Ambient Water Monitoring Strategy for Iowa
2016-2021

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Abstract

The Iowa Department of Natural Resources (DNR) Ambient Water Monitoring Program provides consistent, unbiased information about the condition of Iowa's water resources to support decisions affecting the development, management and protection of these resources. To strengthen its services, the program worked with a variety of stakeholders and other DNR programs to develop a five-year strategy for Iowa's ambient water monitoring efforts.

Background
The Ambient Water Monitoring Program seeks to provide comprehensive monitoring of Iowa's water resources, including all major types of groundwater aquifers and surface waters (lakes, streams, wetlands). The kinds of monitoring data collected include biological, chemical, and physical characteristics of waterbodies such as the concentration of phosphorus in a lake, the amount of water flowing in a stream, or the composition of aquatic plants in a wetland. Ambient monitoring focuses on measuring background water quality conditions across broad geographic areas, unlike other monitoring that often targets specific local needs (like swimming advisories). For example, the ambient fixed-monthly stream monitoring program monitors a wide range of water quality parameters monthly at 60 sites across Iowa's major landform regions.

Goals
Iowa DNR managers and technical staff will use the new strategy to guide decisions affecting the ambient monitoring program over the next five years. The strategy should also serve as a robust informational resource for stakeholders, policy makers, legislators and the public.

Method
The DNR developed the monitoring strategy with input from a diverse group of stakeholders, including representatives from the academic and research communities, private industry, conservation and environmental organizations, water utilities, and local, state and federal government agencies. In five listening sessions, DNR staff and external stakeholders responded to a series of questions relating to current uses of water monitoring data and information, additional needs for monitoring products and services, and suggestions to improve the ambient monitoring program to better serve their needs. Following the input from stakeholders and technical experts, an experienced team of DNR water resource professionals completed a comprehensive review of the ambient monitoring program, which included a detailed listing of the program's strengths and weaknesses as well as recommendations for improvement.

Results
While no single aspect of the ambient monitoring program stood out as being in most need of improvement, the group did identify opportunities to improve the program's effectiveness in several categories: monitoring objectives, sampling design, data management, products and services, and program evaluation and coordination. In all, the strategy team identified 153 specific recommendations. Using a systematic process, the strategy team rated both the anticipated positive impact of each recommendation and the difficulty of implementation in regards to cost, staffing, and technical complexity. Additional challenges, such as forming partnerships and coordinating work with other entities, were also considered.

Moving Forward
Based on the impact and difficulty ratings, the plan includes three implementation tiers for putting the strategy into action. The first tier contains 48 high-impact improvements that can be made with existing funding and staffing resources. Most first-tier recommendations consist of work that can be completed in-house, such as developing sampling plans, managing and analyzing data, preparing reports and improving program coordination. The second and third tiers contain several recommendations that call for expanding the program

to address gaps in monitoring coverage. Full implementation of these recommendations, however, would require substantial increases in funding and staffing resources as outlined in the strategy.

Acronyms and Abbreviations

ALU	Aquatic Life Use
BMIBI	Benthic Macroinvertebrate Index of Biotic Integrity
BMP	Best Management Practice
CBI	Coldwater Benthic Index
CW	Cold Water
CWA	(Federal) Clean Water Act
DNR	Iowa Department of Natural Resources
ELIS	Enterprise Laboratory Information System
ELISA	Enzyme Linked Immunosorbent Assay
EQuISTM	Environmental Quality Information System (EarthSoft, Inc.)
FIBI	Fish Index of Biotic Integrity
GIS	Geographic Information System
HUC	Hydrologic Unit Code
IDPH	Iowa Department of Public Health
IFTMP	Iowa Fish Tissue Monitoring Program
IGS	Iowa Geological Survey
ILIS	Iowa Lake Information System
IR	Integrated Report (combining reporting requirements of CWA Sections 303(d), 305(b), and 314)
ISULL	Iowa State University Limnology Laboratory
IT	Information Technology
NAWQA	National Water-Quality Assessment Program
NPDES	National Pollutant Discharge Elimination System
NRS	Nutrient Reduction Strategy
POCIS	Polar Organic Chemical Integrative Sampler
QAPP	Quality Assurance Project Plan
QMP	Quality Management Plan
SHL	State Hygienic Laboratory of Iowa
SOP	Standard Operating Procedure
SPOL	Significant Publically Owned Lake
STORET	Storage and Retrieval Data Warehouse
TALU	Tiered Aquatic Life Uses
TMDL	Total Maximum Daily Load
UAA	Use Attainability Analysis
UMRR-LTRM	Upper Mississippi River Restoration - Long Term Resource Monitoring
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WLA	Wasteload Allocation
WQ	Water Quality
WQI	Water Quality Index
WQMAS	Water Quality Monitoring and Assessment Section
WQS	Water Quality Standards
WQX	Water Quality Exchange
WW	Warm Water

Table of Contents

List of Tables and Figures

Tables

Figures

Executive Summary

Introduction

Iowa is endowed with abundant groundwater and surface water resources that provide for the state's domestic, ecological, industrial, and recreational water needs. The value of these resources is unquestionably immense and worthy of protection by all Iowans. Under Chapter 455.172 of the Iowa Code, the primary governmental authority for management and protection of Iowa's water resources is delegated to the Iowa Department of Natural Resources (DNR).

The DNR Ambient Water Monitoring Program strives to develop and deliver consistent, unbiased information about the condition of Iowa's surface and groundwater resources so that decisions regarding the development, management, and protection of these resources may be improved. Monitoring of status and trends in biological, chemical, and physical characteristics of Iowa's water resources is the program's main objective. The program is funded by an annual appropriation of $2.9 million from the State of Iowa Environment First Fund and is administered by the DNR Water Quality Monitoring and Assessment Section.

This report describes a strategy to improve the effectiveness of the Ambient Water Monitoring Program over the next five years. The document can also serve as an informational resource for anyone who would like to learn more about what is being done to monitor the condition of Iowa's water resources.

The ambient monitoring program currently includes the following ongoing projects:

- fish tissue monitoring in lakes and streams;
- groundwater monitoring;
- lake and reservoir water quality monitoring;
- stream aquatic life and physical habitat monitoring;
- stream water quality and flow/stage monitoring; and
- wetland aquatic life and water quality monitoring.

Descriptions of the individual monitoring projects can be found in the main body of this report.

The DNR also conducts 'targeted' water monitoring projects that support various water quality program functions and objectives including: swimming beach advisory development; nonpoint source pollution control planning and evaluation; Total Maximum Daily Load (TMDL) development; lake restoration planning and evaluation; wastewater discharge permitting; and water quality standards development.

These types of monitoring projects require tailored approaches that are beyond the scope of the ambient monitoring program; therefore, the strategy does not include recommendations for improving the effectiveness of targeted monitoring. The strategy team did, however, obtain substantial input from DNR staff and external stakeholders regarding their specific needs for monitoring data and information. This input was utilized in developing recommendations that, when implemented, will improve the ambient monitoring program's ability to deliver products and services that better meet stakeholder needs.
Strategy Development Process

The strategy was developed by an experienced team within the DNR and reflects input from program managers and technical staff as well as numerous outside experts and stakeholders. The development process included the following steps:

- Engage DNR staff and external stakeholders to learn about their uses and unmet needs for monitoring data and information;
- Evaluate existing programs to identify monitoring strengths, weaknesses, and improvement alternatives;

- Engage experts in the field of water monitoring to learn about new approaches and technologies for improving monitoring effectiveness; and
- Rank and prioritize improvement alternatives taking into consideration how best to use current funding and staffing resources as well as potential uses for new resources.

The strategy team held five stakeholder listening sessions. Input was received from 34 individuals representing a cross-section of DNR programs and outside organizations that use water monitoring data in their work. The stakeholders were asked to respond to a series of questions relating to their use of monitoring data and unmet needs for additional data and information. A total of 132 response items were received, categorized, and considered by the team in their evaluation of the current program and development of monitoring improvement alternatives.

The strategy team also met with a technical advisory group of water scientists and monitoring experts representing academic, governmental, and private organizations. The advisory group considered the stakeholder input, provided feedback on the design of the current program, and offered advice to improve it.

After completing the stakeholder and technical advisory meetings, the strategy team completed a detailed evaluation of monitoring program strengths and weaknesses patterned after the "Elements of a Monitoring Program" (2003) guidance developed by the U.S. Environmental Protection Agency. From the evaluation, the strategy team identified 153 recommendations addressing gaps and deficiencies in the program.

Members of the strategy team rated each recommendation for its potential impact (i.e., benefit) to the program and the difficulty of implementing the recommendation on the basis of cost, staffing, and technical complexity. The anticipated timeline required to fully implement each recommendation was also estimated. Using a conceptual matrix for ranking the relative levels of impact and difficulty ratings, the team prioritized the recommendations and developed an implementation strategy.

Program Evaluation

The program review pointed out several general strengths and weaknesses listed below. A detailed accounting of the strengths and weaknesses within the individual monitoring projects is provided in the main body of the report.

Strengths:

- Ambient monitoring is conducted in all major types of water resources (i.e., groundwater, lakes, streams, and wetlands);
- A strong emphasis is placed on status and trends monitoring and reporting. Most of the data are sufficient in quality and quantity to be used in preparing the biennial Integrated Report required by the Federal Clean Water Act (CWA). The report includes assessments of the support status of waterbody-specific designated uses as required by CWA Section 305(b) and, in accordance with CWA Section 303(d), a listing of impaired waters that do not fully support designated uses;
- Data and summarized information produced by the Ambient Water Monitoring Program are used extensively by many DNR programs and outside stakeholders including: academic institutions, government agencies, non-profit and private organizations, and the public.

Weaknesses:

- Gaps in monitoring coverage exist for several resource subclassifications (e.g., coldwater streams, non-recreational lakes, groundwater obtained from private wells, and border rivers);
- Data usefulness is limited by shortcomings in the monitoring design (e.g., numbers and locations of sites, sampling frequency and timing, sampling parameters, and analytical capabilities);

- Data management inefficiencies or gaps exist for some types of monitoring data (e.g., high frequency data collected using in-situ water quality sensors);
- Quality Assurance / Quality Control (QA/QC) procedures and documentation need to be strengthened;
- Shortfalls in data analysis, interpretation, and reporting prevent ambient monitoring information from being used more fully by DNR programs, outside stakeholders and the public;
- The program lacks a defined process for regular program evaluation and coordination.

Recommendations

The following overarching recommendations speak generally to the needs of the Ambient Water Monitoring Program in terms of improving its ability to achieve monitoring objectives and support stakeholder needs. Specific recommendations addressing gaps and weaknesses in the individual monitoring projects are provided within the main body of this report.

1. **Ambient monitoring objectives**: Preserve and strengthen ambient monitoring activities that support the primary objective of the ambient monitoring program, which is to report on the status and trends of Iowa's waters.

   It is not feasible for the Ambient Water Monitoring Program to meet all objectives and stakeholder needs for monitoring data and information. One of the main challenges to achieving the status and trends objective is a tendency to alter elements of the monitoring design to accommodate the needs of individual management programs, initiatives, or special requests. In some cases, changes to the design can be made without having a negative impact on ambient objectives. However, when the monitoring design is shifted too far toward serving a specific need, the ambient program's ability to achieve the status and trends objective will be weakened.

2. **Data management**: Continue efforts to improve the capacity to enter, verify, store, and retrieve data efficiently. More effective management of the diverse types of data collected by the program will increase the ability of DNR staff and outside stakeholders to access data and convert it into useful information.

3. **Data analysis, interpretation, and reporting**: Allocate more staff time for data analysis and interpretation for the specific purpose of developing informational products and services that are useful to monitoring stakeholders and the public.

4. **Stakeholder input**: Regularly engage monitoring stakeholders to better understand their evolving data and information needs and to explore opportunities for monitoring collaboration. Meetings with monitoring stakeholders that were held as part of the strategy development process began a dialogue that can serve as a springboard for future communication and potential collaboration.

   Stakeholder input included 29 items that relate directly to the mission and objectives of the Ambient Water Monitoring Program. The items fall in several categories: data analysis/interpretation; emerging contaminants/issues; monitoring coordination; monitoring locations; monitoring parameters; and nutrients. The DNR strategy development team considered all of the input in developing recommendations to improve monitoring effectiveness and better enable the program to respond to stakeholder needs.

5. **Strategy updates**: Review and update the ambient monitoring strategy every five years. Require that each monitoring project coordinator prepare a five-year work plan to address the strategy recommendations. Each plan should be reviewed and updated annually. Maintain a current list of priorities for monitoring improvements to be implemented should additional funding or staffing

resources become available. These actions will ensure that the program is regularly evaluated, priorities are kept up-to-date, and the program is able to adapt to short- or long-term changes in the availability of funding and staffing resources.

Prioritization of Specific Recommendations

Based upon the input received from stakeholders and technical experts, along with the results of the internal program review, the strategy team developed a master list of 153 monitoring improvement recommendations. In keeping with guidance from the U.S. Environmental Protection Agency, the recommendations address all aspects of a comprehensive ambient monitoring program, including: 1) monitoring objectives; 2) sampling design; 3) data management; 4) data analysis and interpretation; 5) products and services; and (6) program coordination and evaluation.

A systematic approach was taken to prioritize the recommendations. The recommendations were evaluated individually and rated for the anticipated impact (i.e., benefit) to the program and the difficulty of implementing the recommendation. The impact and difficulty ratings were then ranked from highest to lowest in each category and the rankings were used to establish first, second, and third tiers for implementation planning.

First Tier

The first implementation tier includes 48 recommendations that received ratings of high potential impact and low-to-moderately low implementation difficulty (i.e., Quadrant 1 of the Impact/Difficulty Plot; see Figure 12 in Strategy Recommendations and Implementation). It is expected that these recommendations can be fully implemented within the 2016-2021 strategy period assuming that funding and staffing resources remain at current levels.

Because funding levels have remained constant for more than 10 years, it is important that the first tier recommendations can be put into effect without requiring additional resources. The implementation of certain recommendations might require some redirection of resources within the ambient program; however, it should not require a commitment of additional resources.

Most of the first tier recommendations involve work to be completed in-house by DNR technical staff. This includes tasks such as developing sampling plans, managing and analyzing data, preparing reports, and increasing the amount of program coordination and evaluation. A full listing of the first tier recommendations is provided in the “Strategy Recommendations and Implementation” section of the report. Several examples are provided below.

Examples:

Monitoring objectives:

- Evaluate monitoring objectives and align monitoring design pieces to fit the objectives.

