and Illinois EPA that these numeric expressions of phosphorus impact and aquatic life harm are valid and meaningful.

ENVIRONMENTAL INDICATORS

Overview

Monitoring the environmental conditions of Illinois waters provides data and related information for assessing attainment of uses, identifying impairment, and determining how to restore impaired waters. Monitoring information also helps evaluate the success of Illinois EPA BOW water-pollution-control programs, restoration efforts, and related activities. To use monitoring data and information effectively, it must be interpreted and represented clearly and concisely in terms of indicators of environmental condition. This section describes the indicators that Illinois EPA BOW uses.

Beneficial Uses and Water Quality Standards

Beneficial uses and water-quality standards provide the primary context in which Illinois EPA BOW interprets and uses indicators of environmental condition. Beneficial uses of Illinois surface waters include *Aquatic Life Use, Primary Contact Use* (e.g., swimming, water skiing), *Secondary Contact Use* (e.g., boating, fishing), *Public and Food Processing Water Supply Use, Fish Consumption Use,* and *Aesthetic Quality*. *Primary Contact Use* is defined as "*any recreational or other water use in which there is prolonged and intimate contact with the water* [where the physical configuration of the waterbody permits it] *involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard, such as swimming and water skiing.*" (35 Ill. Adm. Code 301.355). *Secondary Contact Use* is "*any recreational or other water use in which contact with the water is either incidental or accidental and in which the probability of ingesting appreciable quantities of water is minimal, such as fishing, commercial and recreational boating, and any limited contact incident to shoreline activity.*" (35 Ill. Adm. Code 301.380).

The Illinois Pollution Control Board has established five primary categories of narrative and numeric water-quality standards designed to protect the beneficial uses of Illinois waters: General Use Water Quality Standards, Public and Food Processing Water Supply Standards, Secondary Contact and Indigenous Aquatic Life Standards, Lake Michigan Basin Water Quality Standards, and Groundwater Quality Standards.

1. General Use Water Quality Standards (35 Ill. Adm. Code 302, Subpart B). These standards apply to almost all waters of the state and are intended to protect aquatic-life, wildlife, agricultural, primary-contact, secondary-contact, and most industrial uses. These general-use standards are also designed to ensure the aesthetic quality of the state's aquatic environment.

2. Public and Food Processing Water Supply Standards (35 Ill. Adm. Code 302, Subpart C). These standards protect the state's surface water for human consumption or for processing of food products intended for human consumption. These standards apply at any point at which water is withdrawn for treatment and distribution as a potable water supply or for food processing.

3. Secondary Contact and Indigenous Aquatic Life Standards (35 Ill. Adm. Code 302, Subpart D). These standards are intended to protect limited uses in waters not suited for general-use activities. *Secondary Contact* and *Indigenous Aquatic Life* standards apply only to waters in which the *General Use* standards and the *Public and Food Processing Water Supply s*tandards do not apply. The *Secondary Contact* and *Indigenous Aquatic Life* standards currently apply to portions of the Chicago, Calumet, and Lower Des Plaines river drainages that were altered, in various stages during the mid-1800s into the mid-1900s, to promote commercial navigation and to eliminate untreated sewage from flowing into Lake Michigan. These waters remain impacted by hydromodification, alteration in flow, and storm-water and wastewater discharges from the Chicago area. In the early 1970s, it was believed that these waters could not meet the interim goals of the Clean Water Act. Since the adoption of the s*econdary contact* and *indigenous aquatic life* standards in the 1970s, water quality has improved, which has generated consideration for revising the applicable uses and standards. Two Use Attainability Analyses were conducted: one on the lower Des Plaines River (AquaNova International, Ltd. and Hey & Associates, Inc. 2003), and one on the Chicago Area Waterway System (Camp, Dresser and McKee 2007). The main purpose of these analyses was to determine the potential of these waters with respect to the aquatic-life and human-contact goals of the Clean Water Act. Using the use-attainment analysis and other information, Illinois EPA filed (in October 2007) a proposal-with the Illinois Pollution Control Board to revise the uses and water-quality standards for these waters. Some aspects of this rulemaking are still pending. Details are available at http://www.ipcb.state.il.us/COOL/external/PendingRulemakings.aspx (see docket R2008-009 and associated subdockets).

4. Lake Michigan Basin Water Quality Standards (35 Ill. Adm. Code 302, Subpart E). These standards protect the beneficial uses of the open waters, harbors and waters within breakwaters, and the waters within Illinois jurisdiction tributary to Lake Michigan, except for the Chicago River, North Shore Channel, and Calumet River.

5. Groundwater Quality Standards (35 Ill. Adm. Code 620.410). These standards protect groundwater that has been designated as a Class I (potable resource groundwater) supply, from persons causing, threatening or allowing the release of any contaminant to groundwater so as to cause a groundwater quality standard to be exceeded. Groundwater is not required to meet the *general use* standards and *public and food processing water supply use* standards of 35 Ill. Adm. Code 302, Subparts B and C.

Illinois EPA reconvened a groundwater quality standards regulatory update team to evaluate the electronically reported groundwater data for all Illinois Resource Conservation and Recovery Act and solid waste facilities under our purview. Illinois EPA Bureau of Land (BOL) Permit Section, Groundwater Assistance Unit, and the Federal Site Remediation Section provides regulatory oversight for these facilities. Illinois EPA has also evaluated contaminants detected at various groundwater cleanup/ remediation sites. A data query was conducted for a list of approximately 300 groundwater parameters not included in 35 Ill. Adm. Code 620, Subpart C. Illinois EPA developed a proposal for these contaminants to the Illinois Pollution Control Board. Following two public hearings, the Board adopted a first-notice proposal on October 20, 2011, and those proposed amendments appeared in the

Illinois Register at 31 Ill. Reg. 18502 (Nov. 14, 2011). The final rules were adopted on October 4, 2012, became effective on October 5, 2012, and were published in the *Illinois Register* on October 19, 2012 (36 Ill. Reg. 15206 (Oct. 19, 2012)).

The amendments added groundwater quality standard for chemicals detected and confirmed in Illinois groundwater that have established toxicity values or that have groundwater remediation objectives under the Tiered Approach to Corrective Action Objectives (35 Ill. Adm. Code 742). In all, groundwater quality standards for 39 chemicals constituents and revising the Class I standard for arsenic to reflect the updated federal Maximum Contaminant of 0.010 mg/L were added. The following 39 chemical constituents and associated Class I and Class II groundwater quality standards were adopted by the Illinois Pollution Control Board (Table 4):

Table 4. Groundwater quality standards for newly-added constituents[1]		
Constituent	**Class I Standard**	**Class II Standard (mg/L)**
1. Perchlorate	0.0049	0.0049
2. Vanadium	0.049	0.1
3. Acenaphthene	0.42	2.1
4. Acetone	6.3	6.3
5. Anthracene	2.1	10.5
6. Benzo(a)anthracene*	0.00013	0.00065
7. Benzo(b)fluoranthene*	0.00018	0.0009
8. Benzo(k)fluoranthene*	0.00017	0.006
9. Benzoic acid	28.0	28.0
10. 2-Butanone (MEK)	4.2	4.2
11. Carbon disulfide	0.7	3.5
12. Chloroform*	0.07	0.35
13. Chrysene*	0.012	0.06
14. Dibenzo(a,h)anthracene*	0.0003	0.0015
15. Dicamba	0.21	0.21
16. Dichlorodifluoromethane	1.4	7.0
17. 1,1-Dichloroethane	1.4	7.0
18. Diethyl phthalate	5.6	5.6
19. Di-n-butyl phthalate	0.7	3.5
20. Fluoranthene	0.28	1.4
21. Fluorene	0.28	1.4
22. Indeno(1,2,3-cd)pyrene*	0.00043	0.0022
23. Isopropylbenzene (Cumene)	0.7	3.5
24. MCPP (Mecoprop)	0.007	0.007
25. 2-Methylnaphthalene	0.028	0.14
26. 2-Methylphenol	0.35	0.35
27. Naphthalene	0.14	0.22
28. P-Dioxane*	0.0077	0.0077
29. Pyrene	0.21	1.05
30. alpha-BHC (alpha-Benzene hexachloride) *	0.00011	0.00055
31. Trichlorofluoromethane	2.1	10.5
32. 1,3-Dinitrobenzene [a]	0.0007	0.0007
33. 2,4-Dinitrotoluene* [a]	0.0001	0.0001
34. 2,6-Dinitrotoluene* [a]	0.00031	0.00031
35. HMX (High Melting Explosive, Octogen) [a]	1.4	1.4
36. Nitrobenzene [a]	0.014	0.014
37. RDX (Royal Demolition Explosive, Cyclonite) [a]	0.084	0.084
38. 1,3,5-Trinitrobenzene [a]	0.84	0.84
39. 2,4,6-Trinitrotoluene (TNT) [a]	0.014	0.014

[1] Though the Class I standard for arsenic was proposed for revision, it is not listed because the chemical is already in Part 620.

* Denotes a carcinogen.

[a] Denotes an explosive constituent.

Illinois EPA BOW uses monitoring information to assess the attainment of each of several beneficial uses in Illinois waters (Table 5). Table 5 also indicates the water bodies in which each beneficial use applies and the applicable water quality standards used to help assess attainment of each use.

Table 5. Beneficial uses of Illinois waters and applicable water-quality standards

Beneficial Use	Illinois Water bodies in Which the Use and Standards Apply [1]	Applicable Illinois Water Quality Standards
Aq*uatic Life Use*	Streams, inland lakes	General Use Water Quality Standards
	Lake Michigan basin waters	Lake Michigan Basin Water Quality Standards
Aesthetic Quality Use	Streams, inland lakes	General Use Water Quality Standards
	Lake Michigan basin waters	Lake Michigan Basin Water Quality Standards
	Specific water bodies	Secondary Contact and Indigenous Aquatic Life Standards
Indigenous Aquatic Life Use	Specific water bodies	Secondary Contact and Indigenous Aquatic Life Standards
Primary Contact Use	Streams, inland lakes	General Use Water Quality Standards
	Lake Michigan basin waters	Lake Michigan Basin Water Quality Standards
Secondary Contact Use	Streams, inland lakes	General Use Water Quality Standards
	Lake Michigan basin waters	Lake Michigan Basin Water Quality Standards
	Specific water bodies	Secondary Contact and Indigenous Aquatic Life Standards
Public and Food Processing Water Supply Use	Streams, inland lakes, Lake Michigan basin waters	Public and Food Processing Water Supply Standards
Fish Consumption Use	Streams, inland lakes	General Use Water Quality Standards
	Lake Michigan basin waters	Lake Michigan Basin Water Quality Standards
	Specific water bodies	Secondary Contact and Indigenous Aquatic Life Standards
Potable Resource Water	Groundwater designated as Class I (potable resource groundwater)	Groundwater Quality Standards

[1] 35 Ill. Adm. Code 302.201, 303, and 620.

Indicators of Environmental Condition in Surface Waters

Illinois EPA BOW uses a wide variety of core and supplemental measures to indicate chemical, physical, and biological conditions in surface waters. For each type of waterbody and applicable use as shown in Table 6, Illinois EPA BOW uses the indicators to assess use attainment, to determine the degree of nonattainment, and to identify potential causes of nonattainment. Outside of this primary context, the indicators also are used to help implement or evaluate the effectiveness of various BOW activities:

1. Illinois Clean Lake Projects
2. Projects for Nonpoint Source pollution control
3. Developing and prioritizing Total Maximum Daily Loads
4. Prioritizing inspections of permitted-point source discharges and other regulated facilities
5. Compliance assurance activities of dischargers
6. Assessing the general performance of wastewater-treatment facilities
7. Identify harmful algal blooms and algal toxins
8. Identify and monitor new, emerging contaminants and public-health issues

Indicators of Environmental Condition in Groundwater

Groundwater monitoring data are used to characterize water-quality conditions and statistically evaluate and assess potential impairments to aquifers in Illinois. To accomplish this objective, an average of 350 CWS wells has been maintained as part of a probabilistic monitoring network. Monitoring at all stations is completed by using Hydrolab® samplers to insure that in-situ groundwater conditions are reached prior to sampling. Water-quality parameters include field temperature, field specific conductance, field pH, field pumping rate, inorganic chemical analysis, and synthetic organic compound and volatile organic compound analysis.

Table 6. Environmental indicators used by the Illinois EPA Bureau of Water				
Applicable Use	**Streams**	**Inland Lakes**	**Lake Michigan**	**Ground - water**
Aquatic Life Use	Biological - fish Index of Biological Integrity - macroinvertebrate Index of Biological Integrity - Macroinvertebrate Biotic Index Chemical - dissolved oxygen - pH - conductivity (S [1]) - nutrients in water and sediment (S [1]) - metals in water and sediment (some are S [1]) - various inorganics in water & sediment (some are S [1]) - various organics[3] in water & sediment (some are S [1]) Physical - temperature - turbidity (S [1]) - instream and riparian habitat (inc. Qualitative Habitat Evaluation Index) - flow (S [1])	Biological - Trophic State Index - chlorophyll a - aquatic-macrophyte coverage and assemblage - aquatic macroinvertebrates (S [1]) Chemical - dissolved oxygen (depth profile) - pH - conductivity (S [1]) - phosphorus - metals in water & sediment (S [1]) - various inorganics and organics[3] in water (some S [1]) - suspended solids Physical - temperature (depth profile) - turbidity (S [1]) - Secchi depth - lake shoreline habitat (S [1])	Chemical - dissolved oxygen - pH - conductivity - nutrients in water (S [1]) - metals in water - various inorganics in water - various organics[3] in water Physical - temperature - turbidity	*N.A.*[2]
Aesthetic Quality	Physical - Field observations of sludge, bottom deposits, floating debris, visible oil, odor, plant or algal growth [aquatic macrophytes or aquatic algae], color and turbidity	Biological - Trophic State Index - chlorophyll a - aquatic macrophyte coverage Chemical - total phosphorus - suspended solids Physical - Field observations of sludge, bottom deposits, floating debris, visible oil, odor, plant or algal growth [aquatic macrophytes or aquatic algae], color and turbidity	Physical - Field observations of sludge, bottom deposits, floating debris, visible oil, odor, plant or algal growth [aquatic macrophytes or aquatic algae], color and turbidity	*N.A.*

Table 6 (continued)				
Applicable Use	**Streams**	**Inland Lakes**	**Lake Michigan**	**Groundwater**
Indigenous Aquatic Life Use	Chemical - dissolved oxygen - pH - conductivity - nutrients in water and sediment (S [1]) - metals in water and sediment (some are S [1]) - various inorganics in water & sediment (some are S [1]) - various organics[3] in water and sediment (some are S [1]) Physical - temperature - turbidity (S [1]) - flow (S [1])	Chemical - dissolved oxygen (depth profile) - pH - conductivity - phosphorus in water (S [1]) - metals in water - various inorganics in water (some as S) Physical - temperature (depth profile) - Secchi depth (S [1])	*N.A.*	*N.A.*
Primary Contact Use and *Secondary Contact Use*	Biological (human pathogen indicator) - fecal coliform bacteria Chemical - microcystin (S [1])	*(Human-pathogen indicators not monitored)* Chemical - microcystin (S [1])	Biological (human pathogen indicator) - fecal coliform bacteria - *Escherichia coli*	*N.A.*
Public and Food Processing Water Supply Use	Biological (human pathogen indicator) - fecal coliform bacteria Chemical - various inorganics and organics[3] in raw and finished water	Chemical - various inorganics and organics[3] in raw and finished water	Biological *(pathogen indicator)* - fecal coliform bacteria Chemical - various inorganics and organics[3] in raw and finished water	*N.A.*
Fish Consump-tion Use	Chemical - mercury - chlordane, polychlorinated biphenyls, and other organics in fish tissue			*N.A.*
Potable Resource Water	*N.A.*			- temperature - pH - conductivity - various inorganics - various organics

[1] "S" indicates a supplemental indicator not specified in methodology, all others are core indicators. All indicators collected in sediment are supplemental.
[2] "N.A." means not applicable
[3] See Appendix A for a complete list of inorganic and organic parameters by program.

Recommendations and Strategies for Improvement

The following recommendations and strategies represent Illinois EPA BOW's perspectives on how to improve our use of environmental indicators in resource management and water-pollution control. Because Illinois EPA BOW primarily uses these indicators in the context of protecting, assessing, and restoring attainment of the beneficial uses of Illinois waters, some of the following recommendations also address aspects of this context more than they address specific indicators per se.

1. Define and designate tiered aquatic-life uses and determine corresponding use-attainment criteria. Illinois EPA will continue efforts toward defining tiered aquatic-life uses and corresponding biological criteria as potential revisions to existing Illinois *aquatic life use* designations and corresponding water-quality standards. Illinois EPA is working on a potential implementation schedule for this effort. In existing Illinois water-quality standards, aquatic-life uses are broadly defined and designated, which results in both underestimating and overestimating attainability of aquatic-life conditions for some water bodies. Moreover, existing Illinois numeric water-quality standards that apply to aquatic-life comprise surrogate physicochemical thresholds rather than direct biological thresholds. These water-quality standards do not adequately reflect advances in the use of non-chemical data (i.e., biological criteria) for achieving the Clean Water Act interim aquatic-life goal and ultimate objective to "*restore and maintain the chemical, physical, and biological integrity of the Nation's waters.*" (Clean Water Act Section 101(a)). Although numeric standards for various physicochemical parameters in water have proven effective for controlling point-source discharges, their ability to consistently reflect and thus sufficiently protect biological condition is limited.

2. Define and designate wetland uses, determine corresponding use attainment criteria, and examine the feasibility of CWA integrated reporting. In August 2011, the Illinois Natural History Survey (INHS) used wetland plant and bird data to develop a multivariate and multi-scaled disturbance gradient from which a Wetland Index of Biological Integrity (w-IBI) for Illinois wetlands was created (INHS, 2011). Subsequently, the INHS, under agreement with Illinois EPA, evaluated the applicability of the new w-IBI to restored wetlands and concluded that the w-IBI was applicable to both natural and restored wetlands in Illinois (INHS, 2013). Now that a w-IBI for natural and restored wetlands has been developed, it is recommended that Illinois EPA, USEPA Region 5, and INHS staff engage in discussions related to defining and designating appropriate Illinois wetland uses, determining holistic use attainment criteria or standards including the use of the w-IBI, and examining the feasibility of cooperatively conducting future wetland assessments for integrated CWA 305(b)/303(d) reporting.

3. Potential improvements to guidelines for assessing attainment of *Primary Contact Use, and Secondary Contact Use*. Illinois EPA is in the process of changing the existing Illinois water-quality criteria for fecal coliform bacteria to *E. coli*-based criteria. Once the new standard is finalized, Illinois EPA needs to develop new sampling protocols and revise guidelines for assessing attainment of *Primary Contact Use* and *Secondary Contact Use* in the state's surface waters. Illinois EPA will also consider developing a monitoring program to collect the data necessary to assess these uses in lakes.

4. Develop a lake macroinvertebrate Index of Biological Integrity. In 2008, Illinois EPA BOW began collecting data through expanded monitoring for the development of an Index of Biological Integrity based on macroinvertebrates in lakes. In 2013, on Illinois EPA's behalf, USEPA Region 5 contracted with Tetra Tech to use the data and develop the lake index. The dataset includes water chemistry, shoreline habitat data, macroinvertebrate data, and macrophyte data. The contractor will determine and analyze reference conditions, lake classifications, and candidate metrics to build the index. Once complete, the lake-macroinvertebrate index will be used to help assess attainment *Aquatic Life Use* in inland lakes.

5. Collect environmental data in headwater streams for the purpose of developing indicators of environmental condition. Currently, Illinois EPA does not routinely monitor environmental conditions in frequently intermittent (headwater) streams. Consequently, the data and tools needed to directly assess attainment of uses in those waters are lacking. Illinois EPA recognizes that developing indicators of ecological condition in headwater streams is essential for achieving the ultimate goal of resource management for all surface water types in Illinois.

6. Amend groundwater-quality standards. The Illinois EPA will continue to review, revise, and propose new groundwater quality standards to the Illinois Pollution Control Board utilizing the process described previously. Groundwater quality standards and monitoring data are used as a primary environmental indicator to characterize water quality conditions and statistically evaluate and assess potential impairments to aquifers in Illinois.

7. Begin collecting biological data in Lake Michigan. Currently, Illinois EPA collects water and sediment-quality data quality as part of the Lake Michigan Monitoring Program. Monitoring biology would provide a more complete view of the overall health of Lake Michigan nearshore (in Illinois) and its harbors. Specifically, Illinois EPA BOW sees potential benefit in determining the health of fish and invertebrate assemblages in the Lake. Potentially useful monitoring includes fish-community surveys, benthic-dredge grabs plankton net tows, and artificial substrates. Research and additional staff are needed to determine the best collection methods and data application.

8. Evaluate potential advantages of monitoring suspended-sediment concentration (SSC) rather than total suspended solids (TSS). Illinois EPA monitors TSS in surface waters to quantify concentrations of suspended solids material. The TSS methods were originally developed as an analysis to characterize wastewater and have been shown to be insufficient at characterizing suspended solids in natural water samples. Studies show that when sand sized material exceeds one quarter of the dry sediment mass the results are significantly under report actual concentrations. During this evaluation Illinois EPA will need to consider:

- whether to add monitoring of suspended-sediment concentration or to begin monitoring of suspended-sediment concentration and end monitoring of total suspended sediments.
- the applicability of using SSC instead of TSS, which is currently used as an NPDES Permit condition.
- the cost of additional laboratory equipment and potential need for additional lab staff.

9. Expand the Harmful Algal Bloom Program. In 2013, Illinois EPA initiated a statewide monitoring program for the purpose of protecting Illinois citizens from adverse effects due to recreational exposure to microcystin. Illinois EPA is currently collecting microcystin data and will be investigating the use of microcystin as a criterion for determining attainment of *Primary Contact Use*. However, microcystin is not the only known algal toxin. Adverse human health effects have also been attributed to recreational or drinking water exposure to other known algal toxins (e.g., saxitoxin, anatoxin a, cylindrospermopsin). In addition to algal toxins, cyanobacterial cell counts have been used in other states as an indicator for human health risks associated with recreational exposure to microcystin. Illinois EPA is currently working with other state agencies and local health departments to develop an advisory program for harmful algal blooms. In support of these efforts, Illinois EPA will examine the potential of adding multiple algal toxins and cyanobacterial cell counts to the Harmful Algal Bloom Program.

QUALITY ASSURANCE

Bureau of Water Quality System

The United States Environmental Protection Agency (USEPA) requires that all non-EPA organizations, performing work on behalf of USEPA through extramural agreements, meet minimum quality requirements for the collection, analysis, evaluation, and reporting of environmental data. Collectively, the policies and programmatic management systems developed that pertain to quality are known as a "Quality System." The primary goal of a Quality System is to ensure that environmental programs and decisions are supported by data of the type and quality needed and expected for their intended use (USEPA 2001a). In conjunction with initiating a Quality System, the Illinois EPA BOW developed the *Quality Assurance Project Plan: Integrated Water Monitoring Program Document* (IEPA 1994). Illinois EPA BOW submitted this plan to USEPA in 1994, and USEPA approved it in August 1997. Illinois EPA BOW plans a major revision and update to the BOW Quality Assurance Project Plan (IEPA 1994) during the next five-year monitoring cycle.

Quality System Goals and Objectives

The primary goal of the Illinois EPA Quality System is to ensure that all environmentally related data operations performed by or for the Illinois EPA will result in data that are of known and documented quality, are suitable for its intended purpose, and can be used with a high degree of certainty by the intended user to support specific decisions or actions. This includes those monitoring and measurement activities conducted or supported by the Illinois EPA through grants, contracts, or intergovernmental agreements. This goal is achieved by ensuring that appropriate resources are made available and proper procedures followed throughout the process of planning for, collecting, analyzing, and interpreting environmental data.

Quality Assurance Tools and Practices

The Illinois EPA Quality System comprises the people, functions, tools, and procedures to ensure data of appropriate quality for data users and decision makers. Successful implementation of the Quality System requires various tools and practices for planning and evaluating the Quality System components. All BOW employees involved in environmental-data operations, which includes obtaining, using, and reporting data, have responsibilities for ensuring data quality. This includes staff level personnel, supervisors, project managers, program managers, senior managers, and personnel specifically assigned to assure data quality.

The BOW Quality Assurance Officer coordinates the development and enhancement of the Quality System. The Quality Assurance Officer reports directly to the Bureau Chief and maintains independence from the units generating environmental data. The BOW Quality Assurance Officer serves on the Illinois EPA Quality Systems Steering Committee, which is comprised of the Illinois EPA Quality Assurance Manager and the designated Quality Assurance Officers of each applicable bureau, division, or office. The steering committee develops implements, and oversees agency-wide quality-assurance plans, policies, procedures, and associated activities. The steering committee meets monthly to discuss quality assurance issues.

On the Illinois EPA intranet, the "Agency Quality" webpage can be accessed by all Illinois EPA employees. This page contains information on Field Sampling Quality Assurance Training, Illinois EPA Laboratory Data Qualifiers, Illinois EPA Quality Management Plan, Employee Roles and Responsibilities, Quality Assurance Terms and Definitions, USEPA Requirement and Guidance Documents, and Quality Planning, Implementing, and Assessing Tools.

The quality-assurance tools include the Quality Management Plan, Quality Assurance Project Plans, Data Quality Objectives, and Standard Operating Procedures. The primary evaluation and assessment tools include Management Systems Reviews and Assessments/Audits.

Quality Management Plan

The Quality Management Plan (QMP) documents how the Illinois EPA structures its Quality System, defines and assigns quality-assurance and quality-control responsibilities, and describes processes and procedures used to plan, implement, and assess the effectiveness of the Quality System. The Illinois EPA QMP, of September 9, 2012, was approved by USEPA Region 5 effective February 28, 2013. The QMP accords with the USEPA document, EPA QA/R-2, *EPA Requirements for Quality Management Plans* (USEPA 2001b). The approval of the QMP is valid for five years, through February 27, 2018.

During the next five-year monitoring cycle, the Illinois EPA will annually review the QMP and make necessary minor revisions. A revised and updated QMP will be submitted for Region 5 review and approval by August 27, 2017.

Quality Assurance Project Plans

Quality Assurance Project Plans (QAPPs) are based on the USEPA documents, EPA QA/R-5, *EPA Requirements for Quality Assurance Project Plans* (USEPA 2001a) and EPA QA/G-5, *Guidance for Quality Assurance Project Plans* (USEPA 2002).

QAPPs present the policies and procedures, organization, objectives, quality assurance requirements, and quality control activities to achieve the type and quality of environmental data necessary to support project objectives. All environmental data collection activities, including data collected on behalf of Illinois EPA are subject to this requirement. All QAPPs are reviewed by the BOW Quality Assurance Officer for completeness.

The validity of all QAPPs will be determined during the next five-year monitoring cycle. Obsolete QAPPs will be retired. All other QAPPs will be assigned a new document control number and unique identifier code to be incorporated into the new Document Control Tracking System. The QAPPs will be reviewed for updates, approved, and posted electronically on the Illinois EPA intranet.

Data Quality Objectives

The Data Quality Objective (DQO) process is used to help plan data collection. BOW DQOs are developed, as appropriate, as part of the QAPP planning and development process. The DQOs are developed according to the USEPA document, EPA QA/G-4, *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA 2006a). The

DQOs derived from this process are used as performance criteria to assess data quality. The DQO process will be more widely utilized as Illinois EPA BOW revises QAPPs over the next five-year monitoring cycle.

Standard Operating Procedures

BOW Standard Operating Procedures (SOPs) are developed to document prescribed techniques and steps, demonstrate conformance with accepted standards of practice, serve as a training aid, and enhance data comparability, credibility, and defensibility. SOPs are developed using the USEPA document, EPA QA/G-6, *Guidance for Preparing Standard Operating Procedures* (USEPA 2007), and are prepared for routinely conducted sampling, analytical, and quality-control procedures. Standard operating procedures for Bureau of Water monitoring programs are listed in Table 7.

The validity of all BOW SOPs will be determined during the next five-year monitoring cycle. Obsolete SOPs will be retired. All other SOPs will be assigned a new document control number and unique identifier code to be incorporated into the new Document Control Tracking System. The SOPs will be reviewed for updates, approved, and posted electronically on the Illinois EPA intranet.

Table 7. Standard Operating Procedures for Bureau of Water monitoring programs

Monitored Element or Type of Water	Standard Operating Procedure
Microcystin	Collection of Microcystin Samples for Analysis Using Abraxis Test Kit
Macroinvertebrates	- Sample Processing for the Macroinvertebrate Index of Biotic Integrity (mIBI) - Method to Collect Aquatic Macroinvertebrates from Wadeable Streams for Biotic Integrity Assessments - Methods to Collect Aquatic Macroinvertebrates with Multi-Plate Artificial Substrate Samplers - Calculation of the Macroinvertebrate Index of Biotic Integrity (mIBI) - Methods to Sample Wadeable Stream Macroinvertebrates to Detect Chemical Impacts from Point-Source Discharges - Collection of Macroinvertebrates in Lakes and Reservoirs - Methods to Collect Aquatic Macroinvertebrates with Grab Samplers

Table 7. (cont.) Standard operating procedures for Bureau of Water monitoring programs	
Monitored Element or Type of Water	**Standard Operating Procedure**
Fecal Coliform	Field Fecal Coliform Bacteria Determination
Hydrolab MiniSonde	Calibration and Use of Hydrolab MiniSonde 5
Continuous Monitoring	Continuous Monitoring of Water Quality
Sediment	Surficial Sediment Collection
Fish	Collection of Fish
Streams	- Stream Discharge Measurement and Calculation - Stream Water Quality Sample Monitoring
Lakes	Lake Monitoring
Wastewater	Wastewater Sampling
Groundwater	Groundwater Sampling

Technical Systems Audits

Technical Systems Audits (TSAs) will be conducted to assess the sampling and analytical quality assurance and quality control used to generate environmental data. The Illinois EPA will use TSAs to evaluate laboratory and field procedures used by agency personnel, contractors, and grantees.

Laboratory TSA

Internal audits will be conducted on the Illinois EPA laboratory to review the laboratory's Quality System, laboratory organization, operation and capabilities, determine the reliability of data, and note corrective action for any apparent deficiencies. These internal audits will be conducted annually by the Quality Systems Steering Committee.

Field TSA

All Illinois EPA programs involved in environmental sample collection and analyses are subject to a TSA. Each TSA includes a thorough review of the facilities, equipment, data collection and analysis procedures, documentation, data validation, management, training procedures, and reporting aspects of the technical system for collecting or processing environmental data. A corrective action period follows the issuance of the written report.

Illinois EPA will conduct field surveillance audits of field sampling activities in each BOW water quality monitoring program over the next five-year monitoring cycle.

As resources allow during the next five-year monitoring cycle, Illinois EPA will conduct field audits of field sampling activities for contractors and other governmental agencies that collect samples for programs sponsored by the Illinois EPA BOW.

Management Systems Reviews

Management Systems Reviews (MSRs) qualitatively assess the organization and data collection procedures to determine if the Quality System in place is adequate to ensure the quality of the data. The Quality Systems Steering Committee schedules the MSR based on priorities, resources, and needs. MSRs will be conducted using the USEPA document, EPA QA/G-3, *Guidance on Assessing Quality Systems* (USEPA 2003b).

Illinois EPA will conduct internal assessments of individual programs in each bureau. Program MSRs are generally performed by an internal review team and focus on implementation of quality assurance in a single program area. These reviews will be coordinated by the Quality Systems Steering Committee.

The steering committee is developing an "Illinois EPA Quality MSR Assessment 5-Year Plan." This internal assessment will occur during the next five-year monitoring cycle.

Assessments and Audits

The Quality System includes assessments and audits to demonstrate the effectiveness of the Quality Management Plan, Quality Assurance Project Plans, and Standard Operating Procedures. The assessment/audit may include a review of the facilities, equipment, sampling and analysis procedures, documentation, data validation and management, training procedures, and reporting aspects of the environmental-data collection, analysis, and processing system.

A Data Quality Assessment is a process used to determine whether the quality of data is adequate for its intended use. The assessment involves a statistical comparison of the collected data with the Data Quality Objectives for the project. These assessments will be performed using the USEPA documents, EPA QA/G-9R, *Data Quality Assessment: A Reviewer's Guide* (USEPA 2006b) and EPA QA/G-9S, *Data Quality Assessment Statistical Tools for Practitioners* (USEPA 2006c).

A Data Quality Audit is used to evaluate the documentation of the quality of data generated for a given project. This assessment primarily involves an evaluation of the completeness of the documentation of field and analytical procedures and quality control results; and usually involves tracking the paper trail accompanying the data from sample collection and custody to analytical results and entry into a database. As resources allow, Data Quality Audits will be performed as part of the Quality System Steering Committees assessment of BOW programs.

Personnel Qualifications and Training

The BOW Quality Assurance Officer tracks quality-assurance training of Illinois EPA employees. During 2013, the steering committee provided training opportunities to all BOW personnel involved in field sample collection, sample analysis, and data usage. The training addressed lab-data qualifiers and field sampling, including choice of sample collection containers, required thermal and chemical preservation, sample request sheets, chain-of-custody, analytical methods, parameters and reporting limits. The steering committee provided this training at the Headquarters Office in Springfield and then traveled to the regional offices in Champaign, Collinsville, Des Plaines, Marion, Peoria, and Rockford.

Additional BOW training needs will be determined during the next five-year monitoring cycle. The steering committee will continue to develop and provide training to Illinois EPA staff who collect, analyze, or use environmental data.

Recommendations and Strategies for Improvement

In general, as resources allow and needs arise during the years covered by this monitoring strategy, the quality assurance of various Illinois EPA BOW monitoring programs or activities will be reviewed and updated. Some specific and currently recognized potential improvements follow.

Quality Assurance for Groundwater Monitoring

The Groundwater Sampling SOP provides standardized guidelines and quality control for the collection of water quality data generated in conjunction with the groundwater monitoring programs. Several of the existing sampling techniques and quality-control procedures were based on methods developed and used by the United States Geological Survey (USGS). In addition, the Groundwater Section field staff continues to participate in the annual USGS National Field Quality Assurance program. Specifically, Groundwater Section field staff employees are provided with unknown (blind) samples for both pH and conductivity to analyze using appropriate sampling equipment. The unknown samples are then reported to the USGS to assess performance. Participation in this quality-assurance program has been used to determine when particular sampling equipment may require preventative maintenance, repair, or replacement. In addition, latex gloves have been incorporated into the sample collection procedure based on recommendations from past reviews. As resources allow, it is anticipated this review will continue.

Quality Assurance for Streams and Lakes Monitoring

In 2013, the Surface Water Section field staff participated in the aforementioned National Field Quality Assurance program. As part of this effort, Surface Water Section field staff was provided with unknown (blind) samples for both pH and conductivity to analyze using appropriate sampling equipment. The unknown samples were then reported to the United States Geological Survey to assess performance. As resources allow, it is anticipated this review will continue.

Quality Assurance for Wastewater Monitoring

USEPA has established a Discharge Monitoring Report – Quality Assurance (DMR-QA) Study to monitor the quality of data used in the Clean Water Act's National Pollutant Discharge Elimination System program. The purpose of the DMR-QA Study is to ensure the integrity of data submitted by the permittee for DMR reporting requirements and evaluate performance of the laboratories to analyze wastewater samples. In-house and contract laboratories obtain and analyze Proficiency Testing (PT) samples from accredited PT Providers.

The BOW Quality Assurance Officer is the DMR-QA Coordinator for Illinois. The DMR-QA Coordinator has developed and maintains a database for tracking the NPDES permittees' participation in the DMR-QA Study. During the next five-year monitoring cycle, the efficiency of this tracking system will be investigated.

In 2014, the DMR-QA Coordinator developed training presentations covering the 40 Code of Federal Regulations (CFR) Part 136 *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act: Analysis and Sampling Procedures* and the DMR-QA Study. These training sessions included topics such as approved biological methods and inorganic test procedures; required containers, preservation techniques, and holding times; QA and QC; incorporating the "12 Quality Elements" into the laboratory's SOPs; DMR-QA Study responsibilities of NPDES permittees, in-house and contract laboratories, and PT Providers; and corrective actions for "not acceptable" results.

The DMR-QA Coordinator will provide this training at wastewater operators association and lab committee meetings throughout Illinois during the next five-year monitoring cycle.

DATA MANAGEMENT

Surface Water

Illinois EPA BOW achieves data management of water monitoring and assessment information as described below. The USEPA requests that each state describe how it achieves the monitoring element called "data management." Specifically, USEPA (2003a) requests that each state describe how it "uses an accessible electronic data system for water quality, fish tissue, toxicity, sediment chemistry, habitat, biological data, with timely data entry (following appropriate metadata and State/Federal geo-locational standards) and public access."

Laboratory Results and Corresponding Sample Information for Physicochemical Conditions in Water, Sediment, or Fish Tissue

1. Storage. Information is stored in the Illinois EPA Ambient Water Quality Management System (AWQMS) and then regularly transferred to the analogous national STORET (i.e., STORage and RETrieval) system, created and maintained by USEPA. The Illinois EPA AWQMS was created by Gold Systems and is maintained by the Illinois Department of Central Management Services. All results are geographically referenced via latitude and longitude coordinates of each sampling station.

2. Retrieval/Accessibility. Information in Illinois EPA AWQMS is available to the public upon request. Illinois-based information in national STORET is available to the public via accessing the national STORET website.

3. Timing. Laboratory results and corresponding sample information get stored in Illinois EPA AWQMS and then transferred to the national STORET system up to three years after the collection date of the environmental sample. For all results and corresponding sample information, Illinois EPA is working to decrease the lag time between sample collection and availability in national STORET, with the ultimate goal of no more than one year between collection and availability in national STORET. Existing delays are attributable to several factors: (a) delays in the reporting of lab-analyzed results from the Illinois EPA Division of Laboratories' Laboratory Information Management System; (b) limited capabilities of the Illinois EPA Division of Laboratories to report data in a structure and format that meet the specific structure and formatting that are required by national STORET to allow data to be stored; (c) limited staff time and expertise to review, restructure, and reformat lab-reported data to meet the requirements for transfer and storage of data to national STORET; and (d) limited Illinois EPA resources devoted to systems management of surface-water-monitoring information.

Field-Measured Results and Corresponding Sample Information for Physicochemical Conditions in Water

1. Storage. For streams and Lake Michigan, information is entered initially to a field-result database (Microsoft Access) and then reviewed and uploaded to Illinois EPA

AWQMS. From AWQMS, information is then regularly transferred to national STORET. All results are geographically referenced via latitude and longitude coordinates of each sampling station. For field data from lakes other than Lake Michigan, Illinois EPA created the Lakes Database Management System (Microsoft Access format) specifically for use in the ambient and volunteer lake-monitoring programs. This database allows immediate entry of field-measured results and corresponding information. Once synchronized with the network based data storage, the information is available to the public upon request.

2. Retrieval/Accessibility. Information in Illinois EPA AWQMS is available to the public upon request. Illinois-based information in national STORET is available to the public via accessing the national STORET website. Currently, the Lakes Database Management System is not compatible with Illinois EPA AWQMS; therefore, none of the field related data and information is available in national STORET. Illinois EPA is exploring repair or replacement of the Lakes Database Management System to address the compatibility issue. Field-measured results and corresponding information, from lakes (other than Lake Michigan), are available from the Lakes Database Management System upon request. Volunteer collected physical data are entered, retrievable, and accessible via the web-based online portal. In addition to storage in the Lakes Database, Aquatic Invasive Species data are being entered into the online mapping system EDDMapS (www.eddmaps.org) and are also available to the public.

3. Timing. Because field results typically correspond with lab-analyzed samples, the timing of data transfer and storage of field results to national STORET currently matches that of lab-analyzed results addressed above—except as follows for field data from lakes. Within a week of collection, field-measured results and corresponding information are available from the Lakes Database Management System upon request.

Results and Information from Biological and Physical-Habitat Monitoring

1. Storage. Except as follows for some types of data from lakes, information is stored in an Illinois EPA database called BIOS (Microsoft Access). As needed, Illinois EPA continues to enhance BIOS by accommodating new information, as needed (e.g., lake macroinvertebrate surveys). Because national STORET does not readily accommodate some of the Illinois-based biological and physical-habitat information, the information in Illinois EPA BIOS is not transferred to national STORET. All results in Illinois EPA BIOS are geographically referenced via latitude and longitude coordinates of each sampling station. Illinois EPA stores lake macrophyte surveys and related information in a database called Lake Macrophyte Database (Microsoft Access format). Illinois EPA stores lake-shoreline surveys in spreadsheets (Excel format).

2. Retrieval/Accessibility. Information in Illinois EPA BIOS, in the Lake Macrophyte Database, and in lake-shoreline-survey spreadsheets is available to the public upon request.

3. Timing. For Illinois EPA, most biological and physical-habitat information is available in BIOS within two years of sample collection. Compared to physicochemical results of water, sediment, or fish-tissue samples, biological information has a longer lag time between sample collection and availability, primarily attributable to the longer processing time required for biological samples. Recently, review of biological and physical-habitat data and transfer into BIOS has stopped because the person responsible for such data management retired. Until this position can be filled by a sufficiently qualified and able person, the flow of biological and physical-habitat information will be slowed considerably. The Lake Macrophyte Database and lake-shoreline-survey spreadsheets are updated within six months of collection.

Results and Information from Recently Initiated Monitoring Efforts

1. Storage. Information from recently initiated monitoring efforts (e.g., monitoring of harmful algal blooms) cannot be accommodated entirely in the aforementioned databases currently used by Illinois EPA BOW. Attributes that are compatible with existing databases are stored there. Attributes that are not accommodated in existing databases are being stored in spreadsheets until existing databases can be redesigned or new databases are developed.

2. Retrieval/Accessibility. Information in existing databases is available and accessible as described above. Information in the spreadsheets is available to the public upon request.

3. Timing. Information in existing databases is available as described above. Field results stored in the spreadsheets are entered within six months of collection, and laboratory results are reported and available in spreadsheets within one year of collection.

Information on Assessments of Use Attainment

1. Storage. Illinois EPA regularly assesses the attainment of each of various beneficial uses in Illinois surface waters. When applicable, potential causes and sources of impairment (nonattainment) are identified for each assessment. This assessment information is stored in the Illinois EPA version of the Assessment Database (ADB), which is a nationally standardized database created by USEPA. This database does not store physicochemical, biological or habitat results; rather, it contains the assessment-related conclusions of interpreting those results. In accordance with reporting requirements of the Clean Water Act and corresponding regulations, Illinois EPA regularly provides information in the ADB to USEPA. Each waterbody (assessment unit) in the ADB is geographically referenced to a surface-water feature in the National Hydrography Dataset.

2. Retrieval/Accessibility. Information in the Illinois EPA ADB is available to the public via biennial water-quality reports available on the Illinois EPA website.

3. Timing. Assessment information in the Illinois EPA ADB is updated every two years, based on the schedule of reporting required by federal regulations. Information for every assessment unit is not updated on this schedule; rather, each assessment unit is addressed according to the schedule of sampling of its particular monitoring program (e.g., once every five years for each stream station in the Intensive Basin Survey program). Currently, a lag of up to three years exists between the collection time of information used in assessments and the time the assessment conclusions are entered into the ADB.

Groundwater

There are three basic types of data managed in the groundwater monitoring program: field data, laboratory data, and groundwater station inventory data.

Groundwater Monitoring Data

Field data includes all data/information prepared or added to the groundwater monitoring field sheet, database coding sheet, well-site survey reports, source water assessment fact sheets or other risk assessment documents. Normally, the Groundwater Section staff collecting samples maintains this information. Field and laboratory analysis sheets are filled out completely and accurately. Field parameter data should be collected, as outlined in the Standard Operating Procedure for Groundwater Sampling, and accurately recorded on the field sheet. Likewise, all other reported documentation is field verified to ensure that database information, as well as assessment data maintained by Illinois EPA, is accurate. Then the data are submitted to the appropriate Illinois EPA supervisory staff, such that updates can be made.

Laboratory data are generally obtained through the Illinois EPA Division of Laboratories. The data can be provided in two basic formats, hardcopy and electronically, through databases. Hardcopies are provided to the Planning and Assessment Unit Manager who then submits the results to the appropriate sample collector and Community Water Supply official. Electronic data are currently being compiled on the Laboratory Information Management System (LIMS) and transferred to a holding bin where it is reviewed for quality-control. All change to data must be made manually, and then the data are electronically transferred to Safe Drinking Water Information System (SDWIS) and PROTEUS.

The initial station selection depends on a number of programmatic constraints as described in the Standard Operating Procedure for Groundwater Sampling. Once a well is selected as a sample station and it is included as part of the monitoring network, basic inventory data are assimilated. The groundwater station inventory data should include the geologic profile of the well, physical attributes of the well, and any data describing the well (or well field). These data are researched and verified whenever it is possible, through driller's logs, engineering files, operator interviews, and on-station validation. The data are then reconciled with the Illinois EPA data systems.

1. Storage. All groundwater monitoring network and compliance monitoring data are available in SDWIS. The SDWIS has been integrated with PROTEUS. PROTEUS is a

database designed using web-based development tools. Groundwater, source water, and public water supply engineering evaluation data and SDWIS continue to be integrated into the PROTEUS database.

2. Retrieval/Accessibility. PROTEUS enhances the current retrieval and accessibility to SDWIS data. The SDWIS compliance monitoring data are currently available to the public over the internet via Drinking Water Watch (http://www.epa.state.il.us/drinking-water-watch/index.jsp). PROTEUS also provides accessibility externally via Source Water Assessment Program (SWAP) Arc Internet Map Server (ArcIMS) website (http://www.epa.state.il.us/enfo/) and internally via MSSQL 2005 reporting tools.

3. Timing. The groundwater monitoring network samples are collected and submitted to the Illinois EPA laboratory. Although most laboratory results and corresponding sample information get stored in LIMS within two months of the collection date, other results have much longer delays, having a turnaround time of up to six months. The LIMS transfers the analytical data electronically to a holding bin until QC of the information is completed. The timing for transfer to SDWIS/PROTEUS varies based on the number of errors. Existing delays are attributable to several factors as previously described above.

Recommendations and Strategies for Improvement

Illinois EPA BOW recognizes the need for improving data management. As resources allow during the years covered by this monitoring strategy, Illinois EPA BOW intends to address various gaps and weaknesses in data management as addressed below. These improvements would result in direct benefits to both public users and Illinois EPA users of surface-water and groundwater monitoring information while helping to advance several of Illinois EPA BOW's primary monitoring objectives.

Improvements in Storage

Illinois EPA BOW will specify and begin to evaluate the requirements of managing the results of continuous monitoring, including how to best transfer and store these data in national STORET. Continuous monitoring refers to placement of equipment in ambient conditions to record automatically, over short intervals (e.g., once every 30 minutes), selected parameters such as water temperature, dissolved oxygen, pH, and specific conductivity. Continuous monitoring at a station can last from one day to several weeks depending on specific objectives.

Illinois EPA BOW will continue to improve efficiency of data transfer via direct entry of field-measured physicochemical, biological, and physical-habitat data to computer spreadsheets or databases.

For field-based information from lakes and information from recently initiated monitoring efforts, Illinois EPA BOW will explore how to best transfer data from spreadsheets into existing databases, which then allows eventual transfer to AWQMS and to national STORET, as appropriate. For information from recently initiated monitoring efforts, Illinois

EPA BOW will work with the appropriate laboratories on how to best report data in a format compatible with Illinois EPA AWQMS. Primarily, this improvement applies to results related to algal-toxin monitoring, but may include additional information.

Illinois EPA BOW will continue to develop ad hoc computer-assisted procedures for reviewing data integrity (i.e., logic tests) to enhance the quality of the information being stored. However, due to limited expertise and time, such procedures will necessarily be limited in efficiency or lacking in comprehensiveness. Illinois EPA BOW will continue to advocate that such data review be automated and implemented as much as possible, as part of routine information management and quality control, by the analytical laboratory (e.g., Illinois EPA Division of Laboratories) before the laboratory finalizes and then reports the data. Reviewing data quality and integrity before rather than after storage in Illinois EPA AWQMS improves efficiency and limits the potential of unknowingly providing erroneous data to users.

Illinois EPA BOW plans to improve functionality of the Lakes Database Management System or to replace it with a more-capable alternative that will allow for comprehensive storage of all physiochemical data collected from inland lakes for both the ambient and volunteer programs. Currently, the Lakes database does not hold HAB, chemical, plant or shoreline data and it is also incompatible with AWQMS. Illinois EPA will work with personnel from Central Management Services who created the database to determine if these issues can be resolved.

The USEPA Assessment Database used by Illinois EPA needs major updating. Illinois EPA has experienced problems using the most recent version of the Assessment Database in a Windows 7 environment. Although Illinois EPA has been able to patch fixes for the significant problems, the stability and integrity of the Assessment Database remain vulnerable. Over the past few years, Illinois EPA and other users of the Assessment Database have suggested improvements to it; Illinois EPA will continue to provide such input. One suggested improvement is to link pollutants to violations of water-quality standards. Currently, causes of impairment can be associated with only designated uses.

Improvements in Retrieval and Accessibility

Illinois EPA BOW will develop ways to enhance information retrieval from our primary databases, Illinois EPA AWQMS, BIOS, and SDWIS. Ultimately, Illinois EPA BOW will work toward a single, map-based system—available via the internet—for retrieval of surface-water-monitoring and assessment information relevant to various spatial and temporal scales (e.g., site, watershed, month, year). This system would serve both the public as well as Illinois EPA staff who must interpret monitoring information to meet the various monitoring objectives addressed earlier in this document (Table 1). By making surface-water-monitoring data and related information widely and easily accessible to a broad range of users, this retrieval system would encourage and enhance the use of this information to support a broader range of resource-management objectives than the typical status and trends reporting.

The SDWIS compliance monitoring data are currently available to the public over the internet via the Drinking Water Watch website (http://www.epa.state.il.us/drinking-water-watch/index.jsp). However, due to recent SDWIS updates and programming changes, routing ambient groundwater monitoring results are no longer being uploaded into the Drinking Water Watch website. Illinois EPA BOW will evaluate the feasibility of directly populating ambient groundwater monitoring data from SDWIS into the Drinking Water Watch website to better serve both the public as well as Illinois EPA staff who must interpret monitoring information to meet the various monitoring objectives addressed earlier in this document.