Sampling Design:

- Modify existing sampling designs by:
  - expanding the sampling season for fish tissue monitoring;
  - conducting annual or bi-annual sampling at stream biological trend monitoring sites.
- Develop new sampling designs, plans, or procedures for:
  - addressing inadequacies in the list of monitoring parameters;
  - collecting and assessing in-situ continuous monitoring data for lake and stream water quality parameters;
  - repeating probabilistic (statistical) stream surveys every 5 to 10 years;

- choosing wetland monitoring sites in regions of the state where the GIS-based random selection process is not effective.

Data Management:

- Complete the upload of 2014 ambient groundwater data and future data sets into EQuIS. Assess the best methods for making historical groundwater records available both to internal DNR staff and the public.
- Develop a "How-to" guide that walks new and inexperienced users through the web retrieval of data.
- Create a user group to provide feedback on the usability of the data retrieval functions and provide suggestions on how to make retrieval more understandable to users outside of the DNR.
- Use EQuIS database functions more fully to enhance quality assurance; for example, graphing the data as it comes into the system to show outliers and other suspect data points.

Products and Services:

- Annually update the fish tissue monitoring fact sheet and make it more easily accessible from the website.
- Continue issuing regular groundwater monitoring reports.
- Develop lake monitoring reports for public distribution on a regular basis (e.g., biennially).
- Prepare summaries of ambient stream water quality monitoring data for the entire state, individual monitoring sites, river basins (e.g., HUC8 basins), or ecoregions.
- Continue to post reports on the DNR wetland monitoring website, and also utilize current and past project partners to disseminate reports for greater visibility and public awareness of wetland health.
- Program Coordination & Evaluation:
- Periodically review the ambient monitoring strategy and receive continual feedback from internal (DNR) and external stakeholders.
- Develop a technical advisory team within the DNR to address department-wide goals, needs, and priorities for lake management, monitoring and assessment, and restoration.
- Implement the new Iowa Wetland Program Plan statewide in cooperation with wetland monitoring partners and resource managers.

Second Tier

The second implementation tier consists of 28 recommendations that received ratings of high potential impact and moderate-to-moderately high implementation difficulty. These recommendations can only be implemented if accompanied by a moderate increase in funding and staffing resources. Many of the recommendations involve advanced, time-consuming technical work such as statistical data analysis or computer programming. Several recommendations would require additional funding to support new sample collection and analysis work.

Examples:

Sampling Design:

- Identify groundwater monitoring areas and questions for which greater statistical representation is necessary and increase the numbers of samples collected to appropriate levels.
- Periodically sample for algal toxins and emerging contaminants to allow for long-term trend analysis and to prepare for anticipated USEPA guidance and standards for algal toxins in Class A (recreational use) waters.
- Increase the number of river fish tissue trend monitoring sites by approximately fifteen to cover all the major rivers in Iowa.

Data Management:

- Refine the fish tissue database to allow easier access and use of the data. Investigate the possibility of entering Iowa's ambient fish tissue data into a national database (e.g., STORET, WQX) so that it can be included in regional and national studies of tissue contaminant levels.
- Continue to build data reporting capabilities within the EQuIS database. For example, graphs of data can be updated automatically as new data are added. This particular feature would assist staff with quality assurance work and generating monitoring reports for stakeholders and the public.

Products and Services:

- Complete annual assessments of water quality trends in concentrations and loads to align with the Nutrient Reduction Strategy. Examine other water quality influences such as stream flow, seasonality, land use, management actions, policies, and regulations on a less frequent basis (e.g., approximately five years) as these things tend to change more slowly.
- Continue to expand and improve monitoring-related internet applications. For example, a re-designed version of ADBNet (in-progress) will be more user-friendly, especially regarding interactive mapping features. The development of ambient stream water quality data summarization capabilities like those offered by the BioNet (stream bioassessment) application would be a step in the right direction.

Third Tier

The third implementation tier contains 22 recommendations that were given ratings of high potential impact and moderately high-to-high difficulty. These recommendations can only be implemented with a substantial increase in monitoring resources. Implementing the recommendations might require specialized skills that are not widely available (e.g., for the development of an online database), or it could involve increases in sampling frequency, monitoring parameters, or site coverage.

<u>*Examples:*</u>

Sampling Design:

- Add fixed monitoring stations in coldwater streams and small warmwater streams representing all of Iowa's designated use classifications and ecological regions. This monitoring data would allow DNR to better understand, assess, and protect water quality conditions in largely un-monitored stream types.
- Extend monitoring to multiple locations within many lakes on a rotational basis. This will provide data needed to understand how the arms of impoundment lakes may function differently than in the main basin where monitoring usually occurs.
- Designate sentinel stream monitoring stations and use them to implement monitoring enhancements, such as expanding the list of monitoring parameters to include pesticides and pharmaceuticals or increasing sampling frequency to improve pollutant load estimation.
- Increase the inventory of wells for future groundwater sampling efforts by working with small community water supplies including state parks, county conservation areas, industrial users, and private well users.

Products and Services:

- Create a new online lake information system capable of providing stakeholders and the public with access to monitoring data and interpreted water quality information for individual lakes and the monitoring network as a whole.
- Develop and implement wetland water quality standards.

- Create a web-based interactive map providing access to fish tissue contaminant monitoring data and consumption advisory information. Further expand access to the data/information by developing an application for smartphones.

Resources Needed to Implement Recommendations

Rough estimates of funding and staffing resources needed to fully implement the recommendations within each implementation tier are provided below for initial planning purposes. More precise cost information will need to be gathered before decisions about the feasibility of any particular recommendation can be made. The cost and staffing estimates are not cumulative; they only represent resource needs to implement the recommendations in a given tier. It is anticipated that funding requirements for completing the list of first tier recommendations can be met by adjusting current funding allocations; therefore, no additional funding will be necessary. Additional funding would be required to implement the second and third tiers of recommendations.

Estimated additional resources needed to implement ambient water monitoring strategy recommendations within the 2016-2021 strategy period.

Implementation Tier (*)	Total # of Recommendations	Additional Annual External Costs	Additional Annual Internal Staffing (FTE**)
First (1)	48	no additional resources needed (assumes current resource allocations remain the same)	
Second (2a)	28	$433,160 - $848,683	1.3 - 2.7
Third (2b)	22	$959,622 - $2,099,458	1.7 - 2.8

*Tier number refers to the quadrant in the Impact/difficulty matrix plot (see Figure 12; "Strategy Recommendations and Implementation.")
**FTE, Full-Time Equivalent

New sample collection and laboratory analysis work represents the largest component of the projected external costs. Other costs might include things like equipment purchases or contracted information technology services. As the table shows, projected external costs increase significantly as implementation efforts move from the first tier to the second and third tiers. For example, just 37 percent of the first tier recommendations include external costs compared with 54 and 95 percent of the second and third tiers, respectively.

As with funding, it is anticipated that staffing requirements for the first tier recommendations can be met by adjusting current staffing allocations within the Water Quality Monitoring and Assessment Section of the DNR; therefore, no additional staffing-related costs are anticipated at this level. Full implementation of the second and third tiers recommendations, however, would require management approval and new funding to add staff at the estimated levels on top of existing levels.

Additional Considerations

Three specific monitoring considerations were raised at the onset of the ambient monitoring strategy development project: 1) impaired waters; 2) nutrient reduction strategy; and 3) rotational basin monitoring. Based on the results of the comprehensive program review, the following recommendations speak to the ability of the ambient monitoring program to effectively address these monitoring issues.

Impaired Waters

Iowa's list of impaired waters, required under Section 303(d) of the Federal Clean Water Act, includes several hundred waterbodies and impairments of many types. Designing and executing a program that would comprehensively monitor the status of impaired waters and provide data for the development of watershed improvement plans or Total Maximum Daily Loads (TMDLs) is beyond the scope of the Ambient Water Monitoring Program.

The ambient program will continue pursuing ways to improve the data and information available to support the impaired waters program. However, any significant redirection of ambient monitoring resources into impaired waters monitoring would hinder the ambient program’s ability to achieve its primary objective of status and trends monitoring, and therefore is not recommended.

Nutrient Reduction Strategy
The ambient monitoring program is currently developing nutrient load calculations in support of Iowa’s Nutrient Reduction Strategy. The strategy team is also evaluating ways to improve the quality and quantity of nutrient data available for load calculation purposes. It is anticipated that some monitoring improvements can be made without jeopardizing the ambient program’s ability to achieve its objectives.

The ambient program is not designed to monitor nutrient loads in small watersheds (e.g., HUC12 scale) where reductions are first likely to be observed following the implementation of nutrient management practices and technologies. Any significant redirection of currently-available ambient monitoring resources into monitoring of implementation effectiveness in small watersheds would severely hinder the ambient program’s ability to achieve its objectives, and therefore is not recommended.

Rotational Basin Monitoring
Many states have adopted a rotational drainage basin or watershed monitoring design to provide more comprehensive monitoring coverage and improve monitoring support for water management and regulatory programs. Many states have established a five-year rotation in which all medium-to-large basins are monitored within one cycle. There are various designs, however, the monitoring site network often includes some combination of fixed trend sites, probabilistic (random) sites, and targeted sites focused on specific concerns or management needs within the basin.

Implementation of a statewide rotational basin monitoring design would require a significant redirection of existing ambient monitoring resources or a substantial investment of new resources. Lacking sufficient funding and a clear expression of support for rotational basin monitoring from DNR programs (e.g., Fisheries, Lake Restoration, Nonpoint Source/319, TMDL, and Wastewater Permitting) and other stakeholders, the implementation of a rotational basin monitoring design is not recommended at this time.

Introduction

Water Resources of Iowa

Iowa is endowed with abundant groundwater and surface water resources providing for the state's various domestic, ecological, industrial, and recreational water needs (Table 1). Water occurring within a basin or watercourse is considered "public water and public wealth of the people of the state" (Iowa Code, 455B.262.3). "Basin" means "a specific subsurface water-bearing reservoir having reasonably ascertainable boundaries." "Watercourse" means "any lake, river, creek, ditch, or other body of water or channel having definite banks and bed with visible evidence of the flow or occurrence of water, except lakes or ponds without outlet to which only one landowner is riparian" (Iowa Code, 455B.171).

Current rules and regulations governing water rights and allocation in Iowa are founded in the landmark Water Conservation Act of 1957[1] also known as the "Iowa Water Rights Law." This act established a water regulatory framework that preserves the public interest in beneficial water uses through the establishment of a permit system for water allocation among regulated uses. Prior to its enactment, water use in Iowa was governed mostly by principles of "riparian" water doctrine that is commonly applied in eastern states rather than the "prior allocation" doctrine of western states (Hines 1967). In simple terms, the riparian doctrine holds that water rights are conferred to the riparian landowner adjacent to a watercourse, while the prior appropriation doctrine confers water rights according to the "first in time, first in right" principle (Ausnus 1978).

The primary authority for water management and protection in Iowa is delegated to the Iowa Department of Natural Resources under Chapter 455.172 of the Iowa Code. Subsection 455B.262(3), which establishes that public water is "…subject to use in accordance with this chapter, and the control and development and use of water for all beneficial purposes is vested in the state, which shall take measures to ensure the conservation and protection of the water resources of the state. These measures shall include the protection of specific surface and groundwater resources as necessary to ensure long-term availability in terms of quantity and quality to preserve the public health and welfare."

Additional background information about Iowa's water law and planning efforts can be found at the DNR web page: http://www.iowadnr.gov/Environmental-Protection/Water-Quality/Iowa-Water-Plan.

Recent reports include:
"Water Planning Law and Government" (DNR, Riessen 2008)
"Comprehensive Water Planning in Iowa: Past Efforts" (DNR, Riessen 2009)
"Iowa's Water Planning History" (DNR, Riessen 2009)
"Water Rights and Allocation" (DNR, Hoyer 2010)

Table 1. Summary of Iowa Water Resources (updated, December 2015)

INFORMATION	SIZE/NUMBER	SOURCE OF INFORMATION
State Population	3,107,126	U.S. Census Bureau, 2014 Census
State Surface Area	56,273 square miles	Total land area is 55,857 square miles; water area is 416 square miles (0.7%); U.S. Census Bureau, Geography: State Area Measurements, 2010
Precipitation, Evapotranspiration, and Stream Discharge		

[1] Iowa Acts, 57 G.A., Ch. 229. (1957)

Table 1. Summary of Iowa Water Resources (updated, December 2015)

INFORMATION	SIZE/NUMBER	SOURCE OF INFORMATION
Average Annual Precipitation (1873-2014)	32.49 inches	Harry Hillaker, State Climatologist, Iowa Department of Agriculture and Land Stewardship
Average Annual Precipitation (1981-2010) (most recent 30-year summary period)	35.27 inches	
Average Evapotranspiration	approx. 26 inches	Harry Hillaker, State Climatologist, Iowa Department of Agriculture and Land Stewardship
Average Stream Discharge (1901-2014)	7.01 inches	U.S. Geological Survey WaterWatch web page at http://waterwatch.usgs.gov. "Table of computed runoff by water-year for Iowa"
Average Stream Discharge (1981-2010)	9.83 inches	
Rivers and Streams	**21.4 % Iowa Population Served with Drinking Water***	
Total Miles of Rivers and Streams	92,852 miles	DNR/GIS Lidar Flood Plain Mapping Project, 2015
Perennial Streams	27,950 miles	U.S. Geological Survey 1:100,000 DLG Hydrography Data Map (published July 1993)
Intermittent Streams	64,902 miles	Difference of perennial miles and total miles (above)
Miles of "Meandered Sovereign Rivers"	1,461 miles	Lower reaches of 17 Iowa rivers (IAC:571 Chapter 13)
Miles of Border Rivers	660 miles	Border rivers are the Mississippi R. (315 miles), Des Moines R. (31 miles), Big Sioux R. (136 miles), and Missouri R. (178 miles); estimated from DNR GIS stream coverage.
Lakes, Reservoirs, and Wetlands	**4.1% Iowa Population Served with Drinking Water***	
Total Acres of "Standing Water" Wetlands	286,385 acres	Permanently flooded, intermittently exposed, and semi-permanently flooded lacustrine and palustrine wetlands; DNR/GIS National Wetland Inventory of Iowa (2002), Polygon Features
Lakes, Reservoirs, and Wetlands having deep water (limnetic) habitat	767 (137,484 acres)	Max depth exceeding 2 meters during dry season excluding 10 artificially flooded water treatment lagoons; DNR/GIS National Wetland Inventory (NWI) coverage
Lakes and Wetlands Designated for Beneficial Uses in Iowa's Water Quality Standards	661	DNR Surface Water Classification. IAC 567(61) rule-referenced document. June 17, 2015
Significant Public Lakes	138 (46,623 acres)	DNR/NRGIS coverage of significant publicly-owned lakes digitized from 2002 color infrared photography. Last updated 5/15/2007.
Federal Flood Control Reservoirs	4 (34,894 acres)	Coralville, Red Rock, Rathbun, and Saylorville reservoirs operated by U.S. Army Corps of Engineers. Source: DNR / NRGIS Library, federal reservoir coverage. Reservoir area determined from 2002 color infrared photography. Last updated 12/20/2006
Number of "Meandered Sovereign Lakes"	67 lakes	Natural lakes of glacial & riverine origin (IAC:571 Chapter 13)