Improvements in Timing

Illinois EPA BOW will examine ways to speed the flow of information at all steps: sample collection, initial processing, computer storage, and computer retrieval. However, increasing the speed of information flow must be balanced with the time required to ensure the integrity of the information. Specifically, to improve initial processing, Illinois EPA BOW has created and continues to refine new data forms to communicate better, with laboratories, the types of analyses requested and essential attributes of each set of samples submitted for analysis (e.g., sampling location, collection date, monitoring-program affiliation). These forms are standardized to improve efficiency and accuracy of computer storage and retrieval of lab results and related sample information. Illinois EPA also continues to refine the requirements of data structure and formatting for reporting lab-analyzed results from the laboratory back to Illinois EPA BOW. By improving the organization and speed of initial flow of results into computer databases and by improving efficiencies of data review and transfer, Illinois EPA BOW speeds the availability of such information and thereby enhances the abilities of data users and decision makers in achieving primary objectives.

Regarding transfer of Illinois data to the national STORET database and additional to the aforementioned activities for improving data flow, Illinois EPA BOW will continue to try to reduce the lag time between data collection and data availability in national STORET. Whereas, the speed of data flow depends heavily on the speed at which the laboratory reports the results of samples submitted for analysis, Illinois EPA intends to implement regularly scheduled compiling and review of the data files (called electronic-data deliverables) reported by the laboratories. Currently, this compiling and review occurs primarily according to the data needs of the biannual 305(b)/303(d) assessment cycle. As resources allow during 2015 through 2020, Illinois EPA intends to increase the frequency of such compiling and reviewing to at least two times per year. This will result in smaller but more-frequent data transfers to national STORET.

DATA ANALYSIS AND ASSESSMENT

Overview

The Clean Water Act requires Illinois EPA to determine and report regularly on the extent to which the beneficial uses of the state's waters are being attained. The beneficial uses assessed by Illinois EPA include *potable resource groundwater*, *primary contact use* (e.g., swimming, water skiing), *secondary contact use*, *fish consumption use*, *aquatic life use*, and *aesthetic quality*. The guidelines and criteria used by Illinois EPA BOW to assess attainment of uses are explained in *Illinois Integrated Water Quality Report and Section 303(d) List*, available at: http://www.epa.state.il.us/water/tmdl/303d-list.html

To assess attainment of beneficial uses of surface water, Illinois EPA BOW uses water-quality data collected via various surface-water-monitoring programs and activities. These monitoring data are also critical for identifying potential causes of use impairment and for reviewing the adequacy of existing water-quality standards, effluent limits in permits, and nondegradation decisions. Table 6 provides a summary of the data typically used. For a more detailed explanation of how Illinois EPA BOW analyzes and interprets water-quality data to assess attainment of uses and to identify causes of impairment, see *Illinois Integrated Water Quality Report and Section 303(d) List*.

Illinois EPA BOW plans to continue participating in interstate cooperative activities on the Mississippi River. This work has been facilitated through the Upper Mississippi River Basin Association and includes five upper-Mississippi River states (Minnesota, Wisconsin, Iowa, Illinois and Missouri) with support from USEPA Regions 5 and 7. These states have a memorandum of understanding that addresses delineation of assessment reaches on the Mississippi River. Also, member states have developed several reports that are available on the Upper Mississippi River Basin Assessment website at http://www.umrba.org/

Regarding assessment of Illinois wetlands, Illinois EPA plans to continue working with USEPA Region 5 and the Illinois Natural History Survey towards defining and designating appropriate beneficial uses, developing use-attainment criteria, and cooperatively assessing use attainment for purposes of Clean Water Act 305(b)/303(d) integrated reporting.

Data Solicitation

Illinois EPA BOW continues to refine the process of soliciting data for consideration in assessing attainment of beneficial uses and in identifying causes of use impairment. Guidance and associated information on how to submit data to Illinois EPA are provided in "*Guidance for Submittal of Surface Water Data,*" available at http://www.epa.state.il.us/water/water-quality/guidance.html. As appropriate, Illinois EPA BOW will update this guidance for the Integrated Report due in 2016, and subsequently thereafter.

Illinois EPA BOW also expects to continue the routine review and consideration of physical and chemical water data provided by public entities such as the City of Chicago (Lake Michigan data), United States Geological Survey, the Lake County Public Health Department, and any organizations that respond to our solicitation.

REPORTING

Illinois EPA BOW produces monitoring data and reports for its various programs. Described below are examples of Illinois EPA reporting.

Illinois Integrated Water Quality Report and Section 303(d) List - 2014

The Integrated Report format is based on federal guidance for meeting the requirements of Sections 305(b), 303(d), and 314 of the Clean Water Act. The 2014 Integrated Report is divided into two volumes: Volume I covering surface water, and Volume II covering groundwater. The basic purpose of this report (Volume I) is to provide information to the federal government and the citizens of Illinois on the condition of surface water in the state. An electronic copy of the current *Illinois Integrated Water Quality Report and Section 303(d) List* and subsequent reports, *may* be found at http://www.epa.state.il.us/water/water-quality/index.html.

Section 319 Nonpoint Source Reports

Grants issued by USEPA under Clean Water Act Section 319 require submission of a status report every six months. This report addresses Illinois EPA efforts to control pollution from non-point sources. A formal Biannual Report for all 319 projects may be found at http://www.epa.state.il.us/water/watershed/reports/biannual-319/index.html.

Beaches Act Reports

Data collected in the open waters of Lake Michigan, with data collected by local agencies at approximately 51 Lake Michigan beaches during the swimming season, are used to assess *primary contact use* in Lake Michigan. These data are reported in *Illinois Integrated Water Quality Report and Section 303(d) List - 2014* (IEPA 2014) and by the Illinois Department of Public Health at http://www.idph.state.il.us/envhealth/beachhome.htm. This program fulfills, in part, requirements of the Beaches Environmental Assessment and Coastal Health Act of 2000.

Intensive Basin Survey Reports

Illinois EPA BOW recognizes the need for enhanced reporting of data to achieve monitoring objectives 1c, 3, and 4 (Table 1). In the past, detailed Intensive Basin Survey Reports were written. Currently, as time allows, each Intensive Basin Survey report primarily comprises an executive summary and data from that survey.

Ambient Lake Monitoring Program Reports

Illinois EPA BOW Lakes Unit recognizes the need for more enhanced reporting of data to achieve monitoring objectives 1c, 3, and 4 (Table 1). Beginning in 2015, the Lakes Unit will endeavor to review and define a format for reporting lake data. These reports will recap historical information, summarize current data, and include suggested management projects and analysis for data trends for the lake. Lake reports will be completed on the individual lakes as staff time allows. This will support monitoring objective 1c by documenting water-quality trends, and providing information to drive future sampling plans. The reporting will support objective 3 by communicating management strategies to stakeholders. It will also support

objective 4 by documenting changes in water quality before and after implementing management programs.

Illinois Clean Lakes Program Monitoring Reports

For each Phase I or Phase II project, a detailed final report is required. A typical Phase I report includes a detailed analysis of historical limnological data and one year of current limnological data, including morphology and bathymetric, shoreline, and macrophyte maps. In addition, nutrient, sediment, and water budgets are defined for the lake. Other information is provided including a summary of lake usage, a detailed description of land use in the watershed, an estimate of the amount of NPS pollution contributed to the lake by each land use category, as well as a discussion of biological resources and their ecological relationships. Finally, recommendations are made for protection/restoration activities, including costs and time schedules. For Phase II projects, the final report includes details for each water quality improvement project implemented and a discussion of the success or failure of each.

Lake Michigan Monitoring Program

Currently, Lake Michigan data are used to develop use support assessments required by CWA Section 305(b) and 303 (d) integrated reporting. These use assessments are based on current general use water quality standards and guidelines as described in the *Illinois Integrated Water Quality Report and Section 303(d) List*. In addition to the Integrated Report, reports on the overall condition of Lake Michigan (within Illinois' boundaries) need to be generated. Reports of this kind had been produced from the start of the program until the late 1990's, but had to be suspended due to losing staff resources. Illinois EPA would like to return to creating these reports; they would promote inter-program communication and serve as valuable products for Illinois EPA to distribute to Lake Michigan stakeholders, local, state, and federal government and the scientific community.

Total Maximum Daily Load Reports

CWA Section 303(d) requires states to identify waters that do not meet applicable water-quality standards. States are required to submit a prioritized list of impaired waters, known as the 303(d) List, to the USEPA for review and approval. The CWA also requires that a TMDL be developed for each identified pollutant in an impaired waterbody. Completed TMDL reports may be found at http://www.epa.state.il.us/water/tmdl/report-status.html .

Reporting of Whole Effluent Toxicity Testing

Results from Illinois EPA sponsored bioassays are distributed to pertinent staff, usually within a few months of the lab report becoming available. The cover memorandum contains explicit instructions for the Permit Section to incorporate the appropriate monitoring conditions in the renewed permit. The report and summary sheet become part of the permit or division files after submission to Permit Section.

Fish Contaminant Monitoring Reporting

The Illinois Department of Public Health posts fish consumption advisories at http://www.idph.state.il.us/envhealth/fishadvisory/index.htm and publishes and distributes additional outreach materials as needed. Additionally, Illinois EPA uses fish consumption advisories and fish tissue data to assess attainment of *fish-consumption use* in waters throughout Illinois. These assessments are reported in the *Illinois Integrated Water Quality Report and Section 303(d) List*.

Illinois Groundwater Protection Program Biennial Comprehensive Status and Self-Assessment Reports

These biennial reports provide a policy perspective on groundwater-quality and -quantity protection in Illinois, including a comprehensive status and assessment of the program. Further, these documents provide the reporting required concerning a water-quantity-planning and management program. The Illinois Groundwater Protection Act created a comprehensive, prevention-based policy focused on the beneficial uses of groundwater and preventing degradation. The biennial reports give the status of various elements of groundwater protection, and provide future directions for groundwater-protection-program activities. The biennial reports, first completed in 1988-1989, may be found at http://www.epa.state.il.us/water/groundwater/groundwater-protection/index.html .

Recommendations and Strategies for Improvement

Illinois EPA BOW recognizes the need for improved and expanded formal reporting in addition to the biennial integrated report; *Illinois Integrated Water Quality Report and Section 303(d) List.* These reports would fulfill a wide range of purposes and could include topics such as status and trends, major watershed assessment and planning, intensive basin survey, lake assessment, special studies, technical, and legislative reports as well as newsletters and USEPA required reports. While Illinois EPA recognizes the benefits of expanded reporting, the time, resources, and information to move in this direction are currently unavailable.

PROGRAMMATIC EVALUATION

Illinois EPA BOW evaluates monitoring programs and activities in various ways to determine if they are meeting internal goals as well as general Clean Water Act objectives (Table 1). Described below are various examples for evaluating program and data needs from both within and outside the Illinois EPA.

Illinois EPA biennially evaluates monitoring programs during the 305(b)/ 303(d) Integrated Report assessment period. Review of this document allows for internal evaluation of data needs required for use attainability. The public comment period opens communication for outside data users to express needs for future monitoring cycles.

Illinois EPA water-monitoring programs are also reviewed every two years in conjunction with preparation of the Illinois EPA/USEPA Environmental Performance Partnership Agreement (IEPA 2012). This agreement, which sets the mutual state/federal agenda of continued environmental progress, outlines Illinois EPA plans to prevent, control, and abate water pollution on a fiscal year basis, and the strategy for conducting ongoing surface-water programs and new monitoring initiatives. This document provides a self-assessment of water-monitoring programs and an outline of programmatic accomplishments for both Illinois and USEPA Region 5.

Individual monitoring programs are evaluated using varying ad hoc methods.

Examples of monitoring program evaluations are provided below.

Ambient Water Quality Monitoring Network

Water-quality monitoring in this stream network is performed by three Illinois EPA field offices, the Illinois State Water Survey, and the United States Geological Survey. These entities ideally meet annually to discuss procedures and logistics. The meeting covers equipment needs, sampling methodology, data management, and quality assurance/quality control. Laboratory procedures and paperwork are also discussed with lab personnel and the BOW Quality Assurance Officer. Any changes that result from this meeting go into effect at the beginning of the next water year, which runs from October to September.

Intensive Basin Surveys

In cooperation with the Illinois Department of Natural Resources, Illinois EPA conducts annual Intensive Basin Surveys of streams. Each spring, biologists from both agencies conduct field reconnaissance to insure continued site accessibility and representativeness. Any other sampling issues are discussed annually prior to the start date of field work. These discussions include equipment needs, field methods, field sheets, and data management. Also, as needed, Illinois EPA BOW Surface Water Section staff who conduct the Intensive Basin Surveys consult with staff of the Watershed Management Section to try to accommodate any mutual monitoring-information needs.

Continuous Dissolved Oxygen Monitoring in Streams

Continuous dissolved oxygen monitoring is conducted at all Intensive Basin Survey sites. Monitoring is conducted by Illinois EPA BOW and the Illinois State Water Survey. Each year, staff from both agencies consult about monitoring issues prior to the start of field work. Issues addressed include equipment, data management, and quality-assurance/quality-control practices.

Facility Related Stream Surveys

Sites selected each year for Facility Related Stream Surveys are based on several needs including: to document Clean Water Act 303(d) listings; to address water-quality standard issues; to renew NPDES permits, and to identify effluent toxicity. Surveys are also frequently linked with the Intensive Basin Survey program (i.e., conducted in the same time frame and watershed). Each year, Illinois EPA BOW Surface Water Section staff in each of the three regional offices weight the aforementioned needs and special requests to select the final sites and then plan accordingly to best accommodate these surveys.

Ambient Lake Monitoring Program

Each year, before the Ambient Lake Monitoring Program sampling schedule is finalized, several sections in the Illinois EPA BOW (e.g., Nonpoint Source, Standards, Permits, Public Water Supply) are consulted regarding the need for monitoring information for the upcoming year (e.g., additional routine and non-routine data to be collected from designated lakes, status verification of Source Water Protection Program lakes, future lake sampling schedule). This annual communication and collaboration allows for a more efficient use of monitoring resources and data is used by multiple programs, which may not have been possible otherwise, due to the varying resource limitations of each section.

An internal annual meeting is also held by the Lakes Unit staff to review and evaluate the Ambient Lake Monitoring Program and to make necessary adjustments and changes in hopes of continued program improvement. These internal reviews of the monitoring program are not formally reported on. As resources allow, the Illinois EPA Lakes Unit will develop a program evaluation report form to be completed and distributed to other sections in the agency, facilitating feedback from them. To meet monitoring objective 3; implement management plans, and 4; evaluate effectiveness of management programs, the Lakes Unit will need to communicate data needs with users outside the agency. Illinois EPA will use the Volunteer Lake Monitoring Program and the annual Illinois Lakes Management Association Conference to solicit feedback from outside the agency on the data needs and data delivery mechanisms.

Harmful Algal Bloom and Algal Toxin Program

Following the initial year of Harmful Algal Bloom sampling in 2013, results were compiled and analyzed. Based on data analyses, the 2014 Harmful Algal Bloom Program monitoring strategy was revised. Data indicated that routine sampling effort was most efficient when

conducted at public access locations in a lake. To meet monitoring objectives 1a, 1b, and 3, future efforts will be geared toward routine sampling of inland lakes at public access locations (e.g., beaches, boat ramps, marinas). To encourage collaboration of efforts among agencies and to initiate discussion of a public health advisory program for Harmful Algal Blooms, the 2013 bloom sampling results were presented to outside agencies, including the Illinois Department of Natural Resources, United States Geological Survey, Illinois Department of Public Health, and the Lake County Health Department.

Volunteer Lake Monitoring Program

The Volunteer Lake Monitoring Program is evaluated after the end of the sampling season, in November or early December. A meeting including all volunteer regional coordinators, headquarters Lake Unit, and the Ambient Lake Monitoring Program's coordinator and regional biologists is held at Headquarters. Additionally, sister programs in the agency that may have data and monitoring needs that can be supported by the Volunteer Lake Monitoring Program, such as Total Maximum Daily Load, Clean Lakes, Watershed Planning, etc., are included in the meeting. Positive and negative sampling issues are discussed and potential solutions and corrective actions are decided upon. Efforts to carry out the corrective actions are outlined for the upcoming season and discussed along with plans to include additional monitoring needs, such as regional or county watershed planning programs. The Ambient Lake Monitoring Program coordinator and field biologists play a significant role in keeping the Volunteer Lake Monitoring Program consistent with the Ambient Lake Monitoring Program approach to allow successful use of data for Integrated Report purposes.

Lake Michigan Monitoring Program

Currently, Illinois EPA evaluates the Lake Michigan Monitoring Program on an annual basis through the process of preparing for an upcoming field season, or during a 305(b)/ 303(d) Integrated Report assessment period. Sampling locations, equipment, and logistics are evaluated for necessity and efficiency, as well as achievements of the Program and Illinois EPA BOW monitoring objectives during assessment periods. While this accomplishes a program evaluation, the move to a more formal, standardized evaluation report is desired. A more formal, standardized evaluation report would better document program performance of the Lake Michigan Monitoring Program and Illinois EPA BOW monitoring objectives, any needed changes, and allow easy comparison to previous evaluations. Formal, standardized programmatic evaluation reports are a desired goal, and would require additional resources (staffing) within the Program and Surface Water Section to alleviate current staffing work load pressures.

Nonpoint Source/Best Management Practices/Total Maximum Daily Load Programs

The Nonpoint Source section publishes a Program Plan every five years that in part summarizes Nonpoint Source evaluation procedures (IEPA 2013b). Those procedures include:

1. A comprehensive evaluation of the Program every four years. This evaluation is scheduled to occur after the release of the Illinois Integrated Water Quality Report and Section 303(d) List, which is released every two years (e.g., 2014, 2016). Throughout the life of the Program, Illinois EPA may also conduct additional evaluations of the Program in response to changes in Agency resource availability and program functionality or per guidance from USEPA or the federal Clean Water Act.

2. In 2012, the Nonpoint Source section began conducting a state-wide biennial Nonpoint Source Management meeting for program partners and general stakeholders to share knowledge on nonpoint source control issues, programs, projects, and practices. The workshop is an opportunity to bring together nonpoint source pollution control experts, watershed associations, environmental advocates, and lay persons to provide information about the Program and nonpoint source pollution control to them while also collecting feedback on the Program as well.

3. The Nonpoint Source section also conducts gap analysis on objectives and milestones. The results of the analysis will be submitted to USEPA with the End-of-Year Report which documents Illinois EPA's Annual Work Plan achievements. The information gathered through the annual gap analysis will be used to help tailor the subsequent year's Annual Work Plan.

Additionally, informal meetings are conducted with the regional offices every spring to evaluate monitoring needs for newly funded projects as well as review ongoing projects. Programs that receive grants issued by USEPA under Clean Water Act Section 319 are required to submit a status report that is used as a tool to evaluate ongoing progress of 319 funded projects. Additionally, project updates, water quality, and watershed planning progress are summarized in a formal Biannual Report for all 319 projects (IEPA 2014b).

Fish Contaminant Monitoring Program

The Fish Contaminant Monitoring Program is a cooperative program between the Illinois Departments of Public Health, Agriculture, and Natural Resources, as well as the Illinois EPA. Fish contaminant samples are collected by Illinois Department of Natural Resource fisheries staff and provided to Illinois EPA for laboratory analysis of various chemicals. Once data are available, staff from the four organizations meet to determine if fish contaminant advisories should be issued to the public. If so, advisory information is provided to the public through various venues. The Fish Contaminant Monitoring Program is evaluated on an ongoing basis through inter-agency meetings. Members of the Program meet roughly 2-3 times annually. Discussions surround where samples should be collected in the future as compared to those collected in past years; Illinois Department of Natural Resources and Illinois EPA fisheries and laboratory resources available to collect and analyze samples; new approaches to getting the word out to the general public when advisories are issued; if modifications to any part of the Program are warranted; and the like.

Probabilistic and Rotating Groundwater Monitoring Networks

The Illinois EPA evaluates the probabilistic and rotating groundwater monitoring networks on an annual basis, as appropriate, through the process of reviewing network stations, sampling equipment, logistics, and monitoring data. The network stations are evaluated for continued viability at the end of a monitoring network and prior to initiating an alternate network. When a groundwater monitoring network well is taken out of service, or otherwise not readily available to be sampled, Illinois EPA monitoring staff designates an alternative well with generally the same location, depth, and aquifer properties. The Groundwater monitoring staff is continually maintaining sampling equipment to insure proper maintenance and calibration standards are met to obtain natural/optimum groundwater conditions prior to sample collection. On an annual basis, the Illinois EPA monitoring staff also participates in the United States Geological Survey National Field Quality Assurance program. Participation in the Quality Assurance program has been used to further determine when sampling equipment may require preventative maintenance, repair or replacement. Analytical groundwater monitoring data from network wells are reviewed to determine if Illinois EPA is meeting primary monitoring program objectives. The results of this evaluation are the basis for determining groundwater use assessments and other reporting requirements including: Illinois Integrated Water Quality Report; Biennial Comprehensive Status and Self-Assessment Report of the Illinois Groundwater Protection Program; and determination of a volatile organic trend analysis associated with Community Water Supply wells. These reporting efforts also affords the Illinois EPA an opportunity to assess the extent to which appropriate data are available for assessment of environmental impairments, short and long-term trends, and the effectiveness of water pollution control and Safe Drinking Water Act programs.

Recommendations and Strategies for Improvement

Illinois EPA recognizes the need for developing a more consistent and formal approach to evaluating state monitoring programs to increase monitoring efficiency and coordination among all monitoring programs, as well as to fully meet monitoring objective 4; evaluate the effectiveness of water management programs (Table 1). Towards the end of calendar year 2014, Illinois EPA plans to prioritize our current monitoring objectives and initiate a monitoring program self-assessment process to determine where to focus limited resources in order to increase efficiency and meet a wider spectrum of data needs. To help guide this process, the "State Self-Assessment Tool," developed by the Monitoring and Assessment Partnership, collaboration between USEPA and the States, may be used. The State Self-Assessment Tool is intended to help states in determining progress toward achieving a fully implemented water monitoring program, and is a reflection of USEPA's guidance, Elements of a State Water Monitoring and Assessment Program (USEPA-2003a). Illinois EPA plans to periodically update the Monitoring Strategy to reflect changes to its programs.

GENERAL SUPPORT AND INFRASTRUCTURE PLANNING

The United States Environmental Protection Agency (USEPA 2003a) requests that each state describe how it addresses the monitoring element called "General Support and Infrastructure Planning." Specifically, USEPA (2003a) requests that "*the State identifies current and future monitoring resources it needs to fully implement its monitoring program strategy.*"

This part of the monitoring strategy describes the current status of Illinois EPA BOW's monitoring resources and the projected needs for advancing our primary monitoring objectives (Tables 1 and 3). These projected needs address monitoring/assessment efforts that either are planned for 2015 through 2020 (Table 3) or represent potential future action.

Current Staff Resources

There are a number of Illinois EPA BOW Sections that are involved with the planning and implementation of the current monitoring design described in this report. These Sections, and their current level of full-time employee equivalent (FTE) staff focused on achieving monitoring program goals and objectives (as of September 2014), include:

BOW/DWPC Surface Water Section – 19 staff
BOW/DWPC Field Operations Section – 4 staff
BOW/DWPC Standards Section – 2 staff
BOW/Watershed Management Section – 5 staff
BOW/DWPC Groundwater Section – 4 staff

Illinois EPA BOW is challenged to fully achieve all of its current monitoring goals and objectives with shrinking resources. However, efforts are being made to optimize internal resources, seek collaborations with external partners that leverage existing resources, and identify the need for filling critical vacancies.

In Table 8, Illinois EPA BOW presents projected needs in terms of additional FTEs to advance and fully meet all of 2015-2020 Monitoring Strategy planned and projected monitoring and assessment efforts.

Current Laboratory Resources

The Illinois EPA Division of Laboratories provides laboratory analysis of water, sediment, and fish-tissue samples to IEPA BOW. In general, this laboratory service is meeting the current analytical needs of Illinois EPA BOW monitoring. A long-term commitment to implementation of this strategy will necessitate that the laboratory is sufficiently staffed and equipment is upgraded as necessary, in keeping with advances in analytical chemistry.

Table 8. Projected needs for advancing Illinois EPA's 2015-2020 Monitoring Strategy objectives		
Monitoring/ Assessment Element	**Monitoring/Assessment Effort**	**Projected Needs**
Monitoring Design	Planned Efforts *Surface Water* -Participate in the National Rivers and Streams Assessment -Coordinate with Nonpoint Source to accommodate mutual monitoring needs -Collaborate with USEPA Region 5 to develop a statewide probability-based design for Illinois streams -Include continuous monitoring in Facility Related Stream Surveys -Participate in National Lakes Assessment Survey -Conduct expanded monitoring of lakes (i.e., macrophyte surveys, shoreline habitat, macroinvertebrate collection) -Update assessment methodology of Aquatic Life Use in lakes by incorporating information from expanded monitoring -Refine and implement Harmful Algal Bloom Monitoring Program -Establish human-health advisory program for microcystin with other state and local agencies -Revise assessment methodologies of Primary Contact Use & Secondary Contact Use -Expand monitoring of harmful algal blooms to include multiple algal toxins and samples for identification and enumeration -Participate in National Coastal Conditions Assessment -Monitor lakes and headwater streams for watershed planning, TMDL development, and effectiveness -Collaborate with Illinois Natural History Survey and participate in National Wetland Condition Assessment -Coordinate with Illinois Natural History Survey and USEPA Region 5 to define and designate uses for Illinois wetlands, to develop use-attainment criteria, and to consider assessment of wetland uses for Clean Water Act purposes *Groundwater* -Evaluate VOC data -Publish trend data -Continue groundwater quality standards development discussions and prepare proposal to the Illinois Pollution Control Board -Continue to implement rotating network	Staff -Field technicians (15 FTE) for monitoring -Specialists (24 FTE) to: -design and implement monitoring -coordinate routine regional monitoring and assessment with project-specific monitoring and assessment identify aquatic macroinvertebrates -Management Staff (2 FTE) Training -Training, for technical staff, in: -developing and using monitoring designs -analyzing and interpreting environmental data, including statistical applications Laboratory Resources -Ensure sufficient laboratory resources to accommodate number of samples and parameters for analysis

Table 8. (cont.) Projected needs for advancing Illinois EPA's 2015-2020 Monitoring Strategy objectives		
Monitoring/ Assessment Element	**Monitoring/Assessment Effort**	**Projected Needs**
Monitoring Design (cont.)	Potential efforts -Collect phytoplankton data for assessing attainment of Aquatic Life Use in lakes -Collect human-pathogen indicator data in lakes -Expand Volunteer Lake Monitoring Program to include training of volunteers to collect and identify aquatic macroinvertebrates -Expand fish-contaminant monitoring in lakes -Conduct fish-assemblage monitoring in lakes -Incorporate biological monitoring in Lake Michigan -Implement new monitoring strategy for upper Mississippi River -Develop biological indicators of ecological health for large rivers -Continue collaboration to study water-quality trends in Illinois River -Refine monitoring of physicochemical conditions at public-water-supply intakes in streams -Monitor for emerging contaminants -Monitor polycyclic aromatic hydrocarbons in Illinois waters -Develop monitoring and assessment of Illinois wetlands -Participate in an initiative to monitor effects of climate change in upper-Midwest streams -Collaborate with USEPA to monitor pesticides not currently covered by Illinois EPA -Develop aquatic-life uses and biological indicators of use attainment for frequently intermittent streams -Incorporation of Selenium as a routine analysis parameter in the Fish Contaminant Monitoring Program -*E. coli* water quality standard development to replace Fecal Coliform and associated future monitoring activity -Collect periphyton data in streams -Low phosphorus (P) stream identification and assessment -Develop a statewide nutrient export loadings network -HUC 8 watershed nutrient export loadings network or export modeling efforts -Offensive Conditions Determinations	

Table 8. (cont.) Projected needs for advancing Illinois EPA's 2015-2020 Monitoring Strategy objectives		
Monitoring/ Assessment Element	**Monitoring/Assessment Effort**	**Projected Needs**
Environmental Indicators	<u>Planned Efforts</u> -Define and designate tiered aquatic life uses and determine corresponding use-attainment criteria -Define and designate uses in wetlands and determine corresponding use-attainment criteria -Investigate and consider potential improvements to guidelines for assessing attainment of the two uses, *primary contact use* and *aesthetic quality* -Develop a lake macroinvertebrate Index of Biological Integrity -Begin collecting environmental data in headwater streams -Amend Groundwater Quality Standards -	<u>Staff</u> -Specialists (4 FTE) to: -develop and apply water quality standards (including new uses) and environmental indicators <u>Training</u> -Training, for technical staff, in: -defining and designating beneficial uses -understanding and applying use-attainability analysis -understanding and developing water quality standards, including biological criteria -understanding and using statistics for all of the above
Quality Assurance	<u>Planned Efforts</u> -Review current sampling techniques, core parameters, and implement changes to applicable "Standard Operating Procedures" as necessary -Review current laboratory analytical methods and instrumentation to evaluate necessary changes and upgrades to improve data quality and usability -Review recent advances in method development and refinement by the USGS and other agencies and build on these improvements -Review new information on biological indices and field-sampling methods as it becomes available, and updating information-collection and information-management guidelines -Enhance post-analysis quality control of analytical results (i.e., incorporate logic tests)	<u>Staff</u> -Specialists (3 FTE) to develop and apply quality assurance and quality control <u>Training</u> -Training, for technical staff, in understanding, developing, and applying quality assurance and quality control <u>Laboratory Resources</u> -Instrumentation to replace outdated equipment and improve on analytical methodologies -Database capability for post-analysis quality control of analytical results before release, including logic tests

Table 8. (cont.) Projected needs for advancing Illinois EPA's 2015-2020 Monitoring Strategy objectives		
Monitoring/ Assessment Element	**Monitoring/Assessment Effort**	**Projected Needs**
Data Management	Planned Efforts -Collaborate with laboratory to decrease delays in data reporting -Improve Lakes Database functionality & database development for all Harmful Algal Bloom-related data. -Collaborate with USEPA to improve the Assessment Database -Develop single, map-based system – available via the internet – for retrieval of surface-water monitoring and assessment information relevant to various spatial and temporal scales -Transfer biological and physical habitat data into BIOS and generate mIBI scores -Examine ways to speed the flow of information at all steps of "data management": sample collection, initial processing, computer storage, and computer retrieval	Staff -Specialists (7 FTE) to: -process and manage data/information -develop geospatial databases -develop and apply web-based applications for storage and retrieval of monitoring and assessment information -coordinate continued out-sourcing of data/information management to non-IEPA entities -Management Staff (1 FTE) Training -Training, for technical staff, in: -processing and managing computer-based data/information -developing and using geospatial databases -developing and using web-based storage and retrieval systems Laboratory Resources -Database capability for post-analysis quality control of analytical results before release, including logic tests -Capability for tracking the status of samples submitted for analysis -Capability for directly querying the IEPA laboratory database (i.e., LIMS)

Table 8. (cont.) Projected needs for advancing Illinois EPA's 2015-2020 Monitoring Strategy objectives		
Monitoring/ Assessment Element	**Monitoring/Assessment Effort**	**Projected Needs**
Data Analysis and Assessment	<u>Planned Efforts</u> -Continue to refine the basis and guidelines for determining attainment of uses, for identifying potential causes of use impairment, and for reviewing the adequacy of existing water quality standards, effluent limits in permits, and nondegradation decisions -Analyze water-quality and biological data for trends -Generate technical reports	<u>Staff</u> -Specialists (1 FTE) to: -gather and review historic and current water-quality and biological data -to analyze trends, to generate technical reports, and to assess attainment of uses - assist in providing the public with requested water quality and biological information <u>Training</u> -Training for technical staff in: -data analysis -technical writing and reporting
Administrative Support		<u>Staff</u> -Staff (5 FTE)
		Total FTE = 62*

*Subject to change based on changing priorities, programs, or objectives.

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APPENDICES

Illinois Water Monitoring Strategy

2015-2020

Illinois Environmental Protection Agency
Bureau of Water
Springfield, Illinois

APPENDIX A

Laboratory and Field Parameters Assessed in Bureau of Water Monitoring Programs

Illinois Environmental Protection Agency
Bureau of Water
Springfield, Illinois

Appendix A. Laboratory and field parameters assessed in Bureau of Water Monitoring Programs

Parameter	BIOSURVEY		FISH		LAKES AND RESERVOIRS							
	Facility-Related	Intensive Basin	TISSUE	AWQMN	ALMP	VLMP	Clean Lakes	Lake Michigan	HAB	POINT SOURCE	GROUND-WATER	PWS
Water Inorganics												
Alkalinity, Total as CaCO3		X		X*	X	X	X				X	
alpha particle activity (gross)												X
Aluminum, Dissolved	X	X		X	X*		X*					
Aluminum, Total	X	X		X	X*		X*	X		X	X	
Antimony											X	X
Arsenic, Total	X*	X*		X*	X*		X*	X		X*	X	X
Asbestos												X
Barium, Dissolved	X	X		X	X*		X*					
Barium, Total	X	X		X	X*		X*	X		X	X	X
Beryllium, Dissolved	X	X		X	X*		X*					
Beryllium, Total	X	X		X	X*		X*	X		X	X	X
beta particle and photon radioactivity												X
BOD, Carbonaceous	X									X		
BOD, Total	X									X*		
Boron, Dissolved	X	X		X	X*		X*					
Boron, Total	X	X		X	X*		X*	X		X	X	
Bromate												X
Cadmium, Dissolved	X	X		X	X*		X*					
Cadmium, Total	X	X		X	X*		X*	X		X	X	X
Calcium, Dissolved	X	X		X	X*		X*					
Calcium, Total	X	X		X	X*		X*	X		X	X	
Chloride, Total	X*	X*		X*	X*		X*	X		X	X	
Chlorite												X
Chromium, Dissolved	X	X		X	X*		X*					
Chromium, Hex.										X*		
Chromium, Total	X	X		X	X*		X*	X		X	X	X
Cobalt, Dissolved	X	X		X	X*		X*					
Cobalt, Total	X	X		X	X*		X*	X		X	X	
Conductivity, Lab	X*	X*		X*	X		X	X		X		
Copper, Dissolved	X	X		X	X*		X*					
Copper, Total	X	X		X	X*		X*	X		X	X	X
Cyanide, Dissolved										X*		
Cyanide, Total	X*	X		X*				X			X	X
Fecal Coliform Bacteria				X				X				
Fluoride	X*	X*		X*	X*		X*	X		X*	X	X
Hardness	X	X		X	X*		X*	X		X	X	
Iron, Dissolved	X	X		X	X*		X*					
Iron, Total	X	X		X	X*		X*	X		X	X	X
Lead, Dissolved	X	X		X	X*		X*					
Lead, Total	X	X		X	X*		X*	X		X	X	X
Magnesium, Dissolved	X	X		X	X*		X*					
Magnesium, Total	X	X		X	X*		X*	X		X	X	X
Manganese, Dissolved	X	X		X	X*		X*					
Manganese, Total	X	X		X	X*		X*	X		X	X	
Mercury	X	X		X				X		X	X	X
Molybdenum											X	
Nickel, Dissolved	X	X		X	X*		X*					
Nickel, Total	X	X		X	X*		X*	X		X	X	X
Nitrogen, Ammonia	X	X		X	X	X	X	X	X*	X	X	
Nitrogen, Kjeldahl	X*	X		X	X	X	X		X*	X*		
Nitrogen, NO3+NO2	X	X		X	X	X	X	X	X*	X	X	X
Oil and Grease	X*									X		
Organic Carbon, Total	X*	X*		X*						X*		
pH, Lab	X*	X*		X*	X		X	X		X		
Phenols	X*	X*		X*	X*		X*	X		X*	X	
Phosphorus, Dissolved	X	X		X	X	X*	X	X				
Phosphorus, Total	X	X		X	X	X*	X	X	X*	X	X	
Potassium Total	X	X		X	X*		X*	X		X	X	
Potassium, Dissolved	X	X		X	X*		X*					
Radium 226 and 228, Total								X*		X*		X
Selenium				X							X	X
Silica								X			X	
Silver, Dissolved	X	X		X	X*		X*					

Appendix A. (cont) Laboratory and field parameters assessed in Bureau of Water Monitoring Programs

Parameter	BIOSURVEY Facility-Related	BIOSURVEY Intensive Basin	FISH TISSUE	AWQMN	LAKES AND RESERVOIRS ALMP	LAKES AND RESERVOIRS VLMP	LAKES AND RESERVOIRS Clean Lakes	LAKES AND RESERVOIRS Lake Michigan	HAB	POINT SOURCE	GROUND-WATER	PWS
Water Inorganics (cont)												
Silver, Total	X	X		X	X*		X*	X		X	X	
Sodium Total	X	X		X	X*		X*	X		X	X	
Sodium, Dissolved	X	X		X	X*		X*					
Solids, Dissolved (ROE)	X*	X		-	X*		X*	X		X	X	
Solids, Total Suspended	X	X		X	X	X	X			X		
Solids, Volatile Suspended	X*	X		X	X	X	X			X		
Strontium, Dissolved	X	X		X	X*		X*					
Strontium, Total	X	X		X	X*		X*	X		X	X	X
Strontium-90												X
Sulfate	X*	X		X*	X*		X*	X		X	X	
Sulfide										X*		
Thallium											X	X
Tritium												X
Turbidity, NTU	X*	X		X	X		X	X		X		
Vanadium, Dissolved	X	X		X	X*		X*					
Vanadium, Total	X	X		X	X*		X*	X		X	X	
Zinc, Dissolved	X	X		X	X*		X*					
Zinc, Total	X	X		X	X*		X*	X		X	X	X
Water Organics												
1,2-Dichloroethane										X*		X
2,4,5-Trichlorophenol										X*		
2,4,6-Trichlorophenol										X*		
2,4-D				X*	X*		X*				X	X
2,4-Dichlorophenol										X*		
2,4-Dimethylphenol										X*		
2,4-Dinitrophenol										X*		
2,4-Dinitrotoluene										X*		
2,6-Dinitrotoluene										X*		
2-Butanone (MEK)										X*		
2-Chloroethylvinyl Ether										X*		
2-Chloronaphthalene										X*		
2-Chlorophenol										X*		
2-Hexanone (MSK)										X*		
2-Methylnaphthalene										X*		
2-Methylphenol										X*		
2-Nitrophenol										X*		
3,3'-Dichlorobenzidine										X*		
3-Nitroaniline										X*		
4,6-Dinitro-2-methylphenol										X*		
4-Bromophenyl Phenyl Ether										X*		
4-Chloro-3-Methylphenol										X*		
4-Chloroaniline										X*		
4-Chlorophenyl Phenyl Ether										X*		
4-Methyl-2-Pentanone(MIBK)										X*		
4-Methylphenol										X*		
4-Nitroaniline										X*		
4-Nitrophenol										X*		
Acenaphthene										X*		
Acenaphthylene										X*		
Acetochlor				X*	X*		X*				X	
Acetochlor Ethanesulfonic Acid												
Acetochlor Oxanilic Acid												
Acetone										X*		
Acifluorfen				X*	X*		X*				X	
Alachlor Ethanesulfonic Acid												
Alachlor, Total (Lasso)				X*	X*	X*	X*				X	X
Aldrin	X*			X	X*		X*	X*			X	X
alpha BHC	X*			X	X*		X*	X*				
Alpha-Chlordane				X*	X*		X*					
Ametryn												
Anthracene										X*		
Atrazine				X*	X*	X	X*				X	X

Appendix A. (cont) Laboratory and field parameters assessed in Bureau of Water Monitoring Programs

Parameter	BIOSURVEY Facility-Related	BIOSURVEY Intensive Basin	FISH TISSUE	AWQMN	LAKES AND RESERVOIRS ALMP	LAKES AND RESERVOIRS VLMP	LAKES AND RESERVOIRS Clean Lakes	LAKES AND RESERVOIRS Lake Michigan	HAB	POINT SOURCE	GROUND-WATER	PWS
Water Organics (cont)												
Benzene										X*		X
Benzo (B) Fluoranthene										X*		
Benzo (GHI) Perylene										X*		
Benzo (K) Fluoranthene										X*		
Benzo(A)Anthracene										X*		
Benzo(a)pyrene					X*		X*			X*	X	X
Benzoic Acid										X*		
Benzyl Alcohol										X*		
Bis (2-Chloroethoxy) Methane										X*		
Bis (2-Chloroethyl) Ether										X*		
Bis (2-Chloroisopropyl)										X*		
Bromochloromethane										X*		
Bromocil											X	
Butachlor					X*		X*					
Butyl Benzyl Phthalate										X*		
Butylate, Total				X*	X*		X*					
Captan				X*	X*		X*					
Carbofuran												X
Carbon Disulfide										X*		
Chlordane cis isomer	X*			X				X*				
Chlordane Tech & Met	X*			X	X*		X*	X*			X	X
Chlordane trans isomer	X*			X				X*				
Chloropyrifos (Dursban)				X*	X*		X*					
Chrysene										X*		
Cyanazine, (Bladex)				X*	X*	X*	X*				X	
Cyanazine-amide												
Dacthal					X*		X*					
Dalapon				X*	X*		X*				X	X
Deethylatrazine												
Deisopropylatrazine												
Di(2-Ethylhexyl) Adipate					X*		X*				X	X
Di(2-Ethylhexyl) Phthalate					X*		X*			X*	X	X
Diazinon				X*	X*		X*					
Dibenz (AH) Anthracene										X*		
Dibenzofuran										X*		
Dibromochloropropane (DBCP)												X
Dicamba				X*	X*		X*				X	
Dieldrin	X*			X*	X*		X*	X*			X	X
Diethylphthalate										X*		
Dimethenamid												
Dimethenamid Ethanesulfonic Acid												
Dimethenamid Oxanilic Acid												
Dimethylphthalate										X*		
Di-N-Butylphthlate										X*		
Di-N-Octylphthalate										X*		
Dinoseb				X*	X*		X*				X	X
Dioxin												X
Dipropylthiocarbamic Acid S-Ethyl Ester (EPTC)					X*		X*					
Diquat												X
Endothall												X
Endrin				X*	X*		X*				X	X
Ethylbenzene										X*		X
Ethylene dibromide												X
Ethyl Parathion					X*		X*					
Flufenacet												
Flufenacet Ethanesulfonic Acid												
Flufenacet Oxanilic Acid												
Fluoranthene										X*		
Fluorene										X*		
Fonofos (Dyfonate)				X*	X*		X*					
gamma BHC (Lindane)	X*			X*	X*		X*	X*			X	X
Gamma-Chlordane				X*	X*		X*					
Glyphosate												X
Haloacetic acids												X
Heptachlor				X*	X*		X*				X	X

Appendix A. (cont) Laboratory and field parameters assessed in Bureau of Water Monitoring Programs

Parameter	BIOSURVEY Facility-Related	BIOSURVEY Intensive Basin	FISH TISSUE	AWQMN	LAKES AND RESERVOIRS ALMP	LAKES AND RESERVOIRS VLMP	LAKES AND RESERVOIRS Clean Lakes	LAKES AND RESERVOIRS Lake Michigan	HAB	POINT SOURCE	GROUND-WATER	PWS
Water Organics (cont)												
Heptachlor epoxide				X*	X*		X*				X	X
Hexachlorobenzene	X*			X*	X*		X*	X*		X*	X	X
Hexachlorobutadiene										X*		
Hexachlorocyclopentadiene					X*		X*			X*	X	X
Hexachloroethane										X*		
Ideno (1,2,3-cd) Pyrene										X*		
Isophorone										X*		
Malathion				X*	X*		X*					
Methoxychlor				X*	X*		X*	X*			X	X
Methyl Parathion				X*	X*		X*					
Metolachlor (Dual)				X*	X*		X*				X	
Metolachlor Ethanesulfonic Acid												
Metolachlor Oxanilic Acid												
Metribuzin, Total				X*	X*	X*	X*				X	
Naphthalene										X*		
Nitrobenzene										X*		
N-Nitroso-di-n-Propylamine										X*		
Oxamyl (Vydate)												X
p,p' DDD	X*			X*	X*		X*	X*				
p,p' DDE	X*			X*	X*		X*	X*				
p,p' DDT	X*			X*	X*		X*	X*				X
Total DDT											X	
PCB's				X*	X*		X*	X*		X*	X	X
Pendimethalin					X*		X*					
Pentachlorophenol	X*			X	X*		X*	X*		X*	X	X
Phenanthrene										X*		
Phenols										X*		
Phorate				X*	X*		X*					
Picloram				X*	X*		X*				X	X
Prometon												
Prometryn												
Propachlor					X*		X*				X	
Propazine												
Pyrene										X*		
Silvex (2,4,5-TP)				X*	X*		X*				X	X
Simazine					X*		X*				X	X
Terbufos, Total				X*	X*		X*					
Terbutryn												
Toluene										X*		X
Total trihalomethanes												X
Toxaphene					X*		X*	X*			X	X
Treflan, Trifluralin				X*	X*	X*	X*				X	
Trichlorofluoromethane										X*		
Vinyl Acetate										X*		
Volatile Organics												
1,1,1-Trichloroethane					X*			X*		X*	X	X
1,1,2,2-Tetrachloroethane										X*		
1,1,2-Trichloroethane					X*					X*	X	X
1,1-Dichloroethane								X*		X*		
1,1-Dichloroethylene					X*			X*		X*	X	X
1,2 Dichloroethane					X*			X*		X*	X	X
1,2,4-Trichlorobenzene					X*					X*	X	X
1,2-Dichlorobenzene					X*					X*	X	
1,2-Dichloropropane					X*					X*	X	X
1,3-Dichlorobenzene										X*		
1,4-Dichlorobenzene					X*					X*	X	
Aldicarb												X
Aldicarb sulfone												X
Aldicarb sulfoxide												X
Benzene					X*			X*		X*	X	X
Bromodichloromethane										X*		
Bromoform								X*		X*		
Bromomethane										X*		
Carbon Tetrachloride					X*			X*		X*	X	X

Appendix A. (cont) Laboratory and field parameters assessed in Bureau of Water Monitoring Programs

Parameter	BIOSURVEY Facility-Related	BIOSURVEY Intensive Basin	FISH TISSUE	AWQMN	LAKES AND RESERVOIRS ALMP	LAKES AND RESERVOIRS VLMP	LAKES AND RESERVOIRS Clean Lakes	LAKES AND RESERVOIRS Lake Michigan	HAB	POINT SOURCE	GROUND-WATER	PWS
Volatile Organics (cont)												
Chlorobenzene								X*		X*	X*	X
Chlorodibromomethane								X*		X*		
Chloroethane										X*		
Chloroform								X*		X*		
Chloromethane					X*					X*		
Cis-1,2-Dichloroethylene					X*			X*		X*	X	X
Cis-1,3-Dichloropropene										X*		
Dichlorobenzene								X*		X*		
Dichlorobromomethane								X*		X*		
Dichloromethane												X
Ethylbenzene					X*			X*		X*	X	X
Methyl Tert-Butyl Ether					X*						X	
Methylene Chloride					X*			X*		X*	X	X
o-Dichlorobenzene												X
p-Dichlorobenzene												X
Styrene					X*					X*	X	X
Tetrachloroethylene										X*	X	X
Tetrachloroethylene					X*			X*		X*		X
Toluene					X*			X*		X*	X	X
Trans - 1,2 Dichloroethylene					X*			X*		X*		X
Trans-1,2-Dichloroethylene										X*	X	X
Trans-1,3-Dichloropropene										X*		
Trichloroethylene					X*			X*		X*	X	X
Vinyl Chloride					X*					X*	X	X
Xylene					X*			X*		X*	X	X
Fish Tissue												
Aldrin		X*	X					X				
alpha BHC		X*	X					X				
Chlordane		X*	X					X				
DDT		X*	X					X				
Dieldrin		X*	X					X				
Endrin		X*	X					X				
Gamma BHC (Lindane)		X*	X					X				
Heptachlor		X*	X					X				
Heptachlorobenzene		X*	X					X				
Heptachloroepoxide		X*	X					X				
Lipids (%)		X*	X					X				
Mercury		X*	X*					X				
Methoxychlor		X*	X					X				
Mirex		X*	X					X				
PCB's		X*	X					X				
Toxaphene		X*	X					X				
Sediment Metals and Nutrients												
Arsenic		X		X*	X		X	X				
Barium		X		X*	X		X	X				
Cadmium		X		X*	X		X	X				
Chromium		X		X*	X		X	X				
Copper		X		X*	X		X	X				
Iron		X		X*	X		X	X				
Kjeldahl Nitrogen		X		X*	X		X	X				
Lead		X		X*	X		X	X				
Manganese		X		X*	X		X	X				
Mercury		X		X*	X		X	X				
Nickel		X		X*	X		X	X				
Phosphorus		X		X*	X		X	X				
Potassium		X		X*	X		X	X				
Silver		X		X*	X		X	X				
Solids, % Wet Sample		X		X*	X		X					
TOC, Sediment %					X		X					
Volatile Solids (%)		X		X*	X		X	X				
Zinc		X		X*	X		X	X				

Appendix A. (cont) Laboratory and field parameters assessed in Bureau of Water Monitoring Programs

Parameter	BIOSURVEY Facility-Related	BIOSURVEY Intensive Basin	FISH TISSUE	AWQMN	LAKES AND RESERVOIRS ALMP	LAKES AND RESERVOIRS VLMP	LAKES AND RESERVOIRS Clean Lakes	LAKES AND RESERVOIRS Lake Michigan	HAB	POINT SOURCE	GROUND-WATER	PWS
Sediment Organochlorine Compounds (µg/kg)												
Acetochlor					X		X					
Alachlor		X		X*	X		X					
Aldrin		X		X*	X		X	X				
alpha BHC		X		X*	X		X	X				
Atrazine		X		X*	X		X					
Captan		X		X*	X		X					
Chlordane, cis isomer (Alpha)		X		X*	X		X	X				
Chlordane, trans isomer (Gamma)		X		X*	X		X	X				
Cyanazine		X		X*	X		X					
DDT		X		X*	X		X	X				
Dieldrin		X		X*	X		X	X				
Endrin		X		X*	X		X	X				
gamma BHC (Lindane)		X		X*	X		X	X				
Heptachlor		X		X*	X		X	X				
Heptachlor epoxide		X		X*	X		X	X				
Hexachlorobenzene		X		X*	X		X	X				
Methoxychlor		X		X*	X		X	X				
Metolachlor		X		X*	X		X					
Metribuzin		X		X*	X		X					
p,p'-DDD		X		X*	X		X					
p,p'-DDE		X		X*	X		X					
p,p'-DDT		X		X*	X		X					
PCB's		X		X*	X		X	X				
Pendimethanlin		X		X*	X		X					
Total Chlordane		X		X*	X		X	X				
Toxaphene					X		X					
Trifluralin		X		X*	X		X					
% Fixed Solids					X		X					
Chlorophyll												
Chlorophyll *a* (corrected)	X*	X		X*	X	X	X	X	X*			
Chlorophyll *a* (uncorrected)	X*	X		X*	X	X	X	X	X*			
Chlorophyll *b*	X*	X		X*	X	X	X	X	X*			
Chlorophyll *c*	X*	X		X*	X	X	X	X	X*			
Phaeophytin	X*	X		X*	X	X	X	X	X*			
Phytoplankton					X		X	X	X*			
FIELD PARAMETERS												
Conductivity	X	X		X	X		X	X			X	
Discharge	X	X					X					
Fecal Coliform Bacteria		X		X								
Microcystin	X*	X*		X*	X*		X*	X*	X*			
Oxygen, Dissolved	X	X		X	X	X*	X					
% D.O. Saturation	X	X		X	X		X					
pH	X	X		X	X		X	X			X	
Redox, Field											X	
Secchi Transparency					X	X	X	X				
Temperature, Air (ºC)	X	X		X	X		X	X		X		
Temperature, Water (ºC)	X	X		X	X		X	X		X	X	
Turbidity, NTU	X*	X		X	X		X					
Fish Tissue												
# of Fish		X	X		X*		X*	X				
Weight of Fish		X	X		X*		X*	X				
Length of Fish		X	X		X*		X*	X				
Fish Species (Numeric)		X	X									
Fish Species (Alpha)		X	X									
Anatomy (Numeric)		X	X									

X - Collected on a Routine basis.
X* - Not a Routine parameter, but site specific.