Table 1. Summary of Iowa Water Resources (updated, December 2015)

INFORMATION	SIZE/NUMBER	SOURCE OF INFORMATION
Ponds	138,571 (122,390 acres)	All "Pond" wetland types including artificially flooded water treatment basins and lagoons; DNR/GIS DNR/GIS National Wetland Inventory of Iowa, Polygon Features
Groundwater*	**Storage (ac.ft.)***	**74.7% Iowa Population Served with Drinking Water ***
Total All Aquifer	>100,000,000	74.7%
Alluvial Aquifers	~25,000,000	22.9%
Drift Aquifers & Pennsylvania	~10,000,000	12.5%
Dakota Aquifer	~3,000,000	6.1%
Mississippian Aquifer	~25,000,000	3.8%
Silurian-Devonian Aquifer	~55,000,000	15.4%
Cambro-Ordovician Aquifer	~15,000,000	14.0%

*2000 Iowa Water Monitoring Plan

Water Quality Standards

In accordance with the Federal Clean Water Act (CWA), individual states are responsible for setting water quality standards to define and protect beneficial uses of waters under their jurisdiction. The Iowa Code (455B) and Chapter 567:61 "Water Quality Standards" of the Iowa Administrative Code (IAC) establish water quality goals for all waters of the state. Waters of the state are defined in Iowa Code 445B.171(36) as the following: "Any stream, lake, pond, marsh, watercourse, waterway, well, spring, reservoir, aquifer, irrigation system, drainage system, and any other body or accumulation of water, surface or underground, natural or artificial, public or private, which are contained within, flow through or border upon the state or any portion thereof."

Iowa's Water Quality Standards include three components: (1) designated uses, (2) criteria, and (3) anti-degradation policy.

Three main types of designated uses are recognized:

- Class A - Water Recreation (i.e., swimming, wading)
- Class B - Aquatic Life and Fishing
- Class C - Drinking Water

Additional subclassifications are defined within the Class A and Class B uses. A fourth designated use, Class HH - Human Health, is applied selectively to waterbodies for which human consumption of aquatic organisms (e.g., fish and turtles) is an expected use.

In addition to these specific designated uses, Iowa's Water Quality Standards also recognize general uses that apply to all waters of the state including designated use waters and general use waters. General use waters are defined as intermittent watercourses and those watercourses which typically flow only for short periods of time following precipitation and whose channels are normally above the water table. These waters do not support a viable aquatic community during low flow and do not maintain pooled conditions during periods of no flow. General uses are protected by narrative water quality standards for livestock and wildlife watering, aquatic life, non-contact recreation, crop irrigation, and industrial, agricultural, domestic and other incidental water withdrawal uses.

Water quality criteria are expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular designated use (40 CFR Part 131)2. Iowa's Water Quality Standards include numeric criteria for conventional water quality parameters such as pH and dissolved oxygen, toxins such as ammonia and copper, and also narrative criteria statements that provide assurance that waters will be "free from" substances that produce aesthetically objectionable or noxious conditions.

Iowa's anti-degradation policy and implementation procedures provide for maintenance and protection of existing surface water uses and the level of water quality necessary to protect the existing uses. Iowa's anti-degradation framework is outlined in the Water Quality Standards and implementation procedures are published in a rule referenced document available at http://www.iowadnr.gov/Environmental-Protection/Water-Quality/Water-Quality-Standards. The anti-degradation framework identifies four-tiers of protection ranging from a basic level afforded to all waters of the state to increased levels of protection in specific waters to which certain human activities or wastewater discharges that may negatively impact water quality are restricted or prohibited.

Monitoring Overview

Iowa DNR Monitoring

Categorizing the many types of water monitoring activities conducted by the DNR is difficult; however, for the purpose of developing this strategy, two broad categories are distinguished: ambient monitoring and targeted monitoring. As an adjective, the word "ambient" means surrounding or encompassing. From the perspective of a state environmental agency, the main objective of ambient monitoring is to report on status and trends in water quality characteristics across broad geographic scales and resource classifications (e.g., regional groundwater aquifers and statewide lakes and reservoirs). In contrast, targeted monitoring activities usually focus on narrower objectives that address a specific event, issue or program need (e.g., tracking of Hazardous Algal Blooms [HABs] or evaluating the effectiveness of nonpoint source pollution control Best Management Practices [BMPs]).

Ambient Monitoring

The ambient water monitoring program is implemented by the Water Quality Monitoring and Assessment Section (WQMAS) within the Water Quality Bureau of the DNR Environmental Services Division. Staff are housed in the DNR Central Office in Des Moines. The ambient monitoring program receives an annual appropriation of $2,995,000 from the State of Iowa's Environment First Fund. This appropriation has remained constant for more than ten years. Inflationary increases in monitoring program costs have effectively resulted in a budget reduction over time.

Supplemental funding from Section 106 of the Federal Clean Water Act (CWA) also has been utilized to support certain types of ambient monitoring. Funding from other CWA programs (e.g., Section 319 and TMDL) that are used to support program-specific needs (i.e., targeted monitoring) are not included in the ambient monitoring budget.

Ambient monitoring funds pay for contracted field and analytical services, monitoring equipment and supplies, and the salary and benefits of DNR staff members. Currently, there are nine DNR staff working full-time or part-time in the ambient monitoring program.

The ambient monitoring program is currently engaged in contractual agreements with the University of Iowa's State Hygienic Laboratory (SHL) and the Iowa State University Limnology Laboratory (ISULL) for field and laboratory analytical services. The program also funds a cooperative agreement with the Iowa District of the U.S. Geological Service (USGS) for water flow gauging and continuous in-situ (sensor) water quality monitoring.

[2]Code of the Federal Register (CFR), Title 40, Part 131 – Water Quality Standards

The DNR ambient water monitoring program currently includes monitoring of groundwater and surface-water resources. Table 2 shows the major categories and subcategories of groundwater and surface-water resources that are monitored and those that currently are not.

The Ambient Water Monitoring Program includes the following ongoing projects:
- Fish and turtle tissue monitoring in lakes and streams;
- Groundwater quality monitoring;
- Lake water quality monitoring;
- Stream biological assemblage and physical habitat monitoring;
- Stream flow and stage monitoring (cooperative agreement with U.S. Geological Survey);
- Stream water quality monitoring; and
- Wetland biological and water quality monitoring.

Additional details about the types of activities encompassed by the ambient monitoring program are found in Table 3 and also in the individual project descriptions provided in the program evaluation section of this report.

Table 2. Water resource categories and subcategories included in Iowa's Ambient Water Monitoring Program.

Category	Subcategory	Monitored	Not Monitored
Groundwater	Major Aquifers	X	
	Minor Aquifers (e.g., Manson)		X
	Shallow Groundwater		X
Lakes / Reservoirs	Artificial Lakes	X	
	Flood Control Reservoirs	X	
	Natural Lakes	X	
	Private Lakes, Ponds, Stormwater Basins		X
Rivers / Streams	Perennial Flowing or Pooled Wadeable Streams	X	
	Non-wadeable Interior Rivers	X	
	Ephemeral or Intermittent Streams		X
	Border Rivers		X
Wetlands	Prairie Potholes	X	
	Riverine Wetlands	X	
	Farmed Wetlands		X

Table 3. Summary of active, recent, or planned DNR ambient water monitoring activities: 2000-2015.

Resource	Project Name	Subcategory / Strata	Project Status	Site Selection	# Sites (total)	# Sites / Yr	Monitoring Duration	Sample Collection Frequency	Sample Type	Parameter Type*	Parameter Group
Groundwater Aquifers	Ambient Groundwater Quality	Non Vulnerable Aquifers	Active	Non-Random	50	10	Rotation (5yr)	Annual (late fall)	Water	ME, PE, RAD, WQL	Core
		Vulnerable Aquifers	Active	Non-Random	50	50	Perennial	Annual (late fall)	Water	ME, PE, WQL	Core
		Dakota/Cretaceous Aquifer	Planned	Non-Random	40	40	One time	Annual (late fall)	Water	PHA	Supplemental
Lakes / Reservoirs	Ambient Lake Water Quality	Significant Publically Owned Lakes & other lakes of interest	Active	Non-Random	138	138	Perennial	3 / season (late spring-early fall)	Aquatic Community	PHY,ZO	Core
									Water	AP,WQF, WQL	Core
Rivers / Streams	Ambient Stream Biological	Headwater Streams (WW)	Active	Non-Random	116	28	Unspecified	1 / Index Period	Aquatic Community	BM, FS	Core
									Habitat	AH, RH	Core
									Water	AP, FL, WQF, WQL	Core
										ME, PE	Supplemental
		Wadeable Perennial Streams (CW)	Active	Non-Random	16	4	Rotation (4yr)	1 / Index Period	Aquatic Community	BM, FS	Core
									Habitat	AH. RH	Core
									Water	AP, FL, WQF, WQL	Core
										ME, PE	Supplemental
								Continuous (July-Sept)	Water	WQF (temp)	Core
		Wadeable Perennial Streams (WW)	Active	Non-Random	100	25	Rotation (4yr)	1 / Index Period	Aquatic Community	BM, FS	Core
									Habitat	AH. RH	Core
									Water	AP, FL, WQF, WQL	Core
										ME, PE	Supplemental
	Ambient Stream Water Quality	Medium-Large Interior Streams (Including Big River Sites)	Active	Non-Random	55	55	Perennial	Monthly	Water	AP, FL, MI, WQF, WQL	Core
							Unspecified	Monthly	Water	PHA	Supplemental
							Unspecified	Quarterly	Water	PS	Supplemental
						43	Unspecified	1/ Index Period	Aquatic Community	BM, PHY	Supplemental
						1	Unspecified	Continuous (month)	Water	WQF	Supplemental
	REMAP Probabilistic Survey	Perennial Streams / Ecoregions	Recent	Probabilistic (Random)	225	45	Rotation (5yr)	1 / Index Period	Aquatic Community	BM, FS	Core
									Fish Tissue	ME, PE	Core
									Habitat	AH, RH	Core

Table 3. Summary of active, recent, or planned DNR ambient water monitoring activities: 2000-2015.

Resource	Project Name	Subcategory / Strata	Project Status	Site Selection	# Sites (total)	# Sites / Yr	Monitoring Duration	Sample Collection Frequency	Sample Type	Parameter Type*	Parameter Group
									Sediment	ME, PE	Core
								2-3 / Index Period	Water	AP, FL, ME, MI, PE, WQF, WQL	Core
								Continuous (week)	Water	WQF	Core
	USGS-DNR Cooperative	Interior Rivers / Streams	Active	Non-Random	26	26	Perennial	Continuous	Water	FL, ST	Core
Tissue- Fish / Turtle	Tissue Contaminants	Non-Wadeable Rivers	Active	Non-Random	10	10	Every other year	Annual	Tissue (Fish)	HG, PE, SOC	Core
		Lakes	Active	Non-Random	Unspeci fied	15	Variable	Annual	Tissue (Fish / Turtle)	HG, PE, SOC	Core
		Rivers/Streams Statewide	Active	Non-Random	Unspeci fied	15	Variable	Annual	Tissue (Fish / Turtle)	HG, PE, SOC	Core
		Lakes	Recent	Probabilistic (Random)	24	24	One time	Annual	Tissue (Fish)	HG, PE, SOC	Core
		River/Streams Statewide	Recent	Probabilistic (Random)	15	15	One time	Annual	Tissue (Fish)	HG, PE, SOC	Core
Wetlands	Ambient Wetland Monitoring	Prairie Pothole Wetlands	Recent	Probabilistic (Random)	30	257	Variable	1 / Season (May-Sept)	Aquatic Community	BM, FS, MA	Core
									Habitat	AH	Core
									Water	WQF, WQL	Core
		Riverine Wetlands	Recent	Probabilistic (Random)	30	85	One time	1 / Season (May-Sept)	Aquatic Community	BM, FS, MA	Core
									Habitat	AH	Core
									Water	WQF, WQL	Core
		Fens	Recent	Probabilistic (Random)	30	31	One time	1 / Season (May-Sept)	Habitat	MA, ST, RH	Core
		Prairie Pothole, Riverine & Fen Wetlands	Active	Non-Random	30	10	Rotation (3yr)	3 / Season (May-Sept)	Aquatic Community	BM, FS, MA	Core
									Habitat	AH, RH	Core
									Water	PE, WQF, WQL	Core

*Parameter Type: AP-Algal Pigments, AH-Aquatic Habitat, AT-Algal Toxins, BM-Benthic Macroinvertebrate Assemblage, FL-Flow (Discharge), FS-Fish Assemblage, HG-Mercury, MA-Macrophyte Assemblage, ME-Metals, MU-Mussel Assemblage, PE-Pesticides, PHA-Pharmaceuticals, PHY-Phytoplankton Assemblage, RAD-Radionuclides, RH-Riparian Habitat, SOC-Synthetic Organic Compounds, ST-Stage (water elevation), WQF-Water Quality Field (analytes), WQL-Water Quality Laboratory (analytes), ZO-Zooplankton Assemblage.

Ambient Water Monitoring Objectives
Ambient water monitoring projects are designed to serve federal and state needs and requirements. The Federal Clean Water Act (CWA) includes several monitoring and assessment requirements, including: (1) reporting on the support status of designated uses under Section 305(b); (2) listing of impaired waters and identification of causes and sources of impairment under Section 303(d); (3) issuing wastewater permits under Section 402 and the National Pollutant Discharge Elimination System; (4) reviewing, modifying, and adopting water quality standards under Section 303(c); and (5) evaluating Section 319 watershed project effectiveness in reducing impacts to Iowa's waters from nonpoint source pollution.