APPENDIX B

Ambient Stream Water Quality Monitoring Network

Illinois Environmental Protection Agency
Bureau of Water
Springfield, Illinois

Purpose of the Network

In general, the goals of Illinois EPA surface water monitoring programs are to identify causes of pollution (toxics, nutrients, sedimentation) and their sources (point and nonpoint) of surface water impairments, determine the overall effectiveness of pollution control programs and identify long-term resource quality trends. The Ambient Water Quality Monitoring Network (AWQMN) specifically is utilized by the Illinois EPA to provide baseline water quality information, to characterize and define trends in the physical, chemical and biological conditions of the state's waters, provide a continuing assessment of BOW programs, identify new or existing water quality problems and to act as a triggering mechanism for special studies or other appropriate actions. With the exception of major population-industrial areas, AWQMN stations are located outside the immediate impact of point sources. Additional uses of the data collected by the Illinois EPA through the AWQMN program include the establishment of water quality based effluent limits for National Pollutant Discharge Elimination System (NPDES) permits. The AWQMN is integrated with other Illinois EPA stream sampling programs, both chemical and biological, which are more localized geographically (specific watershed or point-source receiving stream) and cover a shorter span of time (e.g., one year) to evaluate compliance with water quality standards and to determine designated use supports as required in Clean Water Act Section 305(b).

Station Information

Historically, stream water quality data in Illinois have been collected by several state and federal agencies including the Illinois State Water Survey (ISWS), the Illinois Department of Public Health (IDPH), Illinois EPA, and the United States Geological Survey (USGS). This monitoring has resulted in a rich data set from streams ranging in size from small agricultural drainage ditches to the Mississippi River. Between Water Years 1972 and 1977 (a water year is October 1 through September 30), Illinois EPA operated a 538-station monitoring network. Evaluation of this older data was presented in a series of reports prepared by the Illinois Water Information System Group, headed by Ronald Flemal and Donovan Wilkin (Peckham, 1980).

In 1976, USEPA published *Basic State Water Monitoring Program* (USEPA, 1976). Based upon this document, Illinois EPA developed a set of criteria that were designed to identify baseline water quality conditions on a statewide basis. These criteria included locating stations in recreational areas, commercial or sport fishing areas, shellfish areas, populated areas especially near surface water supply intakes, land use areas such as municipal, industrial, agricultural, and areas of potential development. Additional considerations included clean waters as well as degraded areas of concern, co-location with USGS gaging stations, and, whenever possible, stations with previous historical data (Wallin and Schaeffer, 1979). Of the 538 original stations, 108 met the selection criteria and were retained. This new network, which began operation in October 1977, incorporated USGS water quality sampling methodologies. Older stream water quality data, (i.e., from 1945 through 1971), have also been collected by the ISWS and the IDPH at many of these stations (Winget, 1976).

The present AWQMN design, which began in Water Year 1977, currently includes 146 stations including 11 stations sampled quarterly on the Mississippi River (Appendix B, Figure 1).

Responsibility for sampling these 146 AWQMN stations is presently divided between the Illinois EPA's three monitoring units, the Illinois State Water Survey, and the Illinois office of the United States Geological Survey (Appendix B, Figure 1).

The Illinois EPA utilizes an alphanumeric stream coding system consisting of one to four alphabetic characters, which indicate the stream being sampled, and two numeric characters which represent the station number on the stream. The state is divided into 14 major basins (Appendix B, Figure 2):

A	Ohio River	I	Mississippi River (South)
B, C	Wabash River	J	Mississippi River (South Central)
D	Illinois River	K, L	Mississippi River (North Central)
DT	Fox River	M	Mississippi River (North)
E	Sangamon River	N	Big Muddy River
F	Kankakee River	O	Kaskaskia River
G, H	Des Plaines River	P	Rock River

The few streams which drain directly into Lake Michigan utilize the letter "Q" as a basin identifier. However, there are no AWQMN stations in this basin. Letter designations are generally added alphabetically to major tributaries as one moves upstream from the mouth. For minor tributaries, the second letter is usually "Z". Therefore the letter furthest to the right designates the stream within a watershed being sampled. Station numbers reflect the stations establishment over time (i.e., the oldest stations are generally "01") and are not related to upstream/downstream position within the watershed drainage.

For example, station DJBZ-18 designates:

D- Illinois River
J- Spoon River
B- Big Creek
Z- Slug Run
18- Station number 18 on Slug Run

Sample Collection and Analysis

The Illinois EPA collects water quality samples from AWQMN stations using methods developed by the USGS (Edwards and Glysson, 1988). Stations are sampled nine times per water year (a water year runs from October 1 to September 30) on an approximately six-week cycle. Mississippi River stations are sampled quarterly. In general, water quality samples are collected utilizing three equal width increments and an equal transit rate method. This method requires equal spacing of intervals across the stream cross-section which varies with stream width, and an equal transit rate or constant speed of lowering and raising the sampler. Samples are composited in a churn splitter before being transferred to the appropriate collection bottles. Dissolved parameters are collected by filtering through a 0.45 μm filter. The samples are analyzed by Illinois EPA, Division of Laboratories. Measurements of air and water temperature,

DO, conductivity, pH and turbidity are done in the field. A summary of laboratory methods is provided in Appendix B, Table 2.

Illinois EPA uses the AWQMN to (a) provide baseline water quality information, (b) characterize and define trends in the physical, chemical, and biological conditions of the Illinois' waters, (c) identify new or existing water quality problems, and (d) act as a triggering mechanism for special studies or other appropriate actions. Additional uses of AWQMN data include the review of existing water quality standards and establishment of water quality-based effluent limits for NPDES permits. The AWQMN is integrated with other Illinois EPA chemical and biological stream monitoring programs that are more regionally based (specific watersheds or point source receiving stream) and cover a shorter time span (e.g., one year) to evaluate compliance with water quality standards and determine designated use support as required in CWA Section 305(b). The AWQMN station selection process was intended to allow Illinois EPA to make broad generalizations on the condition of waters statewide. Illinois EPA recognizes that such generalizations are not statistically verifiable but that does not necessarily make it incorrect. Illinois EPA also recognizes that a better way to generalize with statistical validity is to incorporate a probability-based design into station selection.

Data Results

The Illinois EPA stored water quality data through December 1998 in a USEPA database known as STORET. The AWQMN data was divided into two files: 21ILAMB and 21ILL. The 21ILAMB file contains data from the universal parameter groups for all stations beginning in October 1977 (or later depending on when the station was established) through December 1998. Pesticides and industrial solvents data are stored in the 21ILL file. Additional data which may be available from these stations include surficial sediments, stored in 21ILSED, and fish tissue, stored in 21ILFISH. The website for Legacy STORET is www.epa.gov/storpubl/legacy/query.htm. For Illinois EPA data collected after December, 1998 go to http://ofmpub.epa.gov/storpubl/dw_pages.querycriteria.

Appendix B, Table 1. Summary of Illinois EPA laboratory methods for parameters in the AWQMN

Parameter	Sample Container	Chemical/Thermal Preservation	Method of Analysis	Units of Measure	Holding Time
Fecal Coliform Bacteria	120 ml plastic	Contains sodium thiosulfate; Cool, ≤ 6 °C	SM 9222D	no./100ml	24 hours monitoring
Total Suspended Solids (TSS)	500 ml PE	Cool, ≤ 6 °C	SM 2540D	mg/L	7 days
Total Nitrate+Nitrite-N (NO_3+NO_2-N)	250/500 ml HDPE	Contains sulfuric acid; Cool, ≤ 6 °C	USEPA 353.2	mg/L	28 days
Ammonia-N (NH_3+NH_4-N)	250/500 ml HDPE	Contains sulfuric acid; Cool, ≤ 6 °C	USEPA 350.1	mg/L	28 days
Pesticides	1 gallon amber glass	Cool, ≤ 6 °C	USEPA 8081	µg/l	7 days collection-prep; 40 days prep-analysis
Total Organic Carbon (TOC)	Three 40-ml amber vials	Contains phosphoric acid; Cool, ≤ 6 °C	SM 5310C	mg/L	28 days
Chlorophyll	1 L plastic amber	Contains magnesium carbonate; filter in field; freeze filter, -20 °C	SM 10200H	µg/l	28 days collection-prep; 365 days prep-analysis
Total Kjeldahl Nitrogen (TKN)	250/500 ml HDPE	Contains sulfuric acid; Cool, ≤ 6 °C	USEPA 351.2	mg/L	28 days
Total Phosphorus	250/500 ml HDPE	Contains sulfuric acid; Cool, ≤ 6 °C	USEPA 365.1	mg/L	28 days
Dissolved Phosphorus	250 ml HDPE	Contains sulfuric acid; filter in field; Cool, ≤ 6 °C	USEPA 365.1	mg/L	28 days
Total ICP: (Pb, Cu, Fe, Mn, Cd, Cr, Mg, Zn, K, Ba, Be, Co, Ni, Sr, Ca, Na, Al, B, Ag, V, Se, As)	250 ml PE	Preserved in lab with nitric acid; no thermal preservation required	USEPA 200.7, 200.8	µg/l	6 months
Dissolved ICP: (Pb, Cu, Fe, Mn, Cd, Cr, Mg, Zn, K, Ba, Be, Co, Ni, Sr, Ca, Na, Al, B, Ag, V, Se, As)	250 ml PE	Preserved in lab with nitric acid; filter in field; no thermal preservation required	USEPA 200.7, 200.8	µg/l	6 months
Sulfate (SO_4)	500 ml PE	Cool, ≤ 6 °C	USEPA 375.2	mg/L	28 days
Total Dissolved Solids (TDS)	500 ml PE	Cool, ≤ 6 °C	SM 2540C	mg/L	7 days
Cyanide	250 ml PE	Contains sodium hydroxide; Cool, ≤ 6 °C	USEPA 335.4	mg/L	14 days
Chloride	500 ml PE	No thermal preservation required	SM 4500Cl-E	mg/L	28 days
Total Alkalinity	500 ml PE	Cool, ≤ 6 °C	EPA 310.2	mg/L	14 days
Total Mercury	60 ml glass vial	Preserved in lab with nitric acid; no thermal preservation required	USEPA 245.1/7470	µg/l	28 days
Total Hardness (calculated)	250 ml PE	Preserved in lab with nitric acid; no thermal preservation required	SM 2340B	mg/L	6 months
Fluoride	500 ml PE	No thermal preservation required	SM 4500F-C	mg/L	28 days
Phenol	250 ml glass	Contains sulfuric acid; Cool, ≤ 6 °C	USEPA 420.4	µg/l	28 days

Note Dissolved metals and phosphorus are filtered through a 0.45 µm nitrocellulose membrane filter.

**General use* water quality standards based on Section 302(subpart B) of Title 35: Subtitle C: Chapter I, Illinois Pollution Control Board. June 1998. H = hardness dependent acute and chronic standards. a = acute, c = chronic

Note that sample containers have changed somewhat over time. For example, the quart polyethylene bottle was replaced by a 500 ml bottle because the smaller bottle contained enough material for analysis and was less expensive to ship to the laboratory.

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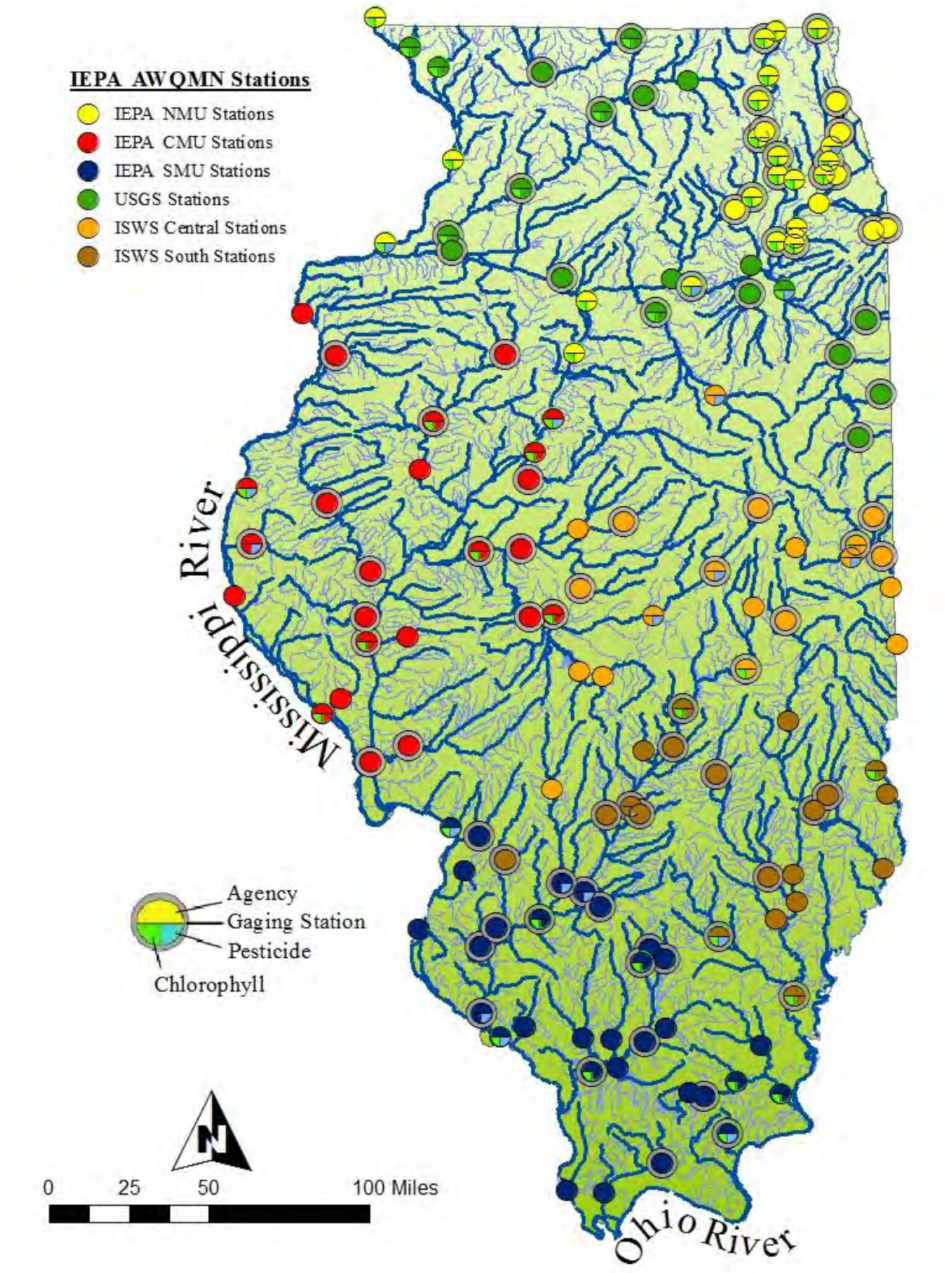
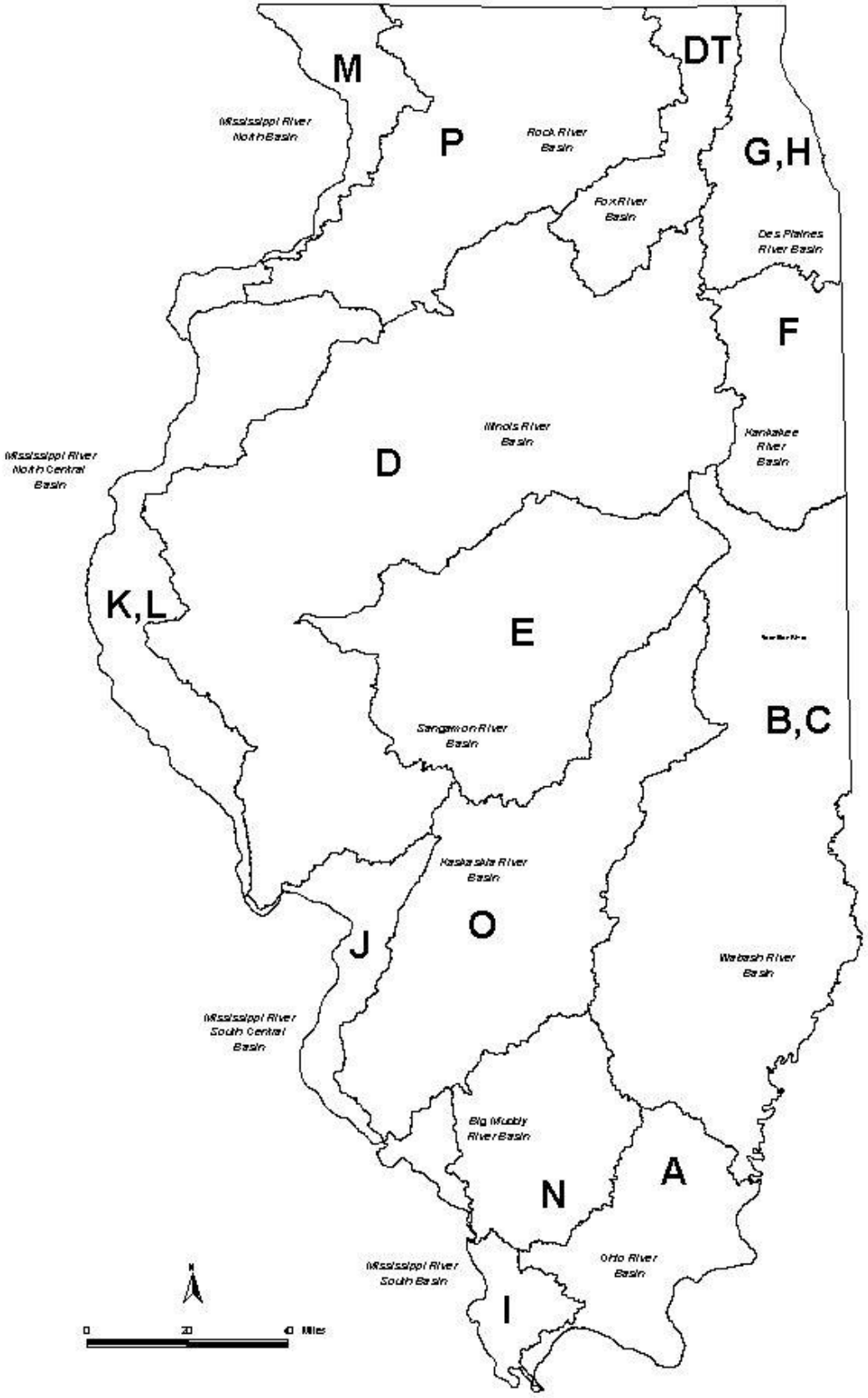
Appendix B, Figure 1. Stream monitoring locations (stations) of the Ambient Water Quality Monitoring Network



Appendix B, Figure 2. Illinois EPA major basin codes



Appendix B, Table 2. Ambient Water Quality Monitoring Network Stations

OFFICE	IEPA STATION CODE	USGS STATION NUMBER	STREAM NAME	DESCRIPTION	COUNTY	LAT.	LONG.
	Ohio River Basin (A)						
SMU	AD-02	03612000	Cache River-Post Creek Cutoff	Belknap Rd br, 1 mi NE of Belknap	Johnson	37.33510	-88.92529
SMU	AK-02	03384450	Lusk Creek	Eddyville Rd br, 3 mi SE of SR 145 and Eddyville	Pope	37.47257	-88.54768
SMU	AT-06	03382530	Saline River	Peabody Rd br, 0.25 mi S of Buckeye Rd and 1.2 mi E of Gibsonia	Gallatin	37.64780	-88.24117
SMU	ATF-08		North Fork Saline River	Buffalo Rd br, 0.25 mi E of School House Rd and 2.4 mi SE of Texas City	Gallatin	37.86765	-88.35078
SMU	ATG-03	03382205	Middle Fork Saline River	Ingram Hill Rd br, 0.3 mi E of Water Hole Rd and 2.8 mi SE of Harrisburg	Saline	37.70781	-88.49185
SMU	ATH-05	03382100	South Fork Saline River	US 45 br, 0.1 mi S of Rock Hole Rd (275N) and 2.3 mi NE of Stonefort	Saline	37.63795	-88.67771
SMU	ATHG-01	03382090	Sugar Creek	Stonefort Rd (CR 12) br, 0.4 mi N of Palzo Rd and 4.7 mi NE of Creal Springs	Williamson	37.65515	-88.76342
	Wabash River Basin (B,C)						
ISWS	B-06	03341920	Wabash River	RM 171.8 at Clover St (1750 N) br, E edge of Hutsonville	Crawford	39.11053	-87.65502
ISWS	BE-01	03346550	Embarras River	CR 620 N br, 1.4 mi E of Billett and 5 mi SE of Lawrenceville	Lawrence	38.66496	-87.62630
ISWS	BE-07	03345500	Embarras River	CR 1900 E (CR 9) br, N edge of Ste. Marie	Jasper	38.93702	-88.02228
ISWS	BE-09	03344000	Embarras River	CR 1200 N (CR 9) at Ryan Br, 6 mi NE of Toledo and 2.6 mi SW of Diona	Cumberland	39.34540	-88.17105
ISWS	BE-14	03343395	Embarras River	CR 1000 N (Main St) br, 150 ft E of River Rd on W edge of Camargo	Douglas	39.79983	-88.17047
ISWS	BEF-05	03346000	North Fork Embarras River	CR 1050 N (Main St) br, 0.4 mi E of CR 2275 E and 2 mi W of Oblong	Crawford	39.00021	-87.94484
ISWS	BF-01	03342050	Sugar Creek	E Franklin St br, 0.3 mi E of Palestine	Crawford	39.00470	-87.59748
ISWS	BN-01	03341414	Brouilletts Creek	IN SR 71 (300W) br, 0.9 mi S of CR 1300 S and 1 mi N of Blanford, IN	Vermillion, IN	39.68167	-87.52095
ISWS	BO-07	03339147	Little Vermilion River	CR 500 N br, 1 mi SW of CR 1250 E (Mill St) and 5 mi SE of Georgetown	Vermilion	39.94133	-87.55137
ISWS	BP-01	03339000	Vermilion River	Grape Creek Rd (1830E)(CR 505) br, 0.2 mi SW of CR 1440 and 3.5 mi SE of Danville	Vermilion	40.08500	-87.59367
ISWS	BPG-09	03338780	North Fork Vermilion River	Bismarck Rd (2750N) br, 0.5 mi E of SR 1 and 2 mi W of Bismarck	Vermilion	40.26573	-87.64245
ISWS	BPJ-03	03338097	Salt Fork Vermilion River	Oakwood Rd (850E)(CR 10) at Singing Br, 2 mi S of Oakwood	Vermilion	40.08298	-87.78050
ISWS	BPJC-06	03337700	Saline Branch	CR 1900 E br, 0.4 mi N of CR 1700 N and 1.5 mi N of Mayview	Champaign	40.13327	-88.10490
ISWS	BPK-07	03336645	Middle Fork Vermilion River	Kickapoo SP (Glenburn Creek) Rd br, 0.5 mi E of CR 1000 E and 2 mi NE of Oakwood	Vermilion	40.13690	-87.74583
ISWS	C-09	03379600	Little Wabash River	West Salem-Mt Erie (1850N) Rd br, 0.3 mi W of CR 125 and 0.4 mi S of Bennington	Edwards	38.51852	-88.13205
ISWS	C-21	03378635	Little Wabash River	US 40 br, 0.2 mi NE of Country Club Rd and 2.2 mi SW of Effingham	Effingham	39.10407	-88.59407
ISWS	C-22	03379500	Little Wabash River	Wilcox Bridge Ln br, 400 ft E of Goldenrod Ln and 4.5 mi SE of Clay City	Richland	38.63463	-88.29757
ISWS	C-23	03381495	Little Wabash River	SR 1 (Main St) br, NE edge of Carmi	White	38.09243	-88.15612
ISWS	CA-05	03380500	Skillet Fork	SR 15 br, 0.4 mi N of CR 700 N and 1 mi N of Wayne City	Wayne	38.36350	-88.58790
ISWS	CD-01	03379950	Elm River	CR 2400 E at Price Bridge, 0.3 mi N of CR 1250 N and 6.5 mi NE of Fairfield	Wayne	38.44077	-88.25805
ISWS	CH-02	03379560	Fox River	Elbow Lane (500N) br, 300 yds E of Midway Rd (750E) and 6.5 mi SW of Olney	Richland	38.64183	-88.15478

OFFICE	IEPA STATION CODE	USGS STATION NUMBER	STREAM NAME	DESCRIPTION	COUNTY	LAT.	LONG.
	Illinois River Basin (D)						
CMU	D-01	05587060	Illinois River	RM 21.5 at SR 16/SR 100 (Page) br, Hardin	Calhoun	39.16022	-90.61478
CMU	D-05	05563800	Illinois River	RM 152.9 at SR 9 (Margaret St), Pekin	Tazewell	40.57373	-89.65432
NMU	D-09	05558995	Illinois River	RM 189.2 at SR 17 (5th St) br, Lacon	Marshall	41.02571	-89.41712
NMU	D-16	05556200	Illinois River	RM 207.6 at old SR 26 br, Hennepin	Putnam	41.25720	-89.34880
NMU	D-23	05543500	Illinois River	RM 246.8 at Main St (CR 15)(2350E) br, Marseilles	LaSalle	41.32335	-88.71025
CMU	D-30	05559900	Illinois River	RM 166.3 at Peoria PWS intake, SR 29 and Lorentz Ave	Peoria	40.72620	-89.55012
CMU	D-32	05586100	Illinois River	RM 61.4 at NS RR bridge, 0.3 mi E of Valley City	Scott	39.70336	-90.64588
CMU	DA-06	05587000	Macoupin Creek	US 67 br, 0.5 mi SE of CR 850 N and 3.5 mi NW of Kane	Greene	39.23450	-90.39467
CMU	DD-04	05586040	Mauvaise Terre Creek	McGlasson Rd br, 0.3 mi W of Bobbitt Ln and 1.3 mi NE of Merritt	Scott	39.73121	-90.40697
CMU	DE-01	05585830	McKee Creek	SR 104 (Mill St) br, E edge of Chambersburg	Pike	39.81777	-90.65360
CMU	DG-01	05585000	LaMoine River	Old US 24 (1500E) br, 0.2 mi E of US 24 and 0.4 mi NE of Ripley	Brown	40.02491	-90.63163
CMU	DG-04	05584500	LaMoine River	SR 61 br, 0.9 mi S of St Marys Rd (1000N) and 1.2 mi SW of Colmar	McDonough	40.33087	-90.89639
CMU	DJ-08	05570000	Spoon River	SR 95 br, 250 yds E of Seville Rd and 0.4 mi NE of Seville	Fulton	40.49033	-90.34068
CMU	DJ-09	05569500	Spoon River	2nd St (925E) br, 0.5 mi N of SR 116 on N edge of London Mills	Fulton	40.71370	-90.26616
CMU	DJL-01	05568800	Indian Creek	Jersey Rd (CR 7)(300N) br, 0.3 mi W of CR 800 E and 4 mi SW of Wyoming	Stark	41.01865	-89.83583
CMU	DK-12	05568005	Mackinaw River	Wagonseller Rd (1200E) br, 0.3 mi N of Weir Rd and 4 mi SW of South Pekin	Tazewell	40.44775	-89.69110
USGS	DQ-03	05556500	Big Bureau Creek	US 6 (Peru St) br, 100 yds W of Park Ave and 1.5 mi SW of Princeton	Bureau	41.36740	-89.49797
ISWS	DS-06	05554490	Vermilion River	CR 24 (1400N) br, 0.3 mi W of Billet Rd and 0.3 mi E of McDowell	Livingston	40.83054	-88.57523
USGS	DS-07	05555300	Vermilion River	CR 57 (1251E) br, 0.6 mi N of CR 1850 N and 3 mi NE of Leonore	LaSalle	41.20858	-88.93032
USGS	DV-04	05542000	Mazon River	SR 113 br, 0.4 mi E of Campbell Rd and 4 mi W of Coal City	Grundy	41.28616	-88.36032
USGS	DW-01	05541710	Aux Sable Creek	US 6 (9000 N) br, 1 mi E of Brisbin Rd and 5 mi NE of Morris	Grundy	41.41703	-88.34787
	Fox River Basin (DT)						
USGS	DT-01		Fox River	US 6/SR 71 (Norris Dr) br, 150 yds E of Champlain St on NE edge of Ottawa	LaSalle	41.35639	-88.82758
NMU	DT-06	05550000	Fox River	SR 62 (Algonquin Rd) br, 2 blks SE of SR 31 (Main St) on N edge of Algonquin	McHenry	42.16592	-88.28982
NMU	DT-09	05551000	Fox River	State St br, 2 blks E of SR 31 (La Fox St) in South Elgin	Kane	41.99425	-88.29433
NMU	DT-22	05549600	Fox River	SR 176 (Crystal Lake Rd) br, 1 mi W of River Rd and 5 mi NE of Crystal Lake	McHenry	42.27962	-88.22700
NMU	DT-35	05546700	Fox River	SR 173 br, 1.3 mi E of Wilmot Rd and 4 mi W of Antioch	Lake	42.47895	-88.17855
NMU	DT-38	05551540	Fox River	Mill St br at River Rd in Montgomery	Kane	41.72939	-88.33897
NMU	DTD-02	05551700	Blackberry Creek	SR 47 (Bridge St) br, 0.2 mi S of Cannonball Trail on N edge of Yorkville	Kendall	41.67164	-88.44272
NMU	DTG-02	05550500	Poplar Creek	US 20 Business (Villa St) br at Ramona Ave, SE edge of Elgin	Cook	42.02575	-88.25563
NMU	DTK-04	05548280	Nippersink Creek	Winn Rd br, 200 ft S of Main St and 0.6 mi W of Spring Grove at fish hatchery	McHenry	42.44365	-88.24752

OFFICE	IEPA STATION CODE	USGS STATION NUMBER	STREAM NAME	DESCRIPTION	COUNTY	LAT.	LONG.
	Sangamon River Basin (E)						
ISWS	E-06	05573504	Sangamon River	Decatur PWS intake (Lincoln Park Dr) at Lake Decatur Dam	Macon	39.82690	-88.95565
ISWS	E-18	05572000	Sangamon River	Bridge St (CR 5) br at County Farm Rd (1550N), 0.4 mi W of Monticello	Piatt	40.03095	-88.58838
CMU	E-25	05583000	Sangamon River	SR 97 br, 1.8 mi NW of Oakford and 2.4 SE of Kilbourne	Mason	40.12389	-89.98453
CMU	E-26	05576500	Sangamon River	Old US 36, 0.6 mi NE of Camp Butler Rd and 0.5 mi SW of Riverton	Sangamon	39.83722	-89.54598
ISWS	E-29	05570910	Sangamon River	US 136 br at CR 700 E, 1 mi E of Fisher	Champaign	40.31093	-88.32278
CMU	EI-02	05582000	Salt Creek	SR 29 br, 0.8 mi S of Maxwell Rd (580N) and 3.4 mi N of Greenview	Mason	40.13362	-89.73567
ISWS	EID-04	05581500	Sugar Creek	CR 1050E br, 0.5 mi S of CR 2150 N and 2.5 mi SE of Hartsburg	Logan	40.22218	-89.40292
ISWS	EIE-04	05580000	Kickapoo Creek	CR 17 (100E) br, 0.6 mi S of CR 1450 N and 1 mi N of Waynesville	DeWitt	40.25500	-89.12950
ISWS	EIG-01	05579500	Lake Fork	SR 54 br, 2.2 mi SW of Lake Fork and and 1.3 mi NE of Cornland	Logan	39.95122	-89.38366
CMU	EL-01	05577505	Spring Creek	Bruns Lane br, 0.3 mi S of Veterans Pkwy on NW edge of Springfield	Sangamon	39.82102	-89.68723
ISWS	EO-02	05575500	South Fork Sangamon River	SR 104 br, 1.6 mi NW of CR 1500 N and 1.25 mi SE of Kincaid	Christian	39.57853	-89.39240
ISWS	EOH-01	05574500	Flat Branch	CR 6 (Lincoln Trail) br, 0.25 mi W of Lakeside Dr and 1 mi E of Taylorville	Christian	39.55264	-89.25380
	Kankakee River Basin (F)						
USGS	F-02	05520500	Kankakee River	SR 1 (Dixie Hwy) br, 0.2 mi N of SR 114 (Indiana St) on S side of Momence	Kankakee	41.16005	-87.66265
USGS	F-16		Kankakee River	SR 53 (Baltimore St) br, 0.3 mi SW of SR 102 (Water St) on W edge of Wilmington	Will	41.30547	-88.15133
USGS	FL-02	05526000	Iroquois River	CR 7760 S br, 1.2 mi E of CR 1000 E and 5.8 mi SW of St Anne	Kankakee	41.00893	-87.82462
USGS	FL-04	05525000	Iroquois River	US 52 (Main St) br, 200 ft N of CR 2115 and 0.1 mi S of Iroquois	Iroquois	40.82312	-87.58157
USGS	FLI-02	05525500	Sugar Creek	CR 980 N (Jones St) br, 0.45 mi E of CR 2100 E and 1 mi W of Milford	Iroquois	40.62983	-87.72388
	Des Plaines River - Lake Michigan Basin (G,H)						
NMU	G-08	05527800	Des Plaines River	Russell Rd (CR 19) br, 1 mi E of I-95 and 0.75 mi dns of WI state line	Lake	42.48938	-87.92588
NMU	G-15	05530590	Des Plaines River	Irving Park Rd (SR 19) br, 200 yds E of River Road in Schiller Park	Cook	41.95306	-87.85420
NMU	G-23	05537980	Des Plaines River	RM 288.7 at Ruby St (SR 53) br, 100 yds W of Chicago St in Joliet	Will	41.53662	-88.08310
NMU	G-39	05532500	Des Plaines River	Barrypoint Rd br, 200 ft dns of Hofmann dam on S edge of Riverside	Cook	41.82128	-87.82183
NMU	GB-11	05540500	DuPage River	US 52 (Jefferson St) br, 0.3 mi W of I-55 and 0.2 mi E of SR 59 on NE edge of Shorewood	Will	41.52160	-88.19498
NMU	GBK-05	05540095	West Branch DuPage River	SR 56 (Butterfield Rd) br, 0.1 mi NE of Batavia Rd on N edge of Warrenville	DuPage	41.82535	-88.17948
NMU	GBK-09	05539900	West Branch DuPage River	St Charles Rd br, 0.1 mi ups of SR 64 (North Ave) on NE edge of West Chicago	DuPage	41.91286	-88.17968
NMU	GBL-10	05540210	East Branch DuPage River	US 34 (Ogden Ave) br, 0.2 mi W of SR 53 in Lisle	DuPage	41.80060	-88.08145

OFFICE	IEPA STATION CODE	USGS STATION NUMBER	STREAM NAME	DESCRIPTION	COUNTY	LAT.	LONG.
NMU	GG-22		Hickory Creek	Joliet St br, 0.2 mi W of US 52/SR 53 br on S edge of Joliet	Will	41.50780	-88.08382
NMU	GI-02	5537000	Chicago Sanitary and Ship Canal	RM 292.1 at Division St, 0.4 mi W of SR 171 (State St) on SW edge of Lockport	Will	41.58254	-88.06881
NMU	GL-09	5531500	Salt Creek	Wolf Rd br, 0.4 mi N of Ogden Ave (SR 34) on N edge of Western Springs	Cook	41.82582	-87.90028
NMU	GLA-02	5532000	Addison Creek	Washington Blvd br, 0.75 mi E of Mannheim Rd (US 12,20,45) in Bellwood	Cook	41.88190	-87.86893
NMU	H-01	5536700	Cal-Sag Channel	RM 304.2 at SR 83/SR 171 (Archer Ave) br, 0.1 mi S of Kingery Hwy and 0.5 mi N of Sag Br.	Cook	41.69630	-87.93642
NMU	HB-42	5536195	Little Calumet River-South	Hohman Ave br, 0.25 mi S of 173rd St and 0.2 mi E of IN state line in Munster, IN	Lake, IN	41.57752	-87.52229
NMU	HBD-04	5536275	Thorn Creek	Margaret St/Thornton Rd br, 0.25 mi E of Vincennes Rd/Williams St on E edge of Thornton	Cook	41.56819	-87.60815
NMU	HCC-07	5536000	North Branch Chicago River	Touhy Ave br, 0.3 mi W of Milwaukee Ave on SE edge of Niles	Cook	42.01231	-87.79558
NMU	HCCC-02	5534500	Mid Fork N Branch Chicago R.	Lake-Cook Rd br, 1 mi W of Edens Expy at Northbrook Court on S edge of Deerfield	Cook	42.15252	-87.81820
	Mississippi River South Basin (I)						
SMU	I-05		Mississippi River-South	RM 111.0, 0.5 mi ups of Menard Correctional Center and 1 mi ups of SR 150 br in Chester	Randolph	37.91250	-89.85194
SMU	I-84	7022000	Mississippi River-South	RM 43.9 in Thebes at ferry landing, 0.75 mi W of SR 3	Alexander	37.21978	-89.46558
SMU	II-03	5595540	Marys River	Wine Hill Rd (CR 2) br at Welge Rd, 0.3 mi E of Welge	Randolph	37.95630	-89.70625
SMU	IX-04	5600150	Cache River-Mississippi	Sandusky Rd br, 0.5 mi W of Morris Rd and 0.7 mi E of Sandusky and SR 127	Pulaski	37.20330	-89.25823
	Mississippi River South Central Basin (J)						
SMU	J-36		Mississippi River-South Central	RM 162.2, 150 yds ups of power line and 1.25 mi ups of Meramec River	Monroe	38.40070	-90.32321
SMU	J-98		Mississippi River-South Central	RM 200.7 at Mel Price L&D 26, 1.5 mi SE of Alton	Madison	38.87033	-90.15228
SMU	JN-02	5589490	Cahokia Creek	Sand Prairie Rd br, 1.25 mi S of SR 111 and 0.6 mi N of Collinsville Rd near Cahokia Mounds SP	Madison	38.66708	-90.06566
SMU	JQ-05	5587900	Cahokia Creek	SR 143 (Main St) br, 0.1 mi NW of SR 159 and 0.5 mi NW of Edwardsville	Madison	38.82442	-89.97455
	Mississippi River Central Basin (K)						
CMU	K-17		Mississippi River-Central	RM 324.9, outside guide wall ups of L&D 21 and 0.75 mi SW of Quincy	Adams	39.90409	-91.42905
CMU	K-21		Mississippi River-Central	RM 273.5, outside guide wall ups of L&D 24 at Clarksville, MO	Pike, MO	39.37498	-90.90659
CMU	K-22		Mississippi River-Central	RM 364.0 at dns end of L&D 19 in Keokuk, IA	Lee, IA	40.39253	-91.37592
CMU	KCA-01	5513000	Bay Creek	Vin Fiz Rd/Bridge St (300N) br, 0.75 mi W of Pittsfield St (3100E) on NW edge of Nebo	Pike	39.44357	-90.79557
CMU	KI-02	5495500	Bear Creek	CR 900 E br, 0.25 mi S of CR 2650 and 2.3 mi NE of Marcelline	Adams	40.14298	-91.33731

OFFICE	IEPA STATION CODE	USGS STATION NUMBER	STREAM NAME	DESCRIPTION	COUNTY	LAT.	LONG.
	Mississippi River North Central Basin (L)						
CMU	L-04		Mississippi River-North Central	RM 437.1 at L&D 17 outer wall, 3.5 mi NW of New Boston	Mercer	41.19202	-91.05823
CMU	LD-02	5469000	Henderson Creek	SR 94 br, 1 mi N of CR 2500 N and 1 mi S of Bald Bluff	Henderson	41.00192	-90.85360
	Mississippi River North Basin (M)						
NMU	M-02		Mississippi River-North	RM 483.1 at L&D 15 on Arsenal Island in Rock Island	Rock Island	41.51830	-90.56563
NMU	M-12		Mississippi River-North	RM 522.5 at L&D 13 on Lock Rd, 1.5 mi N of Fulton	Whiteside	41.89817	-90.15540
NMU	M-13		Mississippi River-North	RM 583.0 at L&D 11, 2 mi NE of Dubuque	Dubuque, IA	42.54042	-90.64513
NMU	MN-03	5418950	Apple River	US 20 br, 0.75 mi SE of SR 84 and 1.5 mi W of Elizabeth	Jo Daviess	42.31883	-90.25435
NMU	MQ-01	5416000	Galena River	US 20/SR 84 (Spring St) br at Main St on S edge of Galena	Jo Daviess	42.41060	-90.43093
	Big Muddy River Basin (N)						
SMU	N-08	5595700	Big Muddy River	SR 15 br, 0.5 mi E of Drivers Rd (800E) and 2 mi W of Mt Vernon	Jefferson	38.30985	-88.98857
SMU	N-11	5597000	Big Muddy River	SR 149 br, 0.7 mi W of Plumfield and 1.8 mi E of Zeigler	Franklin	37.89155	-89.01987
SMU	N-12	5599500	Big Muddy River	SR 127 (Bridge St) br, 0.2 mi SE of Shoemaker Dr on SE edge of Murphysboro	Jackson	37.75793	-89.32738
SMU	NC-07	5599200	Beaucoup Creek	Beaucoup Rd (CR 8) br, 1 mi E of Mudline Rd and 2.2 mi WNW of Vergennes	Jackson	37.90815	-89.37525
SMU	ND-01	5598245	Crab Orchard Creek	Dillinger Rd (CR 11) BR, 1.1 mi W of Reed Station Rd and 3 mi NE of Carbondale	Jackson	37.77257	-89.17891
SMU	NE-05	5597280	Little Muddy River	Royalton Rd (CR 14) br, 1.6 mi NW of Funk Rd and 1.5 mi SE of Elkville	Jackson	37.90103	-89.20862
SMU	NH-06	5596400	Middle Fork Big Muddy River	Deering Rd (CR 5) br, 0.4 mi SE of Ruembler Crossing and 2.7 mi SSE of Benton	Franklin	37.94925	-88.90007
SMU	NJ-07	5595830	Casey Fork	SR 37 (Benton Rd) br, 0.3 mi S of I-64 and 2 mi SSE of Mt Vernon	Jefferson	38.26953	-88.89877
SMU	NK-01	5595730	Rayse Creek	Burlington Ln (600E) br, 0.2 mi S of Bakerville Rd (900N) and 2.75 mi N of Waltonville	Jefferson	38.25412	-89.04036
	Kaskaskia River Basin (O)						
ISWS	O-02	5591200	Kaskaskia River	Cooks Mills Rd (CR 20) br, 0.2 mi SE of CR 1450 N at Cooks Mills	Coles	39.58312	-88.41342
SMU	O-07	5593010	Kaskaskia River	SR 127 br at Jonathon Rd, 2.5 mi S of Carlyle	Clinton	38.57463	-89.36940
ISWS	O-08	5592500	Kaskaskia River	US 40/US 51 (Gallatin St) br on SE edge of Vandalia	Fayette	38.96045	-89.08825
ISWS	O-10	5592100	Kaskaskia River	SR 128 br, 0.7 mi NW of CR 50 N and 1.7 mi SE of Cowden	Shelby	39.23026	-88.84228
ISWS	O-11	5592000	Kaskaskia River	SR 16 (Main St) br on SE edge of Shelbyville and 0.25 mi dns of Lake Shelbyville dam	Shelby	39.40588	-88.78378
SMU	O-20	5594100	Kaskaskia River	SR 160/SR 177 br, 0.8 mi NW of Venedy Station and 4.5 mi NW of Okawville	Clinton	38.45089	-89.62785

OFFICE	IEPA STATION CODE	USGS STATION NUMBER	STREAM NAME	DESCRIPTION	COUNTY	LAT.	LONG.
SMU	O-30	5595400	Kaskaskia River	Roots Rd br, 0.25 mi E of Oakview Rd and 2.8 mi W of Ellis Grove	Randolph	38.01685	-89.95678
ISWS	O-31	5590420	Kaskaskia River	CR 6 (1450N) br, 6 mi SW of Pesotum and 4.4 mi W of Hayes	Douglas	39.86472	-88.36458
SMU	OC-04	5595200	Richland Creek-South	SR 156 br, 1.3 mi E of SR 159 and 1.7 mi NE of Hecker	St. Clair	38.32389	-89.97092
ISWS	OD-06	5594450	Silver Creek	US 40 br, 1.5 mi W of SR 4 and 3 mi SE of Troy	Madison	38.71643	-89.82922
SMU	OD-07	5594800	Silver Creek	SR 15 (Urbanna Dr) br, 1.2 mi NW of Karch Rd/Long Lake Rd and 2 mi SE of Freeburg	St. Clair	38.40638	-89.87405
ISWS	OI-07		Shoal Creek	Longbridge Trail (CR 10)(275N) br, 0.75 mi E of CR 725 E and 1.6 mi NW of Panama	Montgomery	39.04037	-89.55096
SMU	OI-08	5594000	Shoal Creek	Old US 50 br, 1.4 mi E of Breese and 3 mi W of Beckemeyer	Clinton	38.60968	-89.49452
SMU	OJ-08	5593520	Crooked Creek	Hoffman Rd (2300E)(CR 24) br, 2.1 mi S of SR 161 and 2.2 mi SW of Hoffman	Washington	38.50718	-89.27350
ISWS	OL-02	5592800	Hurricane Creek	SR 140 br, 0.3 mi W of CR 100 E and 1.7 mi E of Mulberry Grove	Fayette	38.92251	-89.23697
ISWS	ON-01	5592600	Hickory Creek	CR 1150 E br at CR 1300 N, 2.7 mi SSE of Bluff City and 3.8 mi SE of Vandalia	Fayette	38.92518	-89.03907
ISWS	OQ-01	5592195	Becks Creek	CR 000 N br, 0.3 mi E of CR 600 E and 2 mi W of Herrick on county line	Shelby	39.21582	-89.02040
	Rock River Basin (P)						
USGS	P-04	5446500	Rock River	SR 92 (38th Ave) br, 2 mi E of Joslin	Rock Island	41.55580	-90.18530
USGS	P-06	5443500	Rock River	US 30 (Rock Falls Rd) br, 2 mi W of Rock Falls	Whiteside	41.77220	-89.74580
USGS	P-14	5440700	Rock River	SR 72 (Union St) br on S edge of Byron	Ogle	42.12190	-89.25520
USGS	P-15	5437500	Rock River	SR 75 (Blackhawk Blvd) br on S edge of Rockton	Winnebago	42.44990	-89.07250
USGS	PB-04	5447500	Green River	SR 82 br, 2 mi N of Geneseo	Henry	41.48870	-90.15810
USGS	PQ-10	5438201	Kishwaukee River	Garden Prairie Rd br, 0.5 mi N of Garden Prairie	Boone	42.26100	-88.72530
USGS	PQ-12	5440000	Kishwaukee River	Blackhawk Rd br, 100 yds E of Mulford Rd and 2 mi SW of Perryville	Winnebago	42.19440	-88.99950
USGS	PW-08	5435500	Pecatonica River	SR 75 (Stephenson St) br on NE edge of Freeport	Stephenson	42.30030	-89.61530

APPENDIX C

Intensive Basin Survey Program

Illinois Environmental Protection Agency
Bureau of Water
Springfield, Illinois

Illinois EPA Intensive Basin Survey Program

Background

Since 1981, the Illinois Environmental Protection Agency, Bureau of Water, in cooperation with the Illinois Department of Natural Resources (IDNR), has conducted basin-specific surveys to characterize the chemical, physical and biological conditions of Illinois' streams.