Guidance issued by the U.S. Environmental Protection Agency (USEPA 2003) calls for state and tribal monitoring programs to obtain data that will support the following CWA program objectives:

a. Establishing, reviewing, and revising water quality standards (Section 303(c));
b. Determining water quality standards attainment (Section 305(b));
c. Identifying impaired waters (Section 303(d));
d. Identifying causes and sources of water quality impairments (Sections 303(d) and 305(b));
e. Supporting the implementation of water management programs (Sections 303, 314, 319, 402, etc.); and
f. Supporting the evaluation of program effectiveness (Sections 303, 305, 402, 314, 319, etc.).

As an outgrowth of meeting the objectives, the State's monitoring program should be able to answer the following CWA-related monitoring questions:

1. What is the overall quality of waters in the State?
2. To what extent is water quality changing over time?
3. What are the problem areas and areas needing protection?
4. What level of protection is needed?
5. How effective are clean water projects and programs?

Table 4. Federal Clean Water Act (CWA) monitoring objectives and questions supported by the DNR Ambient Water Monitoring Program.

Monitoring Category	Objectives	Questions
Fish and Turtle Tissue	a,b,c,	1,2,3
Groundwater		1,2,3,4,5
Lakes and Reservoirs	a,b,c,d,e,f	1,2,3,4,5
Rivers and Streams	a,b,c,d,e,f	1,2,3,4,5
Wetlands	b,c,d	1,3,4,5

Iowa's Ambient Water Monitoring Program serves multiple purposes encompassing both CWA and state objectives (Table 4; Table 5). Status and trends monitoring was ranked as the most important objective by DNR ambient monitoring project coordinators. Providing the public with advisory-related information is not specifically identified among the CWA objectives, but it is an important one recognized by the DNR. Monitoring projects such as swimming beach monitoring and fish/turtle tissue contaminant monitoring have the specific objective of informing the public about the risk of exposure to environmental conditions or contaminants that could be hazardous to human health. The ambient monitoring program also addresses other specific state needs such as providing data to calculate nutrient (N & P) loads at the HUC8 watershed scale in support of the state nutrient reduction strategy.

Table 5. Ambient water monitoring objectives identified by the monitoring project coordinators.

Resource Category / Monitoring Project	Objective Type	Description
Fish and Turtle Tissue	Status and Trends	CWA 305(b)/303(d) designated use assessment
	Public Information	Consumption advisory development
	Water Quality Standards	Toxic criteria development
Groundwater	Status and Trends	Aquifer characterization and trends reporting
	Issue/Problem Assessment	Occurrence of emerging contaminants
Lakes and Reservoirs	Status and Trends	CWA 305(b)/303(d) designated use assessment
	Program Implementation / Effectiveness Evaluation	Restoration prioritization
	Water quality standards	Nutrient criteria
Rivers and Streams (biological)	Status and Trends	CWA 305(b)/303(d) designated use assessment
	Water Quality Standards	Biological criteria and nutrient criteria development
	Public Information	Characterization of stream biological health; distributional ranges and occurrences of benthic macroinvertebrates and fish species
Rivers and Streams (2002-2006 probabilistic survey)	Status and Trends	CWA 305(b)/303(d) designated use assessment; statistical data characteristics of fish tissue, physical habitat, sediment, and water quality parameters; frequency of exceedance in water quality standards criteria or other levels of concern
Rivers and Streams (water quality)	Status and Trends	CWA 305(b)/303(d) designated use assessment; long-term trends in water quality parameters
	Issue/Problem Assessment	Nutrient (N & P) load calculation at the HUC8 watershed scale
	Public Information	Reporting on water quality conditions using the Iowa Water Quality Index
Rivers and Streams (water discharge and stage monitoring)	Status and Trends; Public Information	Continuous monitoring of flow and water quality parameters reported on-line in real time.
Wetlands	Status and Trends	Biological and water quality characteristics of aquatic communities that represent Iowa wetlands; CWA 305(b)/303(d) designated use assessment

Targeted Monitoring

In collaboration with other DNR water programs and outside entities, the WQMAS also has conducted monitoring to address more specifically targeted objectives, including:

- Monitoring of pathogen indicator bacteria and nuisance algal blooms at public beaches;
- Water quality monitoring upstream and downstream of urban areas;

- Monitoring of shallow lakes in support of lake restoration projects;
- Water quality monitoring in small watersheds in support of water quality improvement goals;
- Stream biological monitoring to determine stream-specific status of aquatic life uses; and
- Fish tissue contaminant levels in specific lakes or streams to support consumption advisory decisions

In addition to these projects the WQMAS also supports the IOWATER citizen water quality monitoring program, which involves the sampling of chemical and physical parameters in lakes and streams. IOWATER monitoring is customized to address local interests and concerns.

Monitoring Conducted by Other Organizations
Listed below are several examples of programs currently monitoring Iowa's waters and border rivers. The list is not meant to serve as a comprehensive listing of all monitoring efforts taking place in Iowa. The following programs vary widely in their objectives and geographic coverage.

- U.S. Geological Survey (e.g., NAWQA and UMRR-LTRM)
- U.S. Army Corps of Engineers flood control reservoir projects (e.g., Des Moines River Monitoring Network and Iowa River Monitoring Network)
- Watershed coalitions and management authorities (e.g., Northeast Iowa Research and Conservation Development and Rathbun Watershed Project)
- Municipal and regional water suppliers (e.g., Cedar Rapids Water Department and Des Moines Water Works)
- Surrounding states (e.g., Illinois Environmental Protection Agency and South Dakota Department of Environment and Natural Resources)
- Agribusiness (e.g., Syngenta and Iowa Soybean Association)
- Iowa Institute of Hydraulic Research (IIHR)

Every two years the DNR requests monitoring data from outside organizations for use in preparing the biennial CWA Integrated Report. This is one of the main ways that DNR becomes aware of other water quality monitoring programs that are conducted within or bordering Iowa. The strategy team used its knowledge of these programs in evaluating ambient program strengths and weaknesses and developing monitoring improvement recommendations. As an outgrowth of the 2013 Nutrient Reduction Strategy, the State's Water Resources Coordinating Council is compiling information on all water monitoring activities occurring in Iowa and DNR is assisting with this effort. In stakeholder listening sessions held by the DNR ambient water monitoring strategy development team, several stakeholders expressed a desire for the ability to access information about all monitoring programs conducted in the state, not just the monitoring conducted by the DNR.

Strategy Development

Background
In accordance with federal and state requirements, the Iowa Department of Natural Resources (DNR) is responsible for planning and implementing an ambient water monitoring program. Ambient water monitoring is the ongoing process of measuring and assessing the biological, chemical, and physical characteristics of groundwater and surface water. The goal of DNR's ambient monitoring program is to provide consistent, unbiased information about the condition of Iowa's water resources so that decisions regarding the development, management, and protection of these resources may be improved.

In 2000, the DNR prepared a comprehensive water monitoring plan in response to increased public concern about water quality and recognition of the need for better information on the condition of Iowa's water resources. The 2000 plan outlined data collection needs for groundwater, streams, lakes, and wetlands, as well as precipitation and swimming beaches. It also addressed data management and interpretation, monitoring coordination, public information and citizen monitoring. The projected budget to implement the 2000 plan was estimated at $6,539,000 annually, of which approximately 76% ($4,964,000) was anticipated to be funded by the State. The monitoring plan resulted in increased State funding for monitoring, which allowed the ambient water monitoring program to expand and implement several of the plan's recommendations. The State funding allocation for ambient monitoring has remained constant at $2,995,000 since 2001.

Between 2002 and 2005, staff of the DNR and Region VII of the U.S. Environmental Protection Agency completed a review of the ambient monitoring program and developed a long-term strategic plan for achieving a comprehensive monitoring program with respect to meeting CWA monitoring and reporting requirements. This work is described in the document titled "Strategy to Address Monitoring Gaps, Strengths and Weaknesses" (DNR and USEPA-R7, 2006).

The 2006 "Strategy to Address Monitoring Gaps, Strengths and Weaknesses" noted that the State appropriation, while significantly larger than that of many states, was not adequate to cover the monitoring needs identified in the 2000 plan.

The 2006 strategy counted the following accomplishments since the 2000 plan was enacted:

- Successful development of a volunteer monitoring program;
- Beach monitoring;
- Successful implementation of STORET and ArcIMS data retrieval;
- Annual conference and fact sheets;
- Comprehensive monitoring of Iowa's significant publicly owned lakes; and
- Expanded monitoring of Iowa's streams.

The 2006 strategy identified the following program gaps:

- Comprehensive coverage of wetlands;
- Comprehensive coverage of large "border" rivers;
- Non-significant public and private lakes;
- Intermittent streams and first order perennial streams;
- Precipitation / air deposition;
- Stream and lake gaging data & stations;
- Biological indicators and reference conditions for assessing lake health;
- Sediment data for stream bed, bank erosion, lake deposition of sediments, and suspended sediment concentrations in Iowa's waterbodies;
- Targeted TMDL monitoring; and
- Special studies or research (e.g., sediment oxygen demand, nutrients in tile flow, instream nutrient cycling, and bacterial source tracking).

The 2006 Strategy also identified the following program weaknesses and opportunities for improvement:

- Program infrastructure for program evaluation, reporting and coordination;
- Validation and refinement of wadeable stream biological indices and reference conditions;
- Characterization of reference conditions (especially, chemical, biological and habitat) for all water body types, but particularly non-wadeable rivers, small (headwater) perennial streams, and cold water streams;
- Data management;
- Parameter coverage;
- Monitoring of city and county owned beaches; and
- Adding historical biological record to assessments.

Goals and Objectives

The goal of this strategy is to provide direction for the ambient water monitoring program to better enable the program to fulfill its stated mission: “to develop and deliver consistent, unbiased information about the condition of Iowa’s surface and groundwater resources so that decisions regarding the development, management, and protection of these resources may be improved.”

The goal can be achieved by accomplishing the following objectives:

- Establish an experienced team of DNR technical and managerial staff to lead and develop the strategy;
- Engage DNR and external stakeholders to learn about their monitoring data and information needs;
- Evaluate the existing program and identify improvement needs;
- Engage external monitoring experts to learn about new approaches and technologies that may improve monitoring effectiveness;
- Prioritize monitoring improvement alternatives reflecting current availability of monitoring resources; and
- Identify improvement priorities to be implemented should additional resources become available in the future.

This strategy will clarify and prioritize work needed to improve the effectiveness and efficiency of DNR’s ambient water monitoring program. The program encompasses a wide range of monitoring activities and objectives as described in this report. In addition to DNR’s monitoring projects, a substantial range of monitoring activities is conducted by other organizations and citizen volunteers. As such, this strategy also addresses ways to more fully develop monitoring partnerships that can lead to more effective monitoring of the state’s water resources. As recommended in the USEPA (2003) monitoring program guidance, this strategy strives to be comprehensive with respect to addressing all of Iowa’s water resources and the elements of an effective monitoring program including an implementation plan not exceeding ten years in duration.

Stakeholder and Expert Input

Iowa DNR and External Stakeholders

The ambient water monitoring strategy team held a series of five stakeholder listening sessions between January and April, 2015. The meetings were intentionally held prior to the DNR completing its internal review of the program so that stakeholder and expert input would be available to inform the strategy development process. Three sessions were held with DNR staff and two sessions with external stakeholders. Stakeholders were asked to respond to a series of questions relating to their uses of water monitoring data and information and ways to improve the products and services provided by the DNR ambient monitoring program.

<u>Questions asked of water monitoring stakeholders:</u>

- What monitoring data or summarized information do you use and how do you use it?
- How/where do you access monitoring data/information?
- What other types of data, information, or services would be useful?
- Do you have any suggestions to improve monitoring effectiveness?
- What questions would you like the DNR monitoring program to answer?
- How can we best present monitoring data to the public?

Representatives from 20 DNR programs and 42 external organizations were invited to participate in the sessions (Appendix 1). External stakeholders representing the following interests were contacted: academic/research, agribusiness, environmental/conservation, governmental, legislative, municipal/water utility, and professional association. Thirty-three individuals (nineteen DNR staff and fourteen external stakeholders) representing a broad cross-section of interests and uses of monitoring products and services participated in the sessions. Detailed notes were taken from which a list of 132 response items was compiled (Appendix 1). The monitoring strategy team reviewed the input and sorted the items into three categories: (1) applicable to the ambient monitoring strategy; (2) not-applicable to the strategy but meriting additional consideration by the WQMAS or other DNR programs; and (3) not applicable to the strategy and not requiring further action.

Table 6. Stakeholder input items identified as most applicable to the Ambient Water Monitoring Program.

Ctgy.*	Topic	What other types of data, information, or services would be useful in your work?
MP	Arsenic data	Arsenic sampling data
MC	Data availability	Information about what data are available
MC	Data availability	Internal information resources listed on DNR monitoring website or revised database informing people where to find WQ data/information
MP	Dissolved metals data	Dissolved metals data
MP	Lake habitat assessment	Qualitative habitat data/assessment for Iowa lakes (analogous to Ohio EPA stream QHEI)
ML	Lake sampling design	Additional lake sampling points and seasons
N	Nutrient loads	Better data for nutrient load estimation; monthly not good enough; more data to calculate mass loads and bioavailable phosphorus
N	Nutrient monitoring	Real-time sensors for nutrient parameters throughout the state
N	Nutrient trends	Trends in nutrient loads
MC	Sampling metadata	Information to evaluate outside data: quality, source, and methods used

Table 6. Stakeholder input items identified as most applicable to the Ambient Water Monitoring Program.

Ctgy.*	Topic	What other types of data, information, or services would be useful in your work?
ML	Small watershed data	More data from small watersheds (e.g., HUC12, WQI watersheds)
MP	Stream flow data	Better flow data: non-gaged streams; storm hydrographs
		What questions would you like monitoring to answer?
ML	Border river data	What data are available on border waters?
EI	Emerging contaminants	What is the status of emerging contaminants?
EI	Emerging contaminants	Has any monitoring of emerging contaminants been done?
MC	Monitoring coordination / gaps	How is the monitoring system integrated and are there gaps?
N	Nutrient loads	How much N & P are leaving the state?
DA&I	Water quality status	What is the water quality of the entire state at a HUC8 watershed scale?
		Do you have any other suggestions for improving monitoring
MP	Biological monitoring	Continue biological monitoring; the data connect with the public (e.g., status of fish)
MC	Monitoring duplication	Potential overlap in monitoring programs should be examined
DA&I	Public information	Data interpretation needs to be more helpful in informing the general public about water quality
EI	River cyanotoxin monitoring	Cyanotoxin monitoring is needed in rivers, not just lakes/beaches
ML	Rotating basin monitoring	Develop a rotating basin monitoring system that could provide an assessment of water quality conditions at the basin level at least every ten years
DA&I	Water quality trends	Important to continue monitoring the best quality aquatic resources for long-term trend purposes
DA&I	Water quality trends	Show trends in water quality
MP	Well nitrate monitoring	Need monitoring of nitrate levels in wells where detectable levels were not historically seen
		Other Comments / Concerns
EI	Cyanotoxins health risk	DNR needs to get out ahead of the risk of cyanotoxins to water supplies in Iowa
EI	Emerging contaminants	Future water quality issues include pharmaceuticals and personal care products in groundwater
MC	Monitoring coordination	Importance of DNR being able to show how their monitoring program connects to other programs

***Ctgy** (Category): **DA&I**: Data Analysis & Interpretation; **EI:** Emerging Issues; **MC**: Monitoring Coordination; **ML**: Monitoring Locations; **MP**: Monitoring Parameters; **N**: Nutrients.

The strategy team identified 29 items as being most applicable to the development of the ambient water monitoring strategy (Table 6). The items fall within the several general categories: data analysis and interpretation (4 items); emerging issues (5); monitoring coordination (6); monitoring locations (4); monitoring parameters (6); and nutrients (4). These input items were considered by the strategy development team in developing recommendations for improving ambient monitoring and better positioning the program to respond to stakeholder needs.

Technical Experts

The ambient monitoring strategy development team also held a meeting with a group of technical experts in the field of water quality monitoring. The meeting agenda and notes are provided in Appendix 1. The technical experts were given a brief overview of the DNR ambient water monitoring program and the opportunity to ask questions about the program. The group was then provided a list of the questions that were posed to DNR and external stakeholders and a summary of their responses. The technical experts were asked to share their thoughts about the responses. After reviewing the stakeholder input, a discussion was held in which the strategy team received advice and suggestions on ways to improve the effectiveness of the ambient monitoring program. Among several of the experts, there was an acknowledgement that the discussion and exchange of information was useful and it might be beneficial to continue meeting periodically.

Key discussion points and expert feedback:

- Interstate waters: Monitoring and assessment (e.g., 303(d) listings) of interstate waters such as the Missouri River is important. Further discussion about interstate coordination of monitoring efforts would be beneficial.

- Upstream and downstream monitoring of urban areas: This type of monitoring recently conducted by DNR is targeted monitoring, not ambient monitoring. Requirements for this type of monitoring could be placed into NPDES (wastewater) permits.

- Monitoring program goals: The most important issue is to identify the questions that DNR would like monitoring to answer. The questions to be answered need to be listed and prioritized; then the DNR needs to determine what type of monitoring data and monitoring frequencies are needed to answer these questions.

- Identifying trends: It was questioned whether the DNR ambient monitoring program collects samples with enough frequency to provide sufficient data to evaluate for water quality trends. For example, Iowa lakes are monitored three times per summer and streams and rivers are monitored monthly. Weekly monitoring in the summer and including event sampling in addition to monthly monitoring in winter might be more appropriate.

- Identifying improvements: Catchment (local) scale is better for evaluating whether water quality is improving; scaling monitoring down to the local level where implementation takes place is needed. Group discussion explored the issue of watershed scale and ability to detect trends. Monitoring at the local scale is very important for evaluating BMP effectiveness.

- Difficulty of identifying trends: Comments from several stakeholders relate to the question of whether or not water quality is improving over time. It was not clear to the expert group whether the DNR had recently analyzed ambient monitoring program data for trends. Group discussion continued with a focus on the difficulty of observing trends in monitoring data.

- Communicating status of water quality: DNR might consider designing monitoring to compare the percent impairment across river basins (e.g., Raccoon River). This approach, however, does not specifically identify where impairments occur and might not be particularly useful for public communication.

- Monitoring designs and scales: Probabilistic design is better suited for characterizing water quality on a larger scale; however, the smaller, catchment scale may be better for identifying water quality trends.

- Issue of scale in evaluating BMP effectiveness and identifying water quality improvements: It is questionable whether Best Management Practice (BMP) effectiveness monitoring could also answer the question of whether water quality is improving. A trend monitoring approach is needed; however, ambient monitoring is usually conducted at the wrong scale to address BMP effectiveness. The public wants to know whether BMP implementation is working. It was suggested that either the number of acres with BMPs or water quality monitoring data can be used to determine trends.

- Flow variability and trend detection: Flow variability is a complicating factor in trend monitoring; pre-project monitoring is needed to show improvement. A USGS 10-year study in Texas that included pre-project monitoring and nested locations in the watershed was effective and might serve as a useful model.

- Emerging contaminants: New techniques such as passive sampling technology (e.g., POCIS) are useful for monitoring emerging contaminants.

- Sensor-based monitoring: The use of in-situ sensors for continuous monitoring of water quality parameters continues to grow. There have been some problems caused by biological-fouling; a four-week maintenance schedule was needed at one long-term monitoring site to keep the sensor producing useful data. The procedure of mounting/affixing of the sensor is very important to prevent theft or loss of the sensor.

Ambient Monitoring Program Evaluation

Ambient monitoring project coordinators and other experienced staff of the DNR Water Quality Bureau completed an evaluation of ambient monitoring program strengths and weaknesses. Besides using their own knowledge and experience, the evaluators also considered stakeholder input (Appendix 1) as well as input received from the technical advisory group (Appendix 1). From these meetings, the DNR strategy development team was able to learn how stakeholders access and use monitoring products and services, become aware of unmet needs, and receive outside expert perspective on technical issues.

The approach to the strengths and weaknesses evaluation was organized around the framework presented in the the U.S. Environmental Protection Agency's "Elements of a Water Monitoring Program" guidance document (see Appendix 2 for element descriptions).

Elements of a Water Monitoring Program (USEPA 2003):

A. Monitoring Program Strategy
B. Monitoring Objectives
C. Monitoring Design
D. Core and Supplemental Water Quality Indicators
E. Quality Assurance
F. Data Management
G. Data Analysis/Assessment
H. Reporting
I. Programmatic Evaluation
J. General Support and Infrastructure Planning

For evaluation purposes, a program strength was defined as any element of the monitoring system that is entirely adequate with respect to meeting program objectives. A weakness was defined as a deficiency or gap in the program. Weaknesses might consist of elements that are missing entirely or other elements that are represented in the program at some level; however, improvements need to be made before program objectives can be fully achieved. A weakness can also represent an impending threat to a given monitoring element. For example, the anticipated end of a monitoring partnership that has provided staffing for data entry can be described as a potential weakness affecting the data management element.

The program evaluators were also asked to include recommendations to improve on monitoring weaknesses or preserve strengths. Improvement recommendations might include taking advantage of emerging opportunities that might arise from new technologies or monitoring resources that might become available within the next five years. For example, a recent advancement in sensor technology might provide an opportunity to monitor a water quality parameter more frequently and economically than is currently possible.

Below are descriptions of monitoring activities, strengths, weaknesses and improvement recommendations for the following ambient monitoring projects: (1) Fish Tissue, (2) Groundwater, (3) Lakes and Reservoirs, (4) Rivers and Streams (Biological), (5) Rivers and Streams (Water Quality), and (6) Wetlands.

Fish Tissue Monitoring

Description

Status and trends reporting is considered to be the most important objective of the Iowa Fish Tissue Monitoring Program (IFTMP) followed by providing information to the public concerning human health risks and issuance of consumption advisories.

The IFTMP conducts trend monitoring at ten fixed monitoring locations on large interior rivers (Figure 1). Each site is monitored in every other year. The program also conducts fish and turtle tissue monitoring annually at about 15 stream and 15 lakes that are determined in cooperation with the DNR Fisheries Bureau. The sites are located throughout the state to provide a broad geographic coverage of waterbodies from which the public could be expected to harvest fish and/or turtles for consumption. In 2006, the IFTMP participated in a probabilistic (random) monitoring project coordinated by Region VII, USEPA. The project involved a one-time sampling of 24 lakes and 15 streams across Iowa.

The core monitoring indicators consist of mercury, PCBs (Alachlors), legacy (banned) organo-chlorine insecticides (e.g., Chlordane, DDT, and Dieldrin) and their degradation metabolites. Sampling results are reported electronically to the DNR by the State Hygienic Laboratory (SHL), the current analytical contractor. The data are stored by the DNR in a relational database on a shared computer network drive that is not accessible to the public.

DNR maintains an internet web page describing the fish tissue monitoring program, lists consumption advisories and provides links to annual reports and other relevant information. IFTMP data are used to (1) determine whether the fish consumption use is supported for purposes of the CWA Integrated Report and (2) whether consumption advisories should be issued. Updates of Iowa's fish consumption advisories are prepared annually in collaboration with the Iowa Department of Public Health (IDPH) and the DNR Fisheries Bureau.

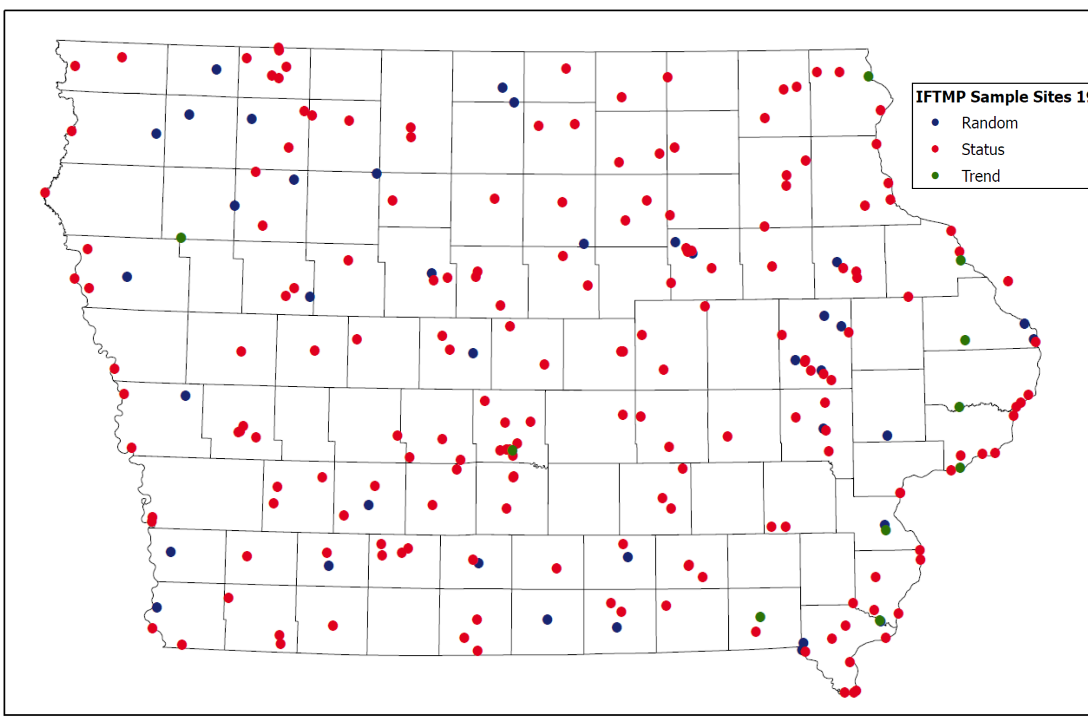

Figure 1. Locations of Iowa Fish Tissue Monitoring Program (IFTMP) sample sites, 1994-2015.

Strengths, Weaknesses, and Recommendations for Improvement

Monitoring Objectives / Questions

Strengths:

- Data collected from program status sites support the objective of assessment of fish consumption (Human Health) designated use support status under CWA Section 305(b) and Section 303(d).
- Data collected from program status sites support the objective of development of fish consumption advisories.
- Data from program trend sites support the objective of determination of trends/changes in fish contaminants over time.

Weaknesses:

- Because of limitations in the monitoring network design, the program is unable to achieve the objective of a comprehensive status assessment of the fish tissue resource to satisfy CWA Section 305(b) requirements.

Recommendations:

- Expand the consumption advisory objective to include issuance of more general (statewide) consumption advice (in progress).

Sampling Design

<u>Site Network Type (e.g., census, fixed, probabilistic, reference, rotational, etc.)</u>

Strengths:

- The current network design targets lakes and river segments with high-use recreational fisheries (status sites) and 10 long-term (fixed/trend) large river sites.
- The network design has remained more or less constant, and therefore consistent, over the approximately 35-year lifespan of the network.

Weaknesses:

- The sampling network has missed some of the Significant Publically Owned Lakes (SPOLs) and high use river segments that support important recreational fisheries. This represents a small, but significant shortfall in monitoring coverage and limits the ability to develop site-specific fish consumption advisories for all recreationally important waters as needed.
- The network design does not include a probabilistic sampling component. The lack of a probabilistic sampling component doesn't allow the program to comprehensively report on the support status of the human health fish consumption designated use in accordance with CWA Section 305(b).
- The network does not include sites located in recreational fisheries of lower significance (e.g., small streams, farm ponds, and city lakes/ponds). The lack of sampling in these waters prevents the DNR from determining contaminant levels and providing consumption advice to recreational fishers of all waters from which caught fish are consumed.
- The network does not specifically target locations frequented by subsistence fishers or locations where fish are seasonally harvested in great numbers (e.g., White Bass in the spring) by recreational fishers. The lack of this type of targeted monitoring potentially puts the health of subsistence fishers and other seasonally-high fish consumers at risk.

Recommendations:

- Continue to incorporate all of the SPOLs and high-use rivers and streams as new sites are established. This will allow the DNR to sample more Iowa waterbodies and allow the DNR to provide more complete consumption advice to recreational fishers.
- Incorporate a probabilistic design either as part of the annual monitoring effort or on a periodic basis (e.g., every 3rd or 5th year). This design would include ponds (farm/urban) in addition to the large rivers and SPOLs. This will allow the DNR to report statistically valid estimates of the attainment of fish consumption uses for the CWA Section 305(b) report.

- The IFTMP could also work with the Ambient Stream Biological Monitoring Program to sample the small streams and rivers when that program encounters game fish or larger bottom feeders. This will provide more data from an underrepresented group of waterbodies and more comprehensive consumption advice to recreational fishers.
- Devote one or two years of the IFTMP monitoring resources to the identification of potential health issues related to fish consumption by subsistence fishers. Follow-up the initial sampling by incorporating such periodic sampling into the program. This will allow the program to provide fish consumption advice to a potentially at risk population.
- Begin the IFTMP sampling season earlier (April and May) to include the collection of seasonally highly consumed fish (e.g., White Bass). This earlier start will allow the program to provide more timely fish consumption advice to a potentially at risk population.

<u>Number and/or Spatial Distribution of Sampling Locations</u>
Strengths:

- Sampling has been conducted at most high-use recreational fisheries on lakes and rivers.
- Sample sites are distributed approximately evenly across the state.

Weaknesses:

- The number of sites sampled in a year is constrained by time demands on the DNR Fisheries biologists responsible for collecting the samples. This limits the program’s ability to identify waterbodies having fish with high contaminant levels and provide that information to the general public.
- Access or other sampling issues (e.g., non-boatable waterbodies) have resulted in failure to sample some types of streams and lakes. This limits the program’s ability to detect waterbodies having fish with high contaminant levels and provide that information to the general public.
- The number of trend monitoring sites is small, not well distributed geographically, and does not include lakes.

Recommendations:

- Consider having DNR, staff other than fisheries biologists, collect samples in order to (1) increase the total number of sample sites and (2) increase the number of sites on small streams or in other locations having difficult access or other logistical sampling issues. This will increase the program’s ability to detect waterbodies with high contaminant levels and provide more complete information to the public.
- Increase the number of river trend sites by approximately fifteen to cover all the major rivers in Iowa.
- Incorporate 5-10 lake trend sites and sample them every other year opposite of the river trend sites.

<u>Sampling Frequency</u>
Strengths:

- The sampling frequency and amount is appropriate given the resources (funds and staff) available and the anticipated gradual change in levels of fish contaminants over time.
- Large river fixed trend monitoring sites are sampled every other year. Given the relatively slow changes in contaminant levels in fish and the limited resources available for monitoring, biennial trend sampling is appropriate.

Weaknesses:

- The timing of advisory-related (follow-up) sampling and availability of results (data) may be more of an issue than sample frequency. That is, follow-up data may be received too late in the year (late fall/winter) to be able to include any new consumption advisories in the DNR “Fishing Regulations” booklet (the primary means of advisory communication to the public).

Recommendations:

- Either conduct advisory-related (follow-up) sampling earlier in the year or conduct the entire program earlier in the year (e.g., sample in May and June instead of August and September).

Parameters

Strengths:

- The IFTMP includes the parameters most likely to trigger consumption advisories nationwide: mercury and PCBs.
- In addition, the IFTMP includes other parameters of interest (e.g., dieldrin, chlordane, and DDE) that either have been the causes of advisories or are likely to be the cause of future advisories.

Weaknesses:

- The IFTMP parameter list is static (fixed) and, while it includes a reasonable list of core indicators, it does not include monitoring for supplemental indicators such as emerging contaminants in fish tissue (e.g., perfluorocarbons (PFCs)) or contaminants of interest to US EPA, DNR, and other stakeholders (e.g., selenium). The lack of baseline/background data on emerging contaminants or other contaminants of interest doesn't allow comparison to any future data and doesn't allow the program to inform the general public of other potentially harmful contaminants in fish.

Recommendations:

- Provide the ability to look for contaminants of concern beyond the few parameters currently monitored. Sampling additional emerging contaminants and other contaminants of interest will provide better baseline/background data for use by the IFTMP and other programs, and will also improve the program's ability to provide more comprehensive and relevant information to the general public.

Data Management

Data Entry, Storage, Retrieval

Strengths:

- The Water Quality Monitoring and Assessment Section has a complete database (MS-Access) of IFTMP fish and turtle tissue data for Iowa.
- Data are entered into the database in a timely manner.
- The DNR has a GIS coverage of the IFTMP sample sites.

Weaknesses:

- The IFTMP database is not accessible to the public and requires knowledge of MS-Access to use. Iowa's fish tissue data are not entered into any national database; therefore, the data are not readily available to interested parties across the country for inclusion in regional or national studies.

Recommendations:

- Refine the fish tissue database to allow easier access and use of the database. Investigate the possibility of entering IFTMP fish tissue data into a national database (e.g., WQX/STORET) so that Iowa's data can be included in regional and national studies of tissue contaminant levels.

Quality Assurance / Quality Control (QA/QC)

Strengths:

- SHL runs both lab blanks and field duplicates on IFTMP samples.

Weaknesses:

- IFTMP doesn't have an approved Standard Operating Procedure (SOP) or Quality Assurance Project Plan (QAPP) covering data management for fish/turtle tissue contaminant monitoring. Data management procedures are currently addressed in the annual work plan.

Recommendations:

- Consider converting the annual work plan into an approved SOP or QAPP document.

Products and Services

Data Analysis and Interpretation

Strengths:

- Sampling data are analyzed on an annual basis for inclusion in the biennial CWA Integrated Report, the annual IFTMP report, and for issuance of consumption advisories.

- Tissue contaminant data are analyzed and interpreted in a timely manner.

Weaknesses:

- The long-term data set is only analyzed intermittently thereby hindering staff from determining if changes to IFTMP can be made that will allow the program to better utilize limited monitoring resources.
- The issuance of consumption advisories is sometimes delayed and not very well broadcast to the general public.

Recommendations:

- Analyze all IFTMP data on an annual basis. Annually analyzing the long-term data set will provide information to support program decisions and changes that will better enable the IFTMP to utilize limited monitoring resources.
- Move the responsibility of consumption advisory issuance to the Iowa Department of Public Health (IDPH). Because IDPH deals with the health of Iowans in many areas, it is logical that this agency would also assume the role of informing Iowans about the risks, or lack thereof, of eating fish caught in Iowa. When merged with other related health information delivered by IDPH, fish consumption advisory information is likely to reach and resound with more Iowans.

<u>Fact Sheets, Reports</u>

Strengths:

- Tissue contaminant data are summarized in an annual report posted on the IFTMP website.
- A fact sheet about the IFTMP was produced in 2006.

Weaknesses:

- The 2006 fact sheet is outdated and is no longer easily accessible from the IFTMP website.

Recommendations:

- Annually update the fact sheet (or produce something similar) and make it more easily accessible from the IFTMP website.

<u>Automated Reports / Internet Applications / Websites</u>

Strengths:

- The IFTMP webpage was completely updated in 2015.
- The IFTMP webpage contains the most recent consumption advisory list.

Weaknesses:

- The program does not offer an internet-based interactive map from which fish tissue contaminant monitoring data and consumption advisory information can be queried.

Recommendations:

- Create an internet-based interactive map providing access to fish tissue contaminant monitoring data and consumption advisory information. Further expand access to the data/information by developing an application for smartphones.

Program Coordination and Evaluation

<u>Monitoring Partnerships</u>

Strengths:

- The IFTMP is implemented in cooperation with the DNR Fisheries Bureau.
- The IFTMP works closely with the IDPH to develop consumption advisory criteria.

Weaknesses:

- Coordination and collaboration among the IFTMP and other agencies that conduct fish tissue contaminant monitoring in Iowa is lacking. The lack of coordination on things such as sampling parameters limits each program’s ability to utilize fish tissue contaminant data from other agencies to suit their own objectives.

Recommendations:

- Expand efforts to coordinate and build monitoring partnerships with state and federal agencies (e.g., USGS; ACOE) and with other DNR programs. Improved coordination and establishment of monitoring partnerships would provide a more consistent fish tissue contaminant data set and allow all of the partners to utilize the data for their objectives and make better use of limited monitoring resources.

Stakeholder / Technical Advisor Input

Strengths:

- (none noted)

Weaknesses:

- The IFTMP does not have a mechanism to receive input from monitoring stakeholders or technical experts. Because programs/agencies sometimes operate in an information vacuum, there is potential for counterproductive program objectives and sampling inefficiencies to exist.

Recommendations:

- Develop a stakeholder/technical advisory panel to possibly include USGS, ACOE, IDPH, DNR Fisheries, DNR Lake Restoration, DNR Air Quality, and IDALS. The panel would allow for the development of an overall fish tissue sampling strategy for Iowa and the sharing of resources and data.

Performance Review, Needs Assessment, Strategy Update

Strengths:

- None noted.

Weaknesses:

- The IFTMP does not conduct performance reviews, needs assessment or strategy updates in a formal manner. Performance reviews (needs assessments, strategy updates) should be a part of every ambient monitoring program to avoid systematic errors and to protect the integrity of the resulting data.

Recommendations:

- Develop a process to regularly review or assess the program after forming a stakeholder/technical advisory panel (see above Stakeholder / Technical Advisor Input recommendation).

Groundwater Monitoring

Description

The Ambient Groundwater Monitoring Program currently uses a network of 120 municipal water supply wells for sampling of untreated groundwater in Iowa's major aquifers. Approximately 72 vulnerable aquifer wells are monitored once-annually in late fall for nutrients and other water quality analytes including pesticides, metals, organic compounds, and microbial contaminants. A network of 48 non-vulnerable (confined) aquifer wells are being sampled once every five years for conventional water quality analytes, metals, and radionuclides. A third ambient groundwater monitoring initiative began in 2015. This project involves continuous monitoring of nitrate in springwater from Big Springs and Manchester Fish Hatcheries. These springs discharge water that has infiltrated karst/shallow bedrock areas of NE Iowa and reflect changes in land-use practices over time.

Status and trends reporting, problem assessment, and public information are the main objectives of the program. Historic ambient groundwater monitoring data are stored on an DNR server and available to the public through IASTORET. The data will be migrated to the DNR's current water quality database, EQuISTM (EarthSoft, Inc.) and are not currently available through the USEPA's WQX/STORET interface. Monitoring data from the past year were analyzed by SHL and reported in the SHL open-ELIS database and waiting to be migrated to EQuIS. These data will also be available to the public through IASTORET.

Historic groundwater monitoring-related reports and publications by the Iowa Geological Survey (IGS) (e.g., Dakota aquifer) are available through the Iowa Institute of Hydraulic Research (IIHR) where they are archived and made available to the public.

Services provided by the Ambient Groundwater Monitoring Program include maintaining a Geo database and GIS data coverages (e.g., geochemical concentration data by bedrock aquifer) available through DNR's GIS Library. A groundwater monitoring web page is currently being revised and recent presentations have been made at the annual conference of the Iowa Groundwater Association and a conference on emerging contaminants.

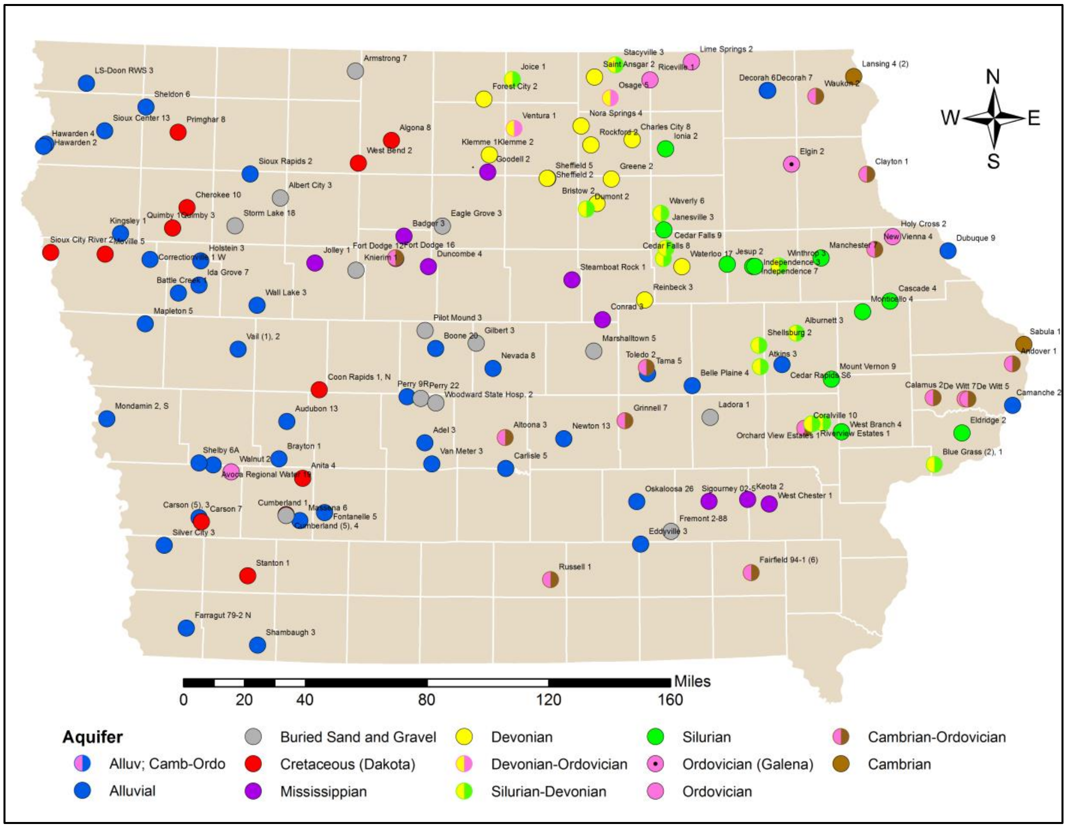

Figure 2. Ambient groundwater quality monitoring sites (2012- 2016).

Strengths, Weaknesses, and Recommendations for Improvement

Monitoring Objectives / Questions

Strengths:

- The objectives of the Ambient Groundwater Monitoring Program (below) cover a wide range of issues related to groundwater quality and encompass most questions asked of the Department.
  1. Characterize the quality of groundwater by aquifer and region.
  2. Evaluate long-term trends in groundwater quality.
  3. Assess new or emerging issues of groundwater quality concern.

Weaknesses:

- The lack of specificity in the objectives leave them open to interpretation.
- Questions of "cause-and-effect" are not specifically addressed and cannot generally be answered by an ambient program.
- Aquifers with high temporal and spatial variability, especially alluvial aquifers, are difficult to represent accurately. This data set is not helpful for addressing localized issues.

Recommendations:

- Support efforts by other, more targeted programs (e.g., IIHR, Source Water Program and others) to answer specific questions about the impacts of land-use practices and effectiveness of protection strategies on groundwater resources.

Sampling Design

Site Network Type (e.g., census, fixed, probabilistic, reference, rotational, etc.)

Strengths:

- The rotation within a fixed well network gives flexibility to focus on both natural and manmade contaminants, while ensuring that long-term variations can be documented.

Weaknesses:
- Small sample sizes reduce statistical "strength" of analyses, especially when results are subdivided by aquifer. Although the sampling network represents all major aquifers, it cannot be stated with high confidence that the results are representative of the entire population. Although probabilistic sampling could improve confidence in the ability to represent each aquifer system, detailed geologic records for all public wells are not available; therefore, the universe of available wells is greatly limited for probabilistic sampling.

Recommendations:
- Identify monitoring areas and questions for which greater statistical representation is necessary and increase the numbers of samples collected to appropriate levels.
- Consider increasing the inventory of wells for future sampling efforts by working with small community water supplies including state parks, county conservation areas, industrial users, and private well users.

<u>Number and/or Spatial Distribution of Sampling Locations</u>

Strengths:
- The monitoring network (Core Wells) represents all aquifers and all regions of the state. The dependence on cooperative municipal water supplies means that population centers are well represented.

Weaknesses:
- The current network is made up exclusively of public supply wells. Public water supply wells often are screened (open) to large sections of an aquifer or even multiple aquifers, although the focus is single-aquifer wells. Additionally, the act of pumping can alter groundwater flow directions and alter chemical conditions within the aquifer. To determine whether groundwater quality variations are the result of differences in background conditions or the result of conditions resulting from the well, samples should be drawn from wells with shorter well screens that are not routinely pumped.
- Dedicated well nests, designed to represent un-pumped, ambient groundwater quality are available but have not been maintained or sampled since 2007. In addition to being pumped at lower rates, private well water quality may also be different than public water supply quality for other reasons. For example, since drinking-water standards do not apply to private wells, private wells may not be sited or constructed to minimize contaminant inputs.

Recommendations:
- In order to more accurately assess the potential levels of exposures to all of Iowa's citizens, private well sampling should be considered. Discussions with public health department staff and others should be continued to determine whether there is a need for additional sampling of private wells, and how best to meet these needs given the available resources.
- Assess the condition of existing dedicated well nests, develop a preliminary monitoring design, and collaborate with IIHR (for water levels), USGS, state parks, county conservation staff, and other partners to develop a plan for sampling, maintenance, and construction of dedicated wells nests.

<u>Sampling Frequency/Timing</u>

Strengths:
- Sampling in late fall - early winter ensures that results are not impacted by seasonal application of pesticides or nutrients.

Weaknesses:
- Discontinuation of the Ambient Groundwater Monitoring Program from 2007 to 2011 makes trend analyses difficult. In addition, dependence on public water supplies means that communities that approach or exceed water quality standards may discontinue use of the wells, thereby biasing trend analyses.
- Furthermore, sufficient data are not available to characterize seasonal variability. Past monitoring efforts focused on summer sampling; therefore, comparison to historical records may include bias.

- The data are also insufficient for answering questions about possible acute exposures related to fast transport of anthropogenic contaminants to groundwater.
- For natural contaminants like arsenic, sulfate, or radionuclides, variability from year-to-year is seen, which may be caused by pumping, sampling, or analytical variability.

Recommendations:

- Identify contaminants for which annual monitoring is a higher priority for accurate trend analyses. Consider more frequent sampling for contaminants that may be impacted by seasonal variations in precipitation or land-use practices as well as natural contaminants with significant variability. Identify contaminants for which acute exposures are a concern and develop a plan to assess these variations.

<u>Parameters</u>

Strengths:

- Chemical contaminants including basic water quality parameters, major ions, nutrients, metals, VOC's and pesticides have been thoroughly assessed. Typical microbial indicators have also been assessed including total coliforms, E. coli, and enterococci. Iowa is one of the first states to survey for viruses and pharmaceuticals in groundwater.

Weaknesses:

- Only one round of sampling for viruses and bacterial pathogens has been conducted (2013). This study indicated that some transport of pathogens to the groundwater may occur and standard methods may not be sufficient for determining groundwater susceptibility to these contaminants.
- Monitoring for radionuclides has followed a tiered approach to analyses as required by the Safe Drinking-Water Act; however, variations in holding times makes interpretation of gross alpha radioactivity distribution difficult. Given the limited data set, it is currently not possible to answer questions such as whether or not high nitrate levels correspond to high uranium concentrations as has been seen in neighboring states.
- The USEPA's Contaminant Candidate List includes parameters that do not currently have drinking water standards, but may be assigned standards in the future once health impacts are better understood. Several contaminants on the CCL4 list that may occur in groundwater have not been assessed.
- No assessment of cyanotoxin occurrence in groundwater under the influence of surface-water has been conducted as part of the Ambient Groundwater Monitoring Program. Some cyanotoxin monitoring in water supplies under the influence of surface-water is currently underway as part of the DNR drinking water program.

Recommendations:

- As funds become available, consider conducting additional monitoring for pathogens during different hydrological conditions to allow for more confidence in characterization of the occurrence of these contaminants. Before collecting any additional radionuclide data, develop a sampling plan, refine standard laboratory procedures, and determine which contaminants on the CCL4 would be appropriate for monitoring.

Data Management

<u>Data Entry, Storage, Retrieval</u>

Strengths:

- A large quantity (over 19,000 records) of groundwater monitoring results from various program efforts dating back to 1905 are housed in the Groundwater Quality geodatabase available to the public on the NRGIS library. Most analyses have been completed by the State Hygienic Laboratory; therefore, raw data are available as needed. All analyses completed by USGS using accepted methods can be found in their publically available NWIS database.

Weaknesses:

- The geodatabase does not contain complete metadata information; therefore, assessment of holding times and other factors cannot be completed. Some, but not all past data from the Ambient

Groundwater Monitoring Program data are included in IASTORET. Efforts to upload recent data (2014/2015) to the new water quality database, EQuIS, are ongoing; however, a significant effort and additional resources would be necessary in order to upload historical records to this system with sufficient quality control. Current plans do not include pushing groundwater data to EPA STORET via WQX.

Recommendations:

- Continue sharing data via the Groundwater Quality geodatabase.
- Complete the upload of recent data and future data sets into EQuIS.
- Assess the best methods for making historical records available both to internal DNR staff and the public.

Quality Assurance / Quality Control (QA/QC)

Strengths:

- Quality control samples (duplicates and field blanks) have been collected each year that sampling has occurred by trained staff members. A Quality Assurance Project Plan (QAPP) was developed and signed in 2012 by DNR and SHL staff, and the principles of this plan were continued in 2014.

Weaknesses:

- Documentation of QA/QC from pre-2012 years has not been collated and may be difficult to find given staff turnover and reorganization. Laboratory QA/QC documentation is not readily available for review. A wide variety of methodologies and focus on emerging contaminants makes evaluation of QA data complex.

Recommendations:

- Review and update the QAPP as necessary to reflect any changes in the standard practices of the program.
- Consider developing a consistent format for reporting QA/QC results on an regular basis.
- Collate and summarize pre-2012 QA/QC data and make it available via the groundwater monitoring website for future reference.

Products and Services

Data Analysis and Interpretation

Strengths:

- Staff expertise are available to conduct sophisticated statistical analyses including assessment of correlation between common water quality parameters and emerging contaminants, as well as site and well construction characteristics.

Weaknesses:

- Analysis and presentation of historical results was done using a patchwork of software packages, some of which are no longer accessible to DNR staff.
- Data gaps make trend analyses difficult.
- Most summaries of groundwater quality by aquifer and region are no longer current and do not represent baseline data for all contaminants that have been monitored.

Recommendations:

- Develop reports regarding groundwater trends and discussion of data gaps.
- Summarize existing data for all contaminants, using very statistics, by aquifer and region and make these reports available to the public via the DNR website.

Fact Sheets, Reports

Strengths:

- Several peer-reviewed publications were developed in the early years of the ambient groundwater quality monitoring program (1980’s and 1990’s).

- Annual summaries and reports have been developed in recent years (2013 and 2014) and are available on the DNR's Groundwater Monitoring website. The annual summary is now being included in the Iowa Groundwater Association's annual publication.

Weaknesses:

- Summarization of sampling efforts was not completed on an annual basis prior to 2006.
- Trend analyses and other comparisons between years have been attempted, but rarely published.
- Previously published reports regarding individual aquifers are outdated.

Recommendations:

- Continue issuing regular reports and collaborate on peer-reviewed publications when appropriate.
- Update existing coverages.
- Develop a prioritization for additional publications by contaminant group and aquifer.
- Continue efforts to collaborate with the Iowa Geological Survey (IGS), USGS, and other groups to document changes to aquifer quality over time.

<u>Automated Reports / Internet Applications / Websites</u>

Strengths:

- The groundwater webpage was recently updated to include accurate links to reports and factsheets.

Weaknesses:

- The website may be difficult to find for users who are not familiar with DNR's organization, or are confused about DNR and IGS roles.
- No automated reports have been developed. The Hydrogeologic Atlas was meant to serve data products to users, however, it is no longer functional.

Recommendations:

- Regularly review the DNR groundwater website to ensure that web links are functional and all other information is up-to-date.
- Work with partner organizations to direct the public to this resource by posting links on their websites.
- Redesign the Hydrogeologic Atlas. Consider developing automated summary reports.

Program Coordination and Evaluation

<u>Monitoring Partnerships</u>

Strengths:

- The Ambient Groundwater Monitoring Program has good relationships with municipal well operators who voluntarily collect samples for the program.
- Program staff regularly communicate with the laboratories contracted for analytical services (i.e., SHL and USGS).
- The program has ongoing discussions with USGS, CHEEC, DNR programs (e.g., Source Water, Contaminated Sites, and Water Supply), and others to help coordinate and prioritize monitoring efforts, and to explore new methodologies.

Weaknesses:

- Contact and goodwill with some partners was lost when annual monitoring ended in 2006.
- The program is not currently taking advantage of a vast amount of "non-ambient" monitoring data and experience residing with DNR regulatory programs.

Recommendations:

- Coordinate with USGS and others to review historical data, fill data gaps, and ensure continued availability of high quality data to meet user's needs.
- Develop a plan for integrating groundwater data from Contaminated Sites, Solid Waste, and others.

Stakeholder / Technical Advisor Input

Strengths:

- A stakeholder survey was completed in early 2014 and groundwater issues were raised in several DNR-led feedback sessions.

Weaknesses:

- Stakeholder comments tend to be broad recommendations for contaminant groups of interest, or focused on issues related to fate and transport of contaminants that are beyond the scope and budget of the current Ambient Groundwater Monitoring Program.

Recommendations:

- Conduct more detailed needs assessments by scheduling meetings with individual stakeholder groups.
- Meet regularly with partner agencies to review monitoring plans and coordinate future plans to the extent that it meets the goals of this program.

Lake and Reservoir Monitoring

Description

The Ambient Lakes Monitoring Program currently monitors 138 Significant Publically Owned Lakes (SPOL) and other lakes of interest throughout the state (Figure 3). The monitoring network includes artificial (impoundment) lakes, natural lakes, and large flood control reservoirs. Two of the main objectives of the program are to provide data for status and trends reporting and to inform the public about the condition of Iowa's main recreational lakes. Ambient lake monitoring data also support DNR water quality programs including: Lake Restoration; TMDL; Watershed Improvement; and Water Quality Standards.

Each lake is sampled three times during the main recreational season between late spring and early fall. Samples are collected from the deepest part of the lake and analyzed for a suite of biological, chemical, and physical water quality parameters. Included in these parameters are Secchi disk depth, dissolved oxygen, pH, water temperature, conductivity, turbidity, nitrogen analytes, phosphorus analytes, chlorophyll-A, dissolved and suspended solids, and turbidity. A water sample is also collected and analyzed for the taxonomic composition and biomass of phytoplankton and zooplankton organisms.

Water quality analytical results and field measurements are stored in the DNR's EQuIS database and available to the public via the IASTORET and USEPA WQX internet data storage and retrieval interfaces. Other data, such as phytoplankton and zooplankton sampling results, lake depth profile data, and photographs are currently stored on the DNR shared network drive and not directly available to the public.

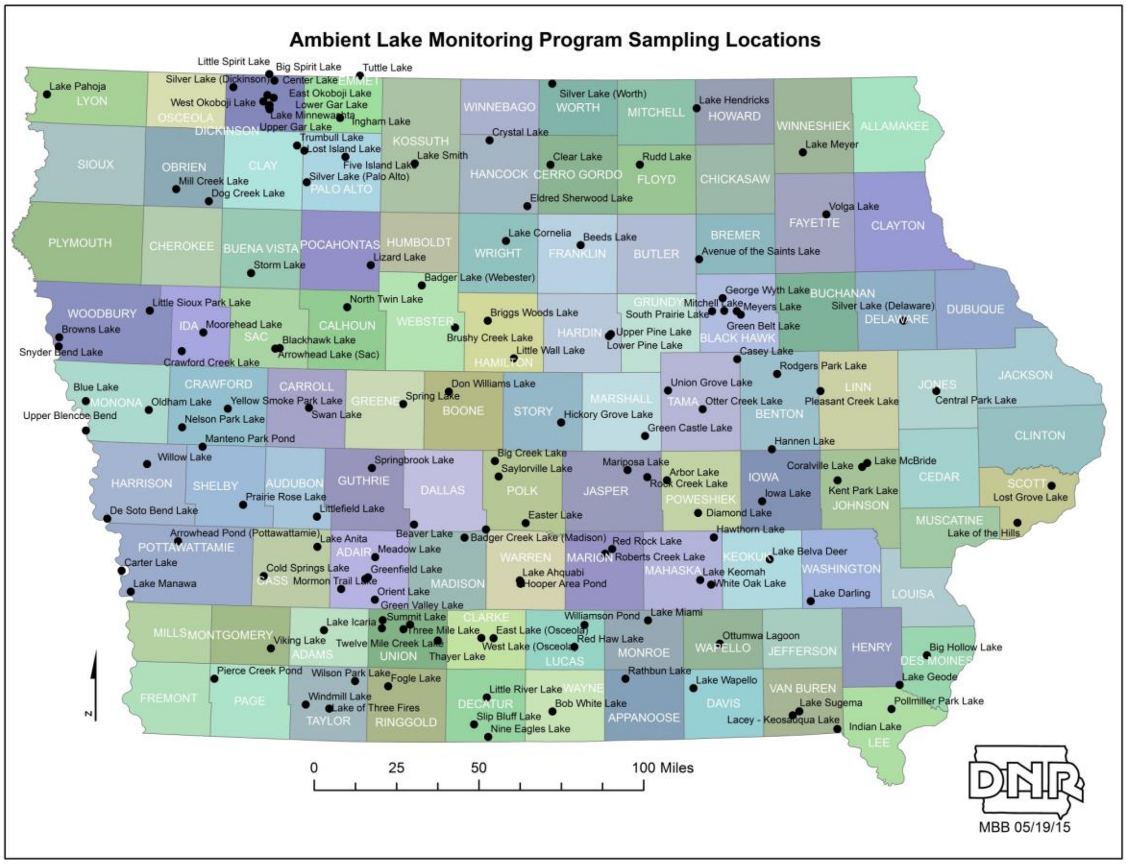

Figure 3. Sampling locations of the Ambient Lake Monitoring Program (May 2015).

One of the main products of the Ambient Lake Monitoring Program is the biennial assessment and report of lake designated uses support status as required by the Federal Clean Water Act (CWA). The assessment results for individual lakes can be viewed at the DNR's Water Quality Assessment Database (ADBnet). A fact sheet reporting format has also been used in recent years to summarize lake monitoring information and results.

Data and information about individual lakes is also available to the public from the Iowa Lakes Information System (ILIS) website. The ILIS website displays current results and summary water quality information for lakes included in the Ambient Lake Monitoring Program. The ILIS is currently housed at Iowa State University with plans to create an internet application for the DNR website.

Strengths, Weaknesses, and Recommendations for Improvement

Monitoring Objectives / Questions

Strengths:

- The objectives for the Ambient Lake Monitoring Program are consistent with CWA objectives. The program meets the following objectives well:
  - Status and trends: The fixed network monitored regularly since 2000 allows DNR to begin to show potential changes in statewide water quality, although the resolution of potential trends is expected to be low due to infrequent sample collection.
  - Section 305(b) assessments: The program provides sufficient data to complete CWA biennial water quality assessments for a large number of Iowa's lakes and reservoirs.
- The Ambient Lake Monitoring Program supports other State and Departmental objectives:
  - Provides information about lake water quality to the public;
  - Provides data to the Lake Restoration Program for restoration prioritization and documenting progress towards meeting water quality restoration goals; and
  - Supports other DNR programs in need of water quality information (e.g., NPS (319), TMDL, Wildlife, Parks, and Fisheries).

Weaknesses:

- The program is not providing the type of data and interpreted information needed to fully achieve the CWA Section 305(b) waterbody assessment objective. Specifically, the program does not provide biological data that can be used to directly evaluate aquatic life uses, nor is lake habitat quality monitored. Consequently, only indirect assessments of aquatic life uses are possible based upon chemical and physical water quality parameters (e.g., DO and pH).
- The program is not providing adequate data needed to fully achieve trend monitoring objectives. The monitoring design is capable of providing good resolution of trends at the statewide scale; however, the limited number of samples collected at each lake and the number of lakes sampled only allows for poor trend resolution at finer spatial scales of interest (e.g., individual lake, county, river basin, ecoregion or landform region).

Recommendations:

- As additional resources are made available, develop a methodology and collect aquatic community data (e.g., invertebrates and fish) and habitat data that will allow for improved CWA Section 305(b) assessments of aquatic life use support status in monitored lakes.
- Bolster the monitoring design and sampling intensity to allow for more robust status and trend analyses and improved accuracy of lake-specific use support assessments for CWA reporting purposes. For example, consider implementing higher intensity monitoring at a subset of lakes on a rotating basis.

Sampling Design

<u>Site Network Type (e.g., census, fixed, probabilistic, reference, rotational, etc.)</u>

Strengths:

- The fixed network of sites allows for status/trends monitoring and robust 305(b) assessments of Class A and Class HH designated uses.

- The monitoring network consists of Significant Publically Owned Lakes (SPOL) including all state park lakes and many county park lakes. The monitoring focus on SPOLs assures that consistent, long-term water quality data are available for a majority of the state's most highly used and valuable lakes.

Weaknesses:

- Only a fixed number (138) of lakes are monitored, thus many (non-SPOL) lakes do not have any water quality monitoring data available for them. No alternative sampling network designs have been considered within the program. For example, a rotational basin approach could be used to increase monitoring coverage over the long term, thus providing data to complete additional lake water quality assessments and provide a more comprehensive assessment of lake conditions in the state.
- Several highly used urban lakes are not currently included in the network (e.g., Ada Hayden, DMACC pond, Gray's Lake, and Blue Heron Lake). Therefore, some lakes that are heavily used by the public currently have little to no data.

Recommendations:

- Consider implementing a rotational basin monitoring network design within the Ambient Lake Monitoring Program as a means to expand monitoring coverage of lakes, particularly those that are heavily used by the public. This would allow for assessment and data for the public/stakeholders for these locations. The expanded coverage would allow for more comprehensive reporting of designated use support status under CWA Section 305(b) and would support lake management objectives such as restoration prioritization.
- As additional resources are made available, add monitoring at heavily used urban lakes to the network of monitored lakes. This would allow for assessment and data for the public/stakeholders for these locations.

<u>Number and/or Spatial Distribution of Sampling Locations</u>

Strengths:

- A high number of lakes (138) are being monitored multiple times each year.
- A consistent sampling location (usually the deep point) is monitored from year to year.
- The network of lakes monitored is spread throughout the state.

Weaknesses:

- The use of one sampling location at each lake is unlikely to represent conditions found in many of the arms of impoundment lakes, and thus provides an incomplete picture when trying to assess the whole lake, either for CWA Section 305(b) assessment or for status and trends analysis. Many of the lakes function differently in the arms than in the main basin of the lake. As a result, the lake may be inaccurately characterized or identified as impaired based on data from a single sampling location at the deepest spot in the lake.
- No sampling locations or work within the program is dedicated to sampling and assessing habitat, vegetation, or other physical characteristics of the lake. The current approach only allows for the collection of chemical and limited biological data (i.e., phytoplankton and zooplankton). As a result, the program is not able to adequately assess the status of designated aquatic life uses for each lake.

Recommendations:

- As additional resources are made available, extend monitoring to multiple locations within many lakes on a rotational basis. This will provide data needed to understand how the arms of impoundment lakes may function differently than in the main basin where monitoring usually occurs.
- Develop and implement sampling protocols that specifically target biologically productive areas of the lake (e.g., littoral zone) for the purpose of developing biological indicators for incorporation into 305(b) aquatic life use assessments.

Sampling Frequency

Strengths:

- Samples are collected consistently (usually within the same week each year for each lake) three times per summer (May – September).
- The even spacing of sampling intervals across the growing season coincides with a progression of natural events in many Iowa lakes (i.e., spring mixing in dimictic lakes, summer stratification, early fall beginning of stratification break-down in dimictic lakes). The sampling intervals often capture algae blooms at least once during the season in lakes where blooms are common.
- A study of ambient monitoring lakes completed in the mid-2000s demonstrated that the current sampling frequency and interval is sufficient for CWA Section 305(b) assessment purposes.

Weaknesses:

- Three sampling events per lake is too infrequent to quantify water quality parameters with much statistical confidence; therefore, results from the analysis of short-term patterns in lake water quality for individual lakes carries little weight. Many years of data are needed before a statistically significant trend can be detected.
- Long intervals between sampling events present the risk that relatively short-lived events of major significance (i.e. hazardous algae blooms) will be missed and can lead to an inaccurate portrayal of lake conditions.
- The data generated from three sampling events annually does not fully meet the needs of the Lake Restoration program (for prioritization and pre/post restoration analysis) and other technical stakeholders (e.g., TMDL Modelers and Fisheries Biologists).

Recommendations:

- As additional resources are made available, expand the sampling frequency (e.g., 5-7 samples each year instead of three) at a subset of lakes each year. The expanded monitoring could be implemented within a five-year basin rotation design such that once every assessment cycle each lake has more data available for preparing CWA Section 305(b) assessments. This recommendation can be combined with the recommendation for sampling more than one location per lake during the year in which the lake is sampled with greater frequency. This would help solve multiple "weaknesses" at once because more robust 305(b) assessments could be completed, and additional data would be available for other data users (e.g., Fisheries Biologists and TMDL modelers) and for better trend analyses. Additionally, the Lake Restoration Program would have better data for making decisions and evaluating project success.

Parameters

Strengths:

- The program includes a large set of lake water quality parameters that provide a good picture of what is going on (chemically) in the lake and driving factors behind algae blooms and other observed phenomena. Having an understanding of the factors that may be driving lake productivity that is supported by monitoring data is essential for assigning causes to designated use impairments and subsequent TMDL development.
- Many of the parameters are not needed for 305(b) assessments directly; however, the complete suite of parameters helps to create an overall picture of water quality both at the level of the individual lake and statewide. The information is useful for drafting reports and sharing information about lake conditions with the program's stakeholders.
- Time intensive parameters are included in the core parameter list (i.e., analyses of phytoplankton and zooplankton biomass and composition) and provided at a very cost effective rate by the current contractor.
- Most of the parameters have been collected since the program's inception in 2000 thus providing continuity and consistency for trend analysis and 305(b) assessments.

Weaknesses:

- Sampling for lake biological indicators is currently limited to phytoplankton and zooplankton taxa composition and biomass. The program does not sample other important components of lake aquatic communities (e.g., fish, macroinvertebrates, and vegetation). This limitation makes it difficult to accurately describe lake biological condition and assess support status of designated aquatic life uses for the CWA Integrated Report.
- The program does not include monitoring for algal toxins, which may become important in the near future as the USEPA works to develop water quality standards for algal toxins. The program also does not include any monitoring for emerging contaminants of concern, such as personal health care products and pesticides. The lack of monitoring for these types of parameters limits what can be said about the water quality of Iowa's lakes and the ability to evaluate for trends in emerging contaminant occurrence and magnitude.
- The program experienced some data quality issues in the early years of the program and there have been some analytical method changes over the life of the program. For example, total nitrogen was monitored through 2007 then it was replaced with total Kjeldahl nitrogen. These issues have created some limitations as far as data continuity for trend analyses.
- The program does not utilize in-situ sensors and continuous data loggers to monitor lake water quality parameters such as ammonia, chlorophyll-A, nitrate, dissolved oxygen, pH, specific conductance, temperature, and turbidity. This technology is an effective way to measure diel cycles and season-long fluctuations in water quality parameters. Continuous monitoring is becoming more common as in-situ technology improves and becomes more affordable. The program's lack of experience with deploying the technology and the lack of a framework for incorporating continuous monitoring data in lake condition assessments is preventing the program from moving forward.

Recommendations:

- Biological components – Form an interdepartmental technical advisory team to evaluate needs and identify existing sources of data (e.g., Fisheries Bureau monitoring) that could be used to address weaknesses. Develop sampling procedures and a methodology for assessing biological condition and habitat. Incorporate them in the Ambient Lake Monitoring Program over time.
- Algal toxins and emerging contaminants – Periodically sample for these parameters to allow for long-term trend analysis and to prepare for anticipated USEPA guidance and standards for algal toxins in Class A (recreational use) waters.
- Data quality/continuity issues – Continue to work with certified laboratories and rigorously implement QA/QC measures for all data received by the program. Ensure that an approved QAPP governs data collection.
- Continuous monitoring data – With the assistance of a technical advisory team, develop a framework for incorporating in-situ continuous monitoring data into lake water quality analyses and designated use assessments. The framework will help the program efficiently manage and utilize this type of data as its availability is expected to increase in the future.

Data Management

<u>Data Entry, Storage, Retrieval</u>

Strengths:

- Most of the program's data are housed in the EQuIS database and available to the public and stakeholders via the STORET online application.
- Water quality data stored in EQuIS are regularly uploaded to the USEPA's STORET national data repository.
- Data from field work are entered by the monitoring contractor thus placing less demand on DNR staff.
- DNR controls the format in which data are submitted by the contractor– making the data upload process to EQuIS very easy. The contractor also provides the data in another format which is easy to manipulate for performing statistical analysis and summarization.

Weaknesses:

- There is lag time between when data are collected and when they are available online to the public. While the DNR only has to wait about a month from when samples are collected and analyzed until the results are submitted by the contractor, the data are not uploaded to EQuIS until the end of the monitoring season after all the data has been submitted. Consequently, data from the current year are not available to the public and stakeholders in a timely manner to make decisions about lake recreational use or for other time-sensitive purposes.
- Not all information collected as a part of the program are stored in a state database, including: phytoplankton and zooplankton composition data, lake water quality depth profile data, and photos of Secchi disk submergence (water transparency) or other field conditions. As a result, there is a greater risk that this information could be lost over time.
- There is no direct connection between water quality data stored in EQuIS and the DNR's water quality assessment database (ADBnet); therefore, additional data manipulation steps and a significant amount of staff time are required to complete lake designated use status assessments.
- The database only provides access to raw monitoring data for any given lake monitoring site. Stakeholders and the public are not able to view statistically or graphically summarized monitoring information. The database's limited query capabilities make pulling data cumbersome for stakeholders and the public.
- The lack of connectivity or linkages between lake monitoring information and GIS data and spatial analysis tools makes it difficult for program personnel to build more comprehensive reports.

Recommendations:

- Find a mechanism for storing all monitoring data and related monitoring information in a database maintained by the DNR to minimize chance for data loss over time.
- Using the data from the Ambient Lake Monitoring Program, develop products for stakeholders and the public allowing them easy access to both raw data for individual lakes of interest and data for the entire state. Ideally, this functionality would be accomplished as part of the development of a new and improved Iowa Lake Information System.
- Connect GIS data and tools with the EQuIS water quality database to help program personnel and other stakeholders better integrate information from both sources for multiple purposes, including: general lake condition reporting, lake status and trends analysis, lake problem diagnosis, TMDL development, and lake restoration prioritization and effectiveness evaluation.

<u>Quality Assurance / Quality Control (QA/QC)</u>

Strengths:

- The DNR's laboratory contractor is certified by the state for most of the water quality analytes sampled in the program (i.e., all of the analytes that are included in the DNR's current certification program). The contractor has passed annual proficiency tests.
- The Quality Assurance Project Plan (QAPP) and all Standard Operating Procedure (SOPs) related to the program are reviewed annually by the DNR and the contractor and approved before work for the year begins. All training records are maintained by the contractor.
- The approved QAPP follows USEPA guidelines.
- Both the contractor and DNR perform quality control checks on the data before it is uploaded to EQuIS.
- Actions taken by the DNR concerning the approval and utilization of data submitted by the contractor follow an established SOP.
- Duplicate laboratory analyses are performed on 10% of the samples collected.
- Annual field and laboratory audits are performed to ensure the QAPP is being followed.

Weaknesses:

- The replicability of analysis results is poor (i.e., low