Samples and information collected include: water and sediment chemistry, instream physical habitat, fish and macroinvertebrate assemblages, and fish tissue samples. Data collected from these surveys are used primarily to:

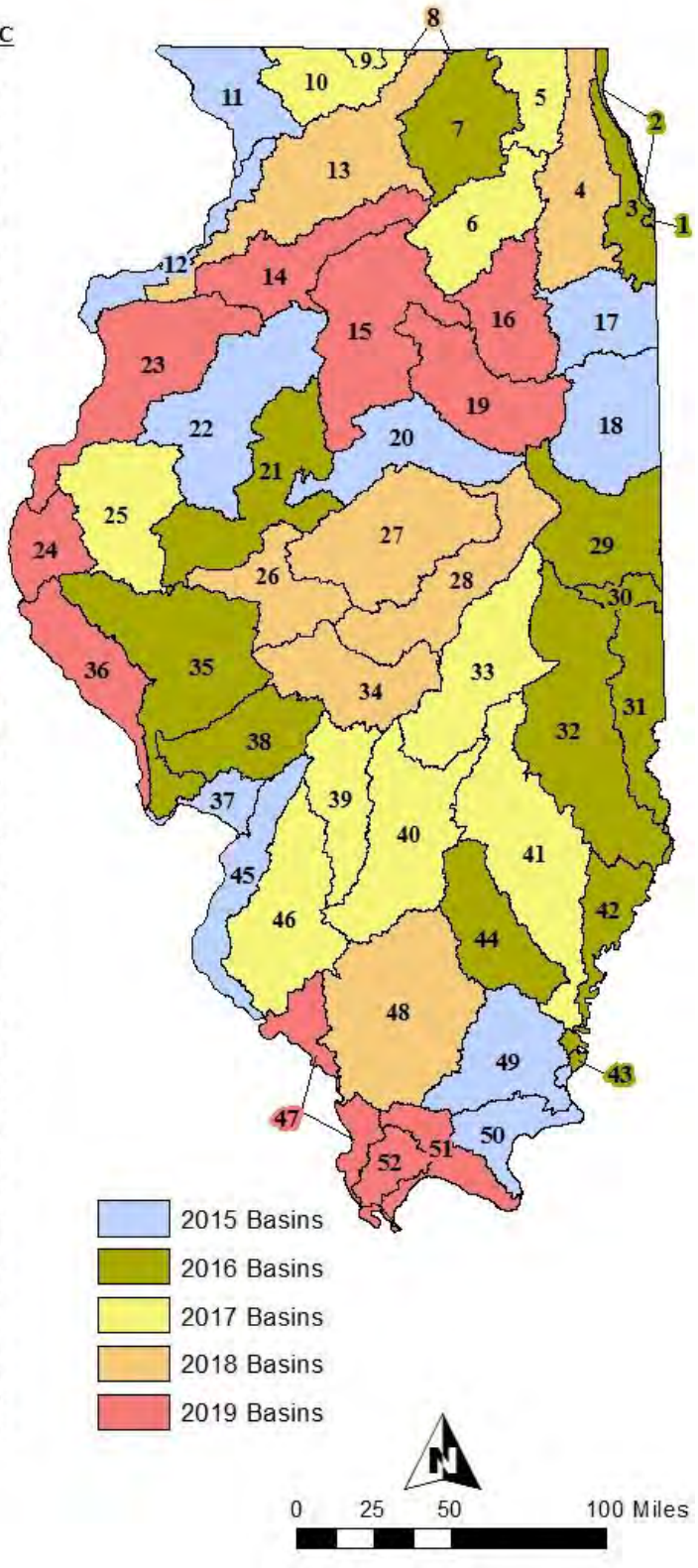
- assess attainment of *aquatic life* use and other designated uses in Illinois streams and identify potential causes and sources of use impairment,
- determine the success of water pollution control programs in achieving the aquatic life goals of the Clean Water Act,
- determine the presence of contaminants in fish tissue to facilitate the development of fish consumption advisories for applicable Illinois streams,
- determine the potential for sport fishing opportunities and fisheries management, assess the status of river fisheries resources of Illinois, identify where those resources exist, and determine the need for legislation for their protection, and,
- establish an aquatic resource database for agencies with regulatory authority and responsibility for environmental management and focus greater emphasis on the importance of Illinois aquatic resources in part through Biological Stream Characterization system (Bertrand et al. 1996) activities.

Station Information

Each year, two or three of the thirty-three major watersheds in Illinois are sampled by each Surface Water Section regional office in the Bureau of Water. Under this cooperative agreement with IDNR, more than 100 stations are monitored annually for biological, chemical and physical indicators of water resource quality. This schedule, which allows each of the State's major watersheds to be sampled on a five-year rotational basis, is provided in Appendix C, Figure 1.

Appendix C, Figure 1. Intensive Basin Surveys 2015-2020 Monitoring Schedule

ID	Basin Name	8-Digit HUC
1	Little Calumet-Galien	04040001
2	Pike-Root	04040002
3	Chicago	07120003
4	Des Plaines	07120004
5	Upper Fox	07120006
6	Lower Fox	07120007
7	Kishwaukee	07090006
8	Upper Rock	07090002
9	Sugar	07090004
10	Pecatonica	07090003
11	Apple-Plum	07060005
12	Copperas-Duck	07080101
13	Lower Rock	07090005
14	Green	07090007
15	Lower Illinois-Senachwine Lake	07130001
16	Upper Illinois	07120005
17	Kankakee	07120001
18	Iroquois	07120002
19	Vermilion	07130002
20	Mackinaw	07130004
21	Lower Illinois-Lake Chautauqua	07130003
22	Spoon	07130005
23	Flint-Henderson	07080104
24	Bear-Wyaconda	07110001
25	La Moine	07130010
26	Lower Sangamon	07130008
27	Salt	07130009
28	Upper Sangamon	07130006
29	Vermilion	05120109
30	Middle Wabash-Little Vermilion	05120108
31	Middle Wabash-Busseron	05120111
32	Embarras	05120112
33	Upper Kaskaskia	07140201
34	South Fork Sangamon	07130007
35	Lower Illinois	07130011
36	The Sny	07110004
37	Peruque-Piasa	07110009
38	Macoupin	07130012
39	Shoal	07140203
40	Middle Kaskaskia	07140202
41	Little Wabash	05120114
42	Lower Wabash	05120113
43	Highland-Pigeon	05140202
44	Skillet	05120115
45	Cahokia-Joachim	07140101
46	Lower Kaskaskia	07140204
47	Upper Mississippi-Cape Girardeau	07140105
48	Big Muddy	07140106
49	Saline	05140204
50	Lower Ohio-Bay	05140203
51	Lower Ohio	05140206
52	Cache	07140108



Intensive basin survey monitoring stations are routinely located at Illinois EPA Ambient Water Quality Monitoring Network stations and IDNR fish monitoring locations. The number of stations per basin is dependent on the size of the watershed. Historically, the number of stations sampled for all constituents (water, sediment, habitat and biology) range from approximately ten to thirty per basin. However, additional stations may be added to provide adequate spatial coverage of the watershed. Criteria for selecting stations include: a sampling area representative of the stream, flowing water at the time of sampling, suitable instream habitat, and accessibility for crew and equipment (see Section D, IEPA 1994).

Station codes are based on the Illinois EPA's alphanumeric coding system consisting of one to eight alphabetic characters and two numeric characters. The alpha characters indicate the stream and the numeric characters represent the specific station location on the stream. This coding system provides a uniform method of identifying station locations throughout the state. For additional information on the coding system used for station identification, please refer to Appendix B (Illinois EPA Ambient Stream Water Quality Monitoring Network) of this document.

Sample Collection and Analysis

Water and sediment chemistry, physical habitat, biological (macroinvertebrate and fish) assemblages, and fish tissue samples are collected to assess stream quality. One round of biological and habitat sampling is conducted at each station, typically during summer low flow conditions. Three water samples are collected at each survey station; one prior to biological sampling, one on the day of biological sample collection and one post-biological sampling in late summer/early fall. Instream surficial sediment is collected at each station to screen for toxic substances. Fish tissue samples are taken from fish assemblage collections (typically those stations known to support sport fishing) to screen for toxic substances. In order to minimize sample variability and enhance data comparability across time, all samples are collected within a June to mid-October time period.

Water Chemistry:
Water chemistry samples are collected at each station and composited into a splitter churn before being transferred into the appropriate collection bottle. Typically, parameters analyzed include: a full spectrum of total and dissolved nutrients and metals. Dissolved parameters are collected after filtering through a 0.45µm filter. Instream physiochemical parameters (pH, DO, conductivity, and temperature) are recorded at the time of water sample collection. A full list of water chemistry parameters and sampling methods is found in Illinois EPA's Standard Operating Procedures. Chemical results are compared to existing State water quality standards to determine compliance.

Continuous Monitoring:
Continuous Monitoring is a stream monitoring tool that is implemented in conjunction with Intensive Basin Surveys (IBS), Facility Related Stream Surveys (FRSS), and special surveys in Illinois. Continuous Monitoring originated in 2004 as a pilot program, and has expanded repeatedly since that time, currently monitoring over 100 IBS stations a year for dissolved oxygen, pH, water temperature, and conductivity. In addition, continuous monitoring is

conducted alongside FRSS and special surveys as appropriate. Continuous Monitoring is used to augment information for chemical and biological sampling associated with the IBS and FRSS programs. In short, continuous monitoring can be implemented in any instance where ongoing physiochemical characteristics are needed for waters in the state of Illinois. Stations are sampled for one week periods, twice a year, to coincide with seasonal dissolved oxygen water quality standards. The first sampling event takes place during the period from June 1 to July 31, and the second event occurring from August 1 through October 15.

Sediment Chemistry:

Instream surficial sediment samples are collected once at all stations during the survey. Sediments are collected at multiple locations from surface deposits within the sampling reach. These sediments are composited and then wet-sieved through a 63µm stainless steel sieve. Sieving samples assures comparability across stations by standardizing sample particle size submitted to the laboratory for analysis and also eliminates sand and other coarse materials for the sample. All equipment used for sediment sampling are either stainless steel or glass and are cleaned prior to use at each station in accordance with the Standard Operating Procedure for Surficial Sediment Collection. Sediment chemistry analysis results are used to screen for contaminants and bioaccumulative chemicals that are not detected in routine water samples. There are no standards in Illinois for sediment concentrations. Results are compared against a statistical classification developed for Illinois sediments based on 14 years of statewide sieved sediment data (Short 1997).

Biological Populations:

An Index of Biotic Integrity (IBI) is used in Illinois to provide a simple and easily communicated measure of biological health of fish and macroinvertebrate assemblages. Multi-metric IBI's are commonly used worldwide to define biological populations. Because stream biological structures are extremely complex, a single attribute (e.g., number of native fish species) will not provide an accurate indication of conditions. However, by examining multiple attributes of the population and assigning an appropriate metric score for each attribute a more accurate picture emerges. After a biological sample is collected and the individuals identified and counted, these data are converted to a score representing each specific metric. The sum of the individual metric scores represents the IBI score for that population sample representing the stream station. Development of an IBI (selecting the appropriate population attributes and assigning metric scores) requires significant statistical analysis of historical biological populations and expert knowledge and judgment by the biologists utilizing the index.

Macroinvertebrates:

Macroinvertebrate population samples have been used as water quality indicators by the Illinois EPA since its inception. Macroinvertebrates are well suited for biological assessment strategies because of their short life cycles, often producing several generations within a year, and they remain in the general area of propagation. Macroinvertebrates are generally abundant and because of their size are relatively easy to see and collect. Aquatic insects are found in almost all streams and their sensitivity to water quality and habitat impacts make them effective indicators of stream impairment. Since 1983 the Illinois EPA has utilized the Macroinvertebrate Biotic Index (MBI) to provide a rapid measure of stream quality. This single metric index has proven effective

for investigating point source (specifically de-oxygenizing) waste related studies. However, due to the increased importance of nonpoint and instream habitat issues in recent years, Illinois EPA contracted with Tetra Tech in 1998 to develop a new multi-metric macroinvertebrate biotic index (mIBI) for Illinois' wadeable streams. As part of this effort, field collection and laboratory sorting procedures were modified.

Since 2001, macroinvertebrates have been collected at each intensive basin wadeable station using the 20-jab semi-quantitative sampling effort (Barbour et al. 1999). Allocation of the collection jabs are based on approximate proportions of major macroinvertebrate habitat types in both bottom and bank zones. Numbers of jabs in each of these zones is based on the mean stream width of the sample reach. Samples are preserved in ethanol in the field. A 300-organism sub-sample is obtained in the laboratory and organisms are identified and counted by either Illinois EPA biologists or a contractor. Macroinvertebrate results are interpreted by analysis of community structure to determine relative quality of the stream. The new multi-metric index developed by Tetra Tech, which includes seven metrics scored 0 – 100, was designed to be sensitive primarily to nonpoint/habitat related disturbances. This new index was used for the first time in the 2008 Integrated Report. Macroinvertebrate collections at non-wadeable stream stations are still accomplished using Hester-Dendy artificial substrates because the macroinvertebrate IBI has not yet been calibrated for unwadeable stations. These samples are generally not sub-sampled and are currently evaluated with the MBI.

Fish:

Illinois EPA has used the Index of Biotic Integrity (Karr, 1986) for evaluating attributes of fish populations as an indication of stream quality for over 20 years. In 2000, in cooperation with the Illinois Department of Natural Resources (IDNR), Illinois EPA completed a project to refine the IBI and revise regional expectations of stream quality based on development of new IBI regions. This modification of the IBI included development of new metrics and scoring procedures to ensure the new index (fish IBI or fIBI) adequately depicts stream quality on a statewide basis.

Fish are collected by two methods. In wadeable streams, a portion of the stream is sectioned off with block nets and an electric seine is used to sample fish. The seine is moved upstream and three netters capture fish as they are stunned by the electric current. Sample effort is approximately 30 minutes per station. At unwadeable stations, a boat-mounted AC electrofishing unit is used. Sample effort is approximately one hour and is supplemented with seine hauls in shallow areas. Collections are sorted, weighed, length measured, identified, and counted in the field. Fish not readily identified in the field are preserved in formalin and later identified by IDNR staff. A fish population survey results in a fIBI score ranging from 12 - 60 and represents very poor to excellent community conditions.

Habitat:

Since 2005, instream habitat has been evaluated using the Qualitative Habitat Evaluation Index (QHEI) as developed by the Ohio EPA. This index is based on six metrics including information on substrate composition, cover type, channel morphology, riparian zone, and riffle and pool

quality. Stream discharge measurements using standard USGS methods are also completed at all wadeable stations.

Fish Contaminant Monitoring:

Fish accumulate contaminants and are thus a good indicator for determining water quality. In Illinois, contaminant levels in fish are routinely monitored via a cooperative program with Illinois EPA, Illinois Department of Natural Resources (IDNR), Illinois Department of Public Health, and the Illinois Department of Agriculture. At Intensive Basin Survey stations the IDNR Fisheries staff is responsible for collection of fish tissue samples. Composite fillet samples of five individual fish from each of the target species (predatory-bass, omnivorous-catfish, and bottom feeder-carp) are obtained. Fish contaminant data are assessed for compliance with risk based criteria adopted by the cooperating agencies/departments or U.S. Food and Drug Administration action levels for issuing sport fish consumption advisories.

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APPENDIX D

Lake Michigan Monitoring Program

Illinois Environmental Protection Agency
Bureau of Water
Springfield, Illinois

Lake Michigan Monitoring Program (LMMP)

Legislative Mandates

There exist two major pieces of federal or state legislation that require the Illinois EPA to routinely monitor and assess the quality of Lake Michigan.

The Federal Water Pollution Control Act Amendments of 1972 (PL-92-500) and subsequent amendments (collectively called the Clean Water Act or "CWA"), namely Sections 305(b) and 303(d), require the biennial assessment of the nations surface water resources. According to Section 305(b), each state must submit to the United States Environmental Protection Agency (USEPA) a report, that among other things, includes a description of the water quality of all navigable waters (inclusive of Lake Michigan), and an analysis of the extent to which navigable waters provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreational activities in and on the water. According to Section 303(d), each state must identify its "water quality-limited waters," as well as the pollutants causing or expecting to cause water quality standards violations in those waters.

Recognizing the great importance of Lake Michigan as a natural asset, the 75th Illinois General Assembly authorized Illinois EPA through *615 ILCS 5/14a of the Rivers, Lakes, and Streams Act* to *"...regularly conduct water quality and lake bed surveys to evaluate the ecology and quality of water in Lake Michigan."* As such, from 1977 to 2009, the Illinois portion of Lake Michigan was monitored under the terms of a cooperative agreement between the City of Chicago and the Illinois EPA. In 2010, the Illinois EPA redesigned the Lake Michigan Monitoring Program to meet new and multiple program needs. The lake continues to be monitored pursuant to this redesign on an annual basis.

LMMP Monitoring Objectives

Illinois EPA conducts its monitoring efforts to meet the following primary monitoring objectives that have been established for all of its surface waters, including streams, inland lakes, and Lake Michigan:

1. Determine attainment of designated uses and identify impaired waters.

2. Identify causes and sources of impairment to water quality.

3. Identify trends in water quality and maintain the flexibility to address emerging threats to water quality.

4. Establish, review and revise water quality standards, including use designations and use attainability.

5. Implement water management programs.

6. Evaluate the effectiveness of water management programs.

LMMP Monitoring Design

Illinois EPA began implementation of its redesigned LMMP in May 2010. This program includes four components: a Nearshore Survey, Harbor monitoring, Public Water Supply/Fixed Station monitoring, and Beach monitoring. Illinois EPA conducts sampling activities for the Nearshore Survey, Harbors, and Public Water Supply/Fixed Station monitoring components of the LMMP. Beach Monitoring is conducted by local municipalities and county health departments.

Nearshore Survey:

This component is designed to describe Lake Michigan water quality within Illinois state boundaries from the shoreline to an offshore distance of 5km, or a depth of 30m, whichever comes first. The design is probability-based, consisting of 50 randomly selected stations, sampled over a period of two years (25 stations/year). Near-surface (0.5m depth) water quality samples are collected by Illinois EPA staff three times throughout the year; generally in June, August, and October. Ten of the 50 stations are randomly selected as "expanded stations", which, in addition to a near-surface water quality sample, a sample is also collected 1m off the lake bottom.. See Table 1 for a list of the physical, chemical, and biological components of the Nearshore Survey.

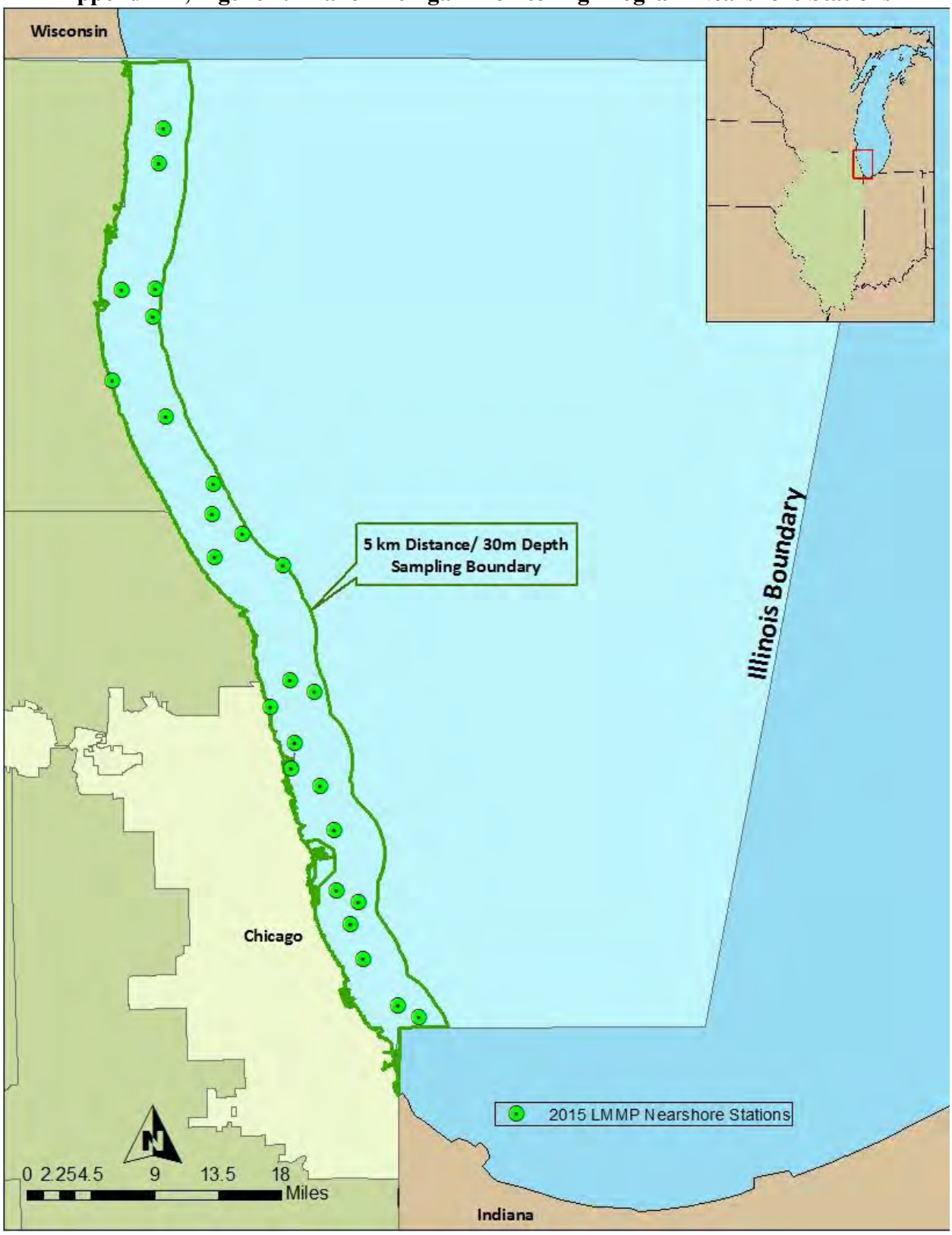
Harbor Monitoring:

There are currently thirteen harbors along the Illinois coastline of Lake Michigan. Illinois EPA samples two to three harbors per year. Each harbor has one to four fixed stations based on harbor size. Water samples are collected three times throughout the year; generally in June, August, and October. Near-surface water samples are collected at 0.5m below the water surface, and an additional bottom water sample (1.0m off the bottom) is collected at one station per harbor. Sediment samples are collected at all harbor stations one time during the sampling season. See Table 1 for a list of the physical and chemical parameters collected as part of this LMMP component.

Public Water Supply/Fixed Station Monitoring:

The Illinois portion of the Lake Michigan watershed is home to half of the total population of Illinois and the lake serves as the largest source of drinking water in the state, serving nearly 6.6 million people. Public Water Supply stations are at fixed water intake locations, sampled three times throughout the year. At each station, samples are collected 1m off the lake bottom (or at intake depth), and an additional sample is taken 0.5m below the water surface. See Table 1 for a list of the physical and chemical parameters collected as part of this LMMP component.

Appendix D, Figure 1. Lake Michigan Monitoring Program Nearshore Stations



Appendix D, Table 1. Summary of the Physical, Chemical, and Biological Components of the LMMP

Component	Nearshore	Expanded Nearshore	Harbors	Public Water Supply/Fixed Station
Total Nutrients	X	X	X	X
Dissolved Phosphorus		X	X	X
Total Metals	X	X	X	X
Dissolved Metals		X	X	X
Chloride	X	X	X	X
Fluoride	X	X	X	X
Sulfate	X	X	X	X
Total Organic Carbon		X	X	X
Total Dissolved Solids	X	X	X	X
Total Suspended Solids	X	X	X	X
Volatile Suspended Solids	X	X	X	X
Cyanide		X	X	X
Phenols		X	X	X
Organics/Pesticides		X		X
Chlorophyll a		X	X	X
Turbidity		X	X	X
Secchi Disk Transparency		X	X	X
Conductivity	X	X	X	X
pH	X	X	X	X
Water Temperature	X			
Dissolved Oxygen	X			
Temperature/Dissolved Oxygen Profile		X	X	X
Fecal Coliform Bacteria		X	X	X
Phytoplankton Identification and Cell Counts		X	X	X
Sediment Organics/Pesticides			X	
Sediment Percent Total Solids			X	
Sediment Volatile Solids			X	
Sediment Total Organic Carbon			X	
Sediment Phosphorus			X	
Sediment Total Kjeldahl Nitrogen			X	
Sediment Metals			X	
Sediment Mercury			X	

Illinois EPA Laboratory Resources

The Illinois EPA has its own laboratory resources. Illinois EPA's Division of Laboratories is located in Springfield, Illinois. It is a full service laboratory that analyzes water, sediment, and fish tissue samples. Lake Michigan samples collected by Northern Monitoring Unit staff are shipped to the Division of Laboratories in Springfield for analysis. Analysis results are electronically transferred via the Laboratory Information Management System (LIMS) to Illinois EPA STORET for subsequent data management of Lake Michigan monitoring data as described below.

Data Management

Illinois EPA achieves data management of Lake Michigan water monitoring and assessment information as described below.

Laboratory and Field-Measured Results and Corresponding Sample Information for Physicochemical Conditions in Water, Sediment, or Fish Tissue:

1. Storage. This information is stored in an Illinois EPA version of the STORET system and then regularly transferred to the analogous national STORET system. The STORET (i.e., STORage and RETrieval) information system was created by USEPA. All results are geographically referenced via latitude and longitude coordinates of each sampling station.

2. Retrieval/Accessibility. Information in Illinois EPA STORET is available to the public upon request. Illinois-based information in national STORET is available to the public via accessing the national STORET website.

3. Timing. Although some laboratory results and corresponding sample information get stored in Illinois EPA STORET within two months of the collection date of the environmental sample, for other results much longer delays exist in the transfer to Illinois EPA STORET and subsequently to national STORET. For all results and corresponding sample information, Illinois EPA is working to decrease the lag between sample collection and availability in national STORET, with the ultimate goal of no more than six months between collection and availability in national STORET.

Information on Assessments of Use Attainment:

1. Storage. Illinois EPA regularly assesses the attainment of each of various beneficial uses in Illinois surface waters, including Lake Michigan. When applicable, potential causes and sources of impairment (nonattainment) are identified for each assessment. This assessment information is stored in the Illinois EPA version of the Assessment Database (ADB), which is a nationally standardized database created by USEPA. This database does not store physicochemical, biological or habitat results; rather, it contains the assessment related conclusions of interpreting those results. In accordance with reporting requirements in the CWA, Illinois EPA regularly provides information in the ADB to USEPA. Each waterbody (assessment unit) in the ADB is geographically referenced to a surface water feature in the National Hydrography Dataset (NHD).

2. Retrieval/Accessibility. Information in the Illinois EPA ADB is available to the public upon request.

3. Timing. Assessment information in the Illinois EPA ADB is updated every two years, based on the schedule of reporting required by the CWA. Currently, a lag of up to two years exists between the collection time of information used in assessments and the time the assessment conclusions are entered into the ADB.

Environmental Indicators

Overview:

Monitoring the environmental conditions of Illinois waters provides vital data and related information for assessing attainment of uses, identifying impairment, and determining how to restore impaired waters. Monitoring information also helps evaluate the success of Illinois EPA water pollution control programs, restoration efforts, and related activities. To use monitoring data and information effectively, it must be interpreted and represented clearly and concisely in terms of indicators of environmental condition. This section describes the indicators that Illinois EPA uses for Lake Michigan water resource assessment.

Beneficial Uses and Water Quality Standards:

Beneficial uses and water quality standards provide the primary context in which Illinois EPA interprets and uses indicators of environmental condition. Beneficial uses of Lake Michigan that are biennially assessed include *Aquatic Life Use* (e.g., is aquatic life in the lake happy?), *Aesthetic Quality Use* (e.g., is the lake visually appealing?), *Primary Contact Use* (e.g., described as prolonged and intimate contact with the water and risk of ingesting water is considerable, such as swimming or water skiing), *Secondary Contact Use* (e.g., described as incidental or accidental contact with the water and risk of ingesting water is minimal, such as boating or fishing), *Public and Food Processing Water Supply Use* (e.g., can you use the water for drinking water purposes?), and *Fish Consumption Use* (can you eat the fish?).
The Illinois Pollution Control Board has established two primary categories of narrative and numeric water quality standards designed to protect these beneficial uses of Lake Michigan waters: Lake Michigan Basin Water Quality Standards and Public and Food Processing Water Supply Standards,

1. Lake Michigan Basin Water Quality Standards (35 Ill. Adm. Code 302, Subpart E). These standards protect the beneficial uses of the open waters, harbors and waters within breakwaters, and the waters within Illinois jurisdiction tributary to Lake Michigan, except for the Chicago River, North Shore Channel, and Calumet River. Lake Michigan data are compared to these standards to assess Aquatic Life Use, Aesthetic Quality Use, Primary Contact Use, and Secondary Contact Use (Appendix D, Table 1).

2. Public and Food Processing Water Supply Standards (35 Ill. Adm. Code 302, Subpart C). These standards protect the state's surface water for human consumption or for processing of food products intended for human consumption. These standards apply at any point at which water is withdrawn for treatment and distribution as a potable water supply or for food

processing. Lake Michigan data are compared to these standards to assess Public and Food Processing Water Supply Use.

Finally, Fish Consumption Use assessments are based on waterbody-specific fish-tissue data and also on fish-consumption advisories issued by the Illinois Fish Contaminant Monitoring Program (FCMP). While not Illinois Pollution Control Board numeric or narrative water quality standards, the FCMP uses the U.S. Food & Drug Administration's (FDA) Action Levels as criteria for determining the need for advisories, except for polychlorinated biphenyls (PCBs), mercury, and chlordane. For these contaminants, the FDA criteria have been replaced by a risk-based process developed in the *Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory* (Anderson et al. 1993, herein after referred to as the Protocol). The Protocol requires the determination of a Health Protection Value (HPV) for a contaminant, which is then used with five meal consumption frequencies (eight ounces of uncooked filet): 1) Unlimited (140 meals/year); 2) One meal/week (52 meals/year); 3) One meal/month (12 meals/year); 4) One meal/two months (six meals/year); and 5) Do not eat (0 meals/year). The level of contaminant in fish is then calculated that will not result in exceeding the HPV at each meal consumption frequency. The Protocol also assumes a 50% reduction of contaminant levels for organic chemicals (not used for mercury) when recommended cleaning and cooking methods are used.

Assessment and Reporting

The legislative mandates identified above require Illinois EPA to determine and report regularly on the extent to which the beneficial uses of the state's waters are being attained. To assess attainment of beneficial uses for Lake Michigan, Illinois EPA uses water quality data collected via this LMMP Monitoring Strategy. These monitoring data are also critical for identifying potential causes of use impairment and for reviewing the adequacy of existing water quality standards, effluent limits in permits, and nondegradation decisions.

The guidelines and criteria used by Illinois EPA to assess attainment of uses are explained in *Illinois Integrated Water Quality Report and Section 303(d) List*, available on the Illinois EPA website, http://www.epa.state.il.us/water/water-quality/index.html.

Appendix D, Table 2. Lake Michigan Basin Water Quality Standards

Parameter	Unit	*Aquatic Life* Use [1]			Human Health Standard [5]	Water Quality or HHS[6] Standard for "Open Waters" only[6]	Water Quality Standard for other uses[7]	Wildlife Standard [8]
		AS [2]	CS [3]	Other [4]				
Arsenic (trivalent, dissolved)	µg/L	340	148	NA[9]	NA	NA	NA	NA
Arsenic (total)	µg/L	NA	NA	NA	NA	50.0	NA	NA
Cadmium (dissolved)	µg/L	exp[A+Bln(H)]X{1.138672–[(lnH)X(0.041838)]}, where A = -3.6867 B = 1.128	exp[A+Bln(H)]X{1.138672–[(lnH)X(0.041838)]}, where A = -2.715 B = 0.7852	NA	NA	NA	NA	NA
Chromium (hexavalent, total)	µg/L	16	11	NA	NA	NA	NA	NA
Chromium (trivalent, dissolved)	µg/L	exp[A+Bln(H)] X 0.316, where A = 3.7256 B = 0.819	exp[A+Bln(H)] X 0.860, where A = 0.6848 B = 0.819	NA	NA	NA	NA	NA
Copper (dissolved)	µg/L	exp[A+Bln(H)] X 0.960, where A = -1.700 B = 0.9422	exp[A+Bln(H)] X 0.960, where A = -1.702 B = 0.8545	NA	NA	NA	NA	NA
Cyanide (weak acid dissociable)	µg/L	22	5.2	NA	NA	NA	NA	NA
Lead (dissolved)	µg/L	exp[A+Bln(H)] X {1.46203-[(lnH)(0.145712)]}, where A = -1.055 B = 1.273	exp[A+Bln(H)] X {1.46203-[(lnH)(0.145712)]}, where A = -4.003 B = 1.273	NA	NA	NA	NA	NA
Lead (total)	µg/L	NA	NA	NA	NA	50.0	NA	NA
Nickel (dissolved)	µg/L	exp[A+Bln(H)] X 0.998, where A = 2.255 B = 0.846	exp[A+Bln(H)] X 0.997, where A = 0.0584 B = 0.846	NA	NA	NA	NA	NA
Selenium (dissolved)	µg/L	NA	5.0	NA	NA	NA	NA	NA
Selenium (total)	µg/L	NA	NA	NA	NA	10.0	NA	NA
Total Residual Chlorine	µg/l	19	11	NA	NA	NA	NA	NA
Zinc (dissolved)	µg/L	exp[A+Bln(H)] X 0.978, where A = 0.884 B = 0.8473	exp[A+B ln(H)] X 0.986, where A = 0.884 B = 0.8473	NA	NA	NA	NA	NA
Benzene	µg/L	3900	800	NA	310	HHS: 12.0	NA	NA
Chlorobenzene	mg/L	NA	NA	NA	3.2	HHS: 0.470	NA	NA
2,4 – Dinitrophenol	mg/L	NA	NA	NA	2.8	HHS: 0.0550	NA	NA
Endrin	µg/L	0.086	0.036	NA	NA	NA	NA	NA
Hexachloroethane	µg/L	NA	NA	NA	6.7	HHS: 5.30	NA	NA
Methylene Chloride	mg/L	NA	NA	NA	2.6	HHS: 0.0470	NA	NA
Parathion	µg/L	0.065	0.013	NA	NA	NA	NA	NA
Pentachlorophenol	µg/L	exp B([pH] + A), where A = -4.869 B = 1.005	exp B([pH] + A), where A = -5.134 B = 1.005	NA	NA	NA	NA	NA

Ethylbenzene	µg/L	150	14	NA	NA	NA	NA	NA
Toluene	mg/L	2000	610	NA	51.0	HHS: 5.60	NA	NA
Xylene(s) (total)	µg/l	1200	490	NA	NA	NA	NA	NA
Trichloroethylene	µg/L	NA	NA	NA	370	HHS: 29.0	NA	NA
Barium (total)	mg/L	NA	NA	5.0	NA	1.0	NA	NA
Boron (total)	mg/L	NA	NA	NA	NA	NA	1.0	NA
Chloride	mg/L	NA	NA	500	NA	12.0	NA	NA
Fluoride	mg/L	NA	NA	NA	NA	NA	1.4	NA
Iron (dissolved)	mg/L	NA	NA	1.0	NA	0.30	NA	NA
Manganese (total)	mg/L	NA	NA	1.0	NA	0.15	NA	NA
Phenols	µg/l	NA	NA	NA	NA	1.0	100	NA
Sulfate	mg/L	NA	NA	NA	NA	24.0	500	NA
Total Dissolved Solids	mg/L	NA	NA	1000	NA	180.0	NA	NA
Nitrate-Nitrogen	mg/L	NA	NA	NA	NA	10.0	NA	NA
Phosphorus	µg/L	NA	NA	NA	NA	7.0	NA	NA
Lindane	µg/L	0.95	NA	NA	0.5	HHS: 0.47	NA	NA
Un-ionized ammonia:								
April-October	mg/L	0.33 (10)	0.057 (10)	NA	NA	NA	NA	NA
November-March	mg/L	0.14 (10)	0.025 (10)	NA	NA	NA	NA	NA
Total Ammonia-Nitrogen	mg/L	NA	NA	15	NA	0.02	NA	NA
Fecal coliform bacteria	#/100 ml	NA	NA	NA	NA	20(11)	200/400(12)	NA
pH minimum	SU	NA	NA	6.5	NA	7.0	NA	NA
pH maximum	SU	NA	NA	9.0	NA	9.0	NA	NA
Dissolved Oxygen	mg/L	NA	NA	– (13)	NA	NA	NA	NA
Mercury (total)	ng/L	1700	910	NA	3.1	NA	NA	1.3
Chlordane	ng/L	NA	NA	NA	0.25	NA	NA	NA
DDT and metabolites	pg/L	NA	NA	NA	150	NA	NA	11.0
Dieldrin	ng/L	240	56	NA	0.0065	NA	NA	NA
Hexachlorobenzene	ng/L	NA	NA	NA	0.45	NA	NA	NA
PCBs (class)	pg/L	NA	NA	NA	26	NA	NA	120
2,3,7,8-TCDD	fg/L	NA	NA	NA	8.6	NA	NA	3.1
Toxaphene	pg/L	NA	NA	NA	68	NA	NA	NA
2,4-Dimethylphenol	mg/L	NA	NA	NA	8.7	HHS: 0.450	NA	NA
Oil (hexane solubles or equivalent)	mg/L	NA	NA	NA	NA	0.10	NA	NA
Temperature	(Refer to 35 Ill. Adm. Code 302.506, 302.507, 302.508, 302.509)							

Where:

mg/L = milligrams per liter (10^{-3} grams per liter)
µg/L = micrograms per liter (10^{-6} grams per liter)
ng/L = nanograms per liter (10^{-9} grams per liter)
pg/L = picograms per liter (10^{-12} grams per liter)
NA = Criterion currently not available or not applicable
Exp (x) = base of natural logarithms raised to the x-power
ln(H) = natural logarithm of Hardness
fg/L – femtograms per liter (10^{-15} grams per liter)

Footnotes for Table 2.

1 35 Ill. Adm. Code 302
2 Acute standard – not to be exceeded at any time (35 Ill. Adm. Code 302.504 a, e). These criteria apply in all waters of the Lake Michigan Basin.
3 Chronic standard – not to be exceeded by the arithmetic average of at least four consecutive samples over a period of at least four days (35 Ill. Adm. Code 302.504 a, e). These criteria apply in all waters of the Lake Michigan Basin.
4 Other water quality standards applicable to *aquatic life* use (35 Ill. Adm. Code 302.502, 302.503, 302.504 b). These criteria apply in all waters of the Lake Michigan Basin unless an open waters water quality standard is specified. In these cases, the criterion in the *aquatic life* use column applies to all waters of the Lake Michigan Basin other than the open waters.
5 Human health standard – not to be exceeded by the arithmetic average of at least four consecutive samples over a period of at least four days (35 Ill. Adm. Code 302.504 a, d, e). For each parameter, the criterion applies in all waters of the Lake Michigan Basin unless an open waters human health standard is specified. In these cases, the standard in the "Human Health Standards" column applies to all waters of the Lake Michigan Basin other than the open waters.
6 Water quality standards or human health standards, specified as "HHS," apply only in the open waters of the Lake Michigan Basin (35 Ill. Adm. Code 302.504 c, d; 302.502; 302.503; 302.505; 302.535).
7 Water quality standards applicable to uses other than *aquatic life* use. These do not include Public and Food Processing Water Supply Standards applicable at some locations in the waters of the Lake Michigan Basin; for these standards see Table B-2.
8 Wildlife standard – not to be exceeded by the arithmetic average of at least four consecutive samples over a period of at least four days (35 Ill. Adm. Code 302.504 e). These criteria apply in all waters of the Lake Michigan Basin.
9 "NA" means that a numeric criterion currently is not available, but may be derived in the future as per 35 Ill. Adm. Code 302.540.
10 Acute standard and chronic standard for un-ionized ammonia computed as per 35 Ill. Adm. Code 302.535 c.
11 Based on a minimum of five samples taken over not more than a 30-day period.
12 For Lake Michigan-basin waters other than open waters, fecal coliform bacteria must not exceed a geometric mean of 200 per 100 ml, nor shall more than 10% of the samples during any 30-day period exceed 400 per 100 ml, based on a minimum of five samples taken over not more than a 30-day period.
13 Dissolved oxygen must not be less than 90% of saturation, except due to natural causes, in the open waters of the Lake Michigan Basin (as defined at 35 Ill. Adm. Code 302.501). The other waters of the Lake Michigan Basin (i.e., tributaries, harbors and areas within breakwaters of Lake Michigan) must not be less than 6.0 mg/L during at least 16 hours of any 24 hour period, nor less than 5.0 mg/L at any time.

APPENDIX E

Groundwater Monitoring Program

Illinois Environmental Protection Agency
Bureau of Water
Springfield, Illinois

Groundwater Monitoring Program

The collection of high quality chemical data is essential in assessing groundwater programs. In response to this belief, Illinois EPA and the United States Geological Survey (USGS) Illinois District Office, located in Urbana, began a cooperative effort to implement a pilot groundwater monitoring network (i.e., ambient monitoring network) in 1984. CWS ambient network design started with pilot efforts in 1984, moved to implementation of the ISWS network design for several years, and was followed by sampling all of Illinois' CWS wells (3,000+) until 1995.

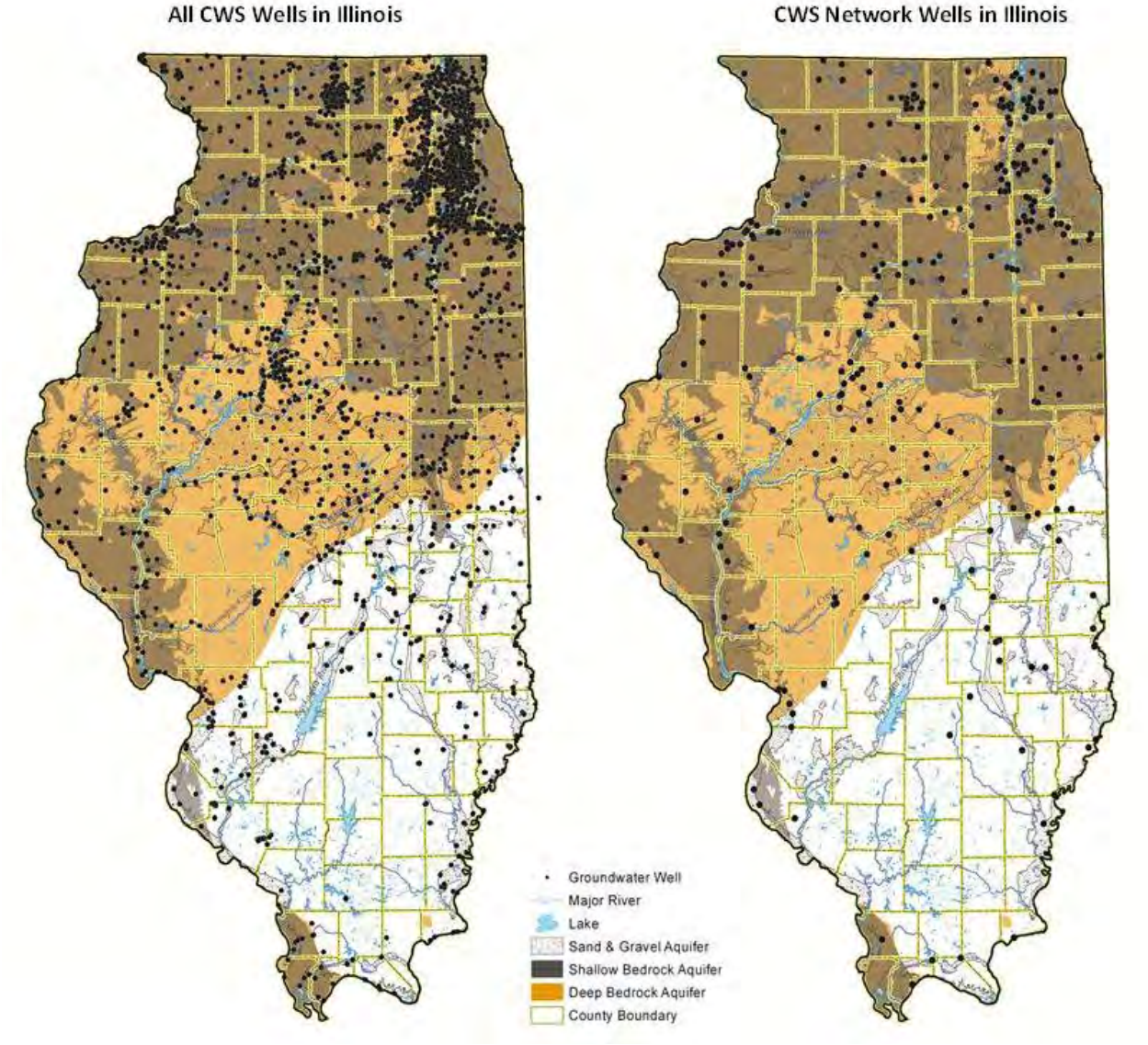
From the experience gained from this prototype network, Illinois EPA designed a probabilistic monitoring network of CWS wells. The design of this network was completed in coordination with the USGS, the Illinois State Geological Survey (ISGS), and the ISWS, with USGS performing the detailed design. These network wells were selected using a random stratified probability-based approach (95 percent statistical confidence in the data with an associated plus or minus five percent precision and accuracy level) with a goal of representing contamination levels in the population of all active CWS wells. Further, the random selection of the CWS wells was stratified by depth, aquifer type, and the presence of aquifer material within 50 feet of land surface. Illinois EPA used geological well log and construction log detail to perform this process.

The random stratified selection process included nearly 3,000 CWS wells resulting in 356 fixed monitoring locations as illustrated in Appendix E, Figure 1. This probabilistic network is designed to (a) provide an overview of the groundwater conditions in the CWS wells; (b) provide an overview of the groundwater conditions in the principle aquifers (e.g., sand and gravel, Silurian, Cambrian-Ordovician, etc.); (c) establish baselines of water quality within the principle aquifers; (d) identify trends in groundwater quality in the principle aquifers; and (e) evaluate the long-term effectiveness of the Illinois Groundwater Protection Act, Clean Water Act, and Safe Drinking Water Act (SDWA) program activities in protecting groundwater in Illinois.

Additionally, in order to prevent spatial or temporal bias, 17 random groups of 21 wells, with alternates, were selected from all 356 fixed station wells. To further assure maximum temporal randomization within practical constraints, the samples from each sample period are collected over a three-week period.

Illinois EPA utilizes routine monitoring data to determine if deterioration (or improvement) in water quality has occurred over time. In principle, this information will accurately represent hydrogeological conditions at a station and enable an understanding of the dynamics of subsurface aquifer systems. Illinois EPA has determined that the practical elements of a viable long-term groundwater monitoring program should include (a) evaluation of hydrogeological setting and program information needs, (b) evaluation of well performance and purging strategies, and (c) execution of effective sampling protocols that include the appropriate selection of sampling mechanisms and materials, as well as sample collection, preservation, and handling procedures.

Appendix E, Figure 1. Active Community Water Supply Wells and Community Water Supply Network Wells



Groundwater in Illinois is routinely monitored for biological and chemical contaminants and, to some degree, withdrawal rates. Since 1997, Illinois EPA has operated an ambient network of CWS wells via a rotating approach. The random stratified probabilistic network consisting of 356 fixed stations is sampled every other year to allow the flexibility to conduct special/intensive monitoring during the second year cycle.

An average of 350 wells has been maintained since the inception of the probabilistic monitoring network in 1996. When a well in this network is taken out of service, or otherwise not readily able to be sampled, Illinois EPA designates an alternative well with generally the same location, depth, and aquifer properties. By doing this, Illinois EPA has historical datasets for over 524 CWS wells that are currently or have been previously sampled in the probabilistic network.

Network stations have been sampled within a fixed three-week time frame biennially since 1996. Monitoring at all stations is completed using Hydrolab® samplers to insure natural/optimum groundwater conditions. Water quality parameters include field temperature, field specific conductance, field pH, field pumping rate, inorganic chemical (IOC) analysis, synthetic organic compound (SOC) analysis, and volatile organic compounds (VOC) analysis. All laboratory analytical procedures are documented in Quality Assurance Program Plans developed by Illinois EPA Division of Laboratories, and in the Illinois Pollution Control Board's Groundwater Quality Standards (35 Ill. Adm. Code 620). Data specific to groundwater monitoring are verified and stored via a multi-step process that includes a transition from the Illinois EPA Laboratory Information Management System (LIMS) database to reside within the Safe Drinking Water Information System (SDWIS) database.

Since 1993, Illinois EPA has operated a pesticide monitoring subnetwork of the ambient CWS network. Initially, Illinois EPA tested all wells in the CWS Network for triazine and alachlor using the immunoassay-screening method. Positive results were resampled and analyzed using gas chromatography and mass spectrometry (GC/MS). However, in the 1998 monitoring cycle, Illinois EPA discontinued the use of immunoassay and randomly selected 50 percent of the network wells to be analyzed for SOC's using Quality Assurance Project Plans. During the 2000 monitoring cycle, the remaining wells in the network were analyzed for SOCs. The rotation has been carried forth to the current day network, and will be maintained in the future pending available resources.

During the 1997 monitoring cycle, Illinois EPA initiated a rotating monitoring network/special intensive monitoring program. The purpose of this monitoring network is to maximize resources and increase monitoring coverage of groundwater quality at CWS wells. It was determined that the primary purposes of the probabilistic network referred to above, could be realized by reducing the monitoring frequency to a biennial basis. As a result, Illinois EPA is currently able to concentrate on specialized monitoring programs at high priority areas during alternative years. The rotation between the probabilistic network and the rotating monitoring network/special intensive monitoring program has been carried forth to the current day, and will be maintained in the future, pending available resources.

Components of the Rotating/Special/Intensive Groundwater Monitoring Network include, but may not be limited to, the following:

a. *Highly Susceptible Community Water Supply Monitoring Network*:
This special/intensive monitoring effort focuses on concerns related to highly susceptible CWS wells. These wells are prioritized as a result of a detection of contaminants from either the probabilistic monitoring network or the treated water samples obtained during routine monitoring required by the Safe Drinking Water Act. The strategy involves having Illinois EPA staff sample the untreated water from CWS wells and the treated water sampling point to identify whether the source water is contaminated or if the contamination occurred after removal of the water from the aquifer (e.g., from recent work at the facility, errant contamination by sampler or laboratory, etc.). Community water supply wells and/or treated water sampling points that have confirmed contamination would be placed on an increased monitoring schedule to determine compliance with either the groundwater quality standards or

maximum contaminant levels pursuant to the Safe Drinking Water Act or sample demand authority under the Illinois Environmental Protection Act.

This monitoring effort also provides information regarding the quality of the water for each well in the event that the facility may need to alter its pumping strategy. Other wells relegated to the highly susceptible CWS network include those in the vicinity of an incident (e.g., spills, emergency response notice) or other unusual events where possible contamination of the source water is of concern. These wells may have no history of contamination and may be periodically sampled to record the data regarding the normal condition of water in case of future contamination and to assure the community that groundwater quality has not been compromised.

b. *New Community Water Supply Well Monitoring Network*:
The purpose of this special/intensive monitoring effort would be to focus on "new" CWS wells with little or no monitoring history. Groundwater monitoring conducted as part of this network include CWS wells from which Illinois EPA staff has not previously taken raw (untreated) water samples. Organic and inorganic samples would be collected from these wells. Sampling new wells provides Illinois EPA with information regarding the characteristics of the water in the aquifers around the state and provides background data for those wells in case the integrity of the water in the aquifer is compromised in the future.

c. *IOC Trend Monitoring Network of Community Water Supply Wells:*
The purpose of this special/intensive monitoring effort would be to focus on a subset of community water supply wells to determine if any trends in certain IOC can be determined. The IOC Trend Monitoring Network could include three trend subsets with 10 wells within each group. The 30 CWS wells would be selected from the probabilistic monitoring network having a history of IOC results. The subsets may include nitrate trend wells, chloride trend wells, or regional/aquifer-specific (e.g., Mahomet aquifer) trend wells. Each well would be sampled once every two months at approximately the same time of the month to maintain an even temporal interval between sampling events. The groundwater monitoring data will be analyzed to determine if there were any fluctuations in the water chemistry during this period. Other IOC monitoring subsets could be developed and maintained in the future, pending available resources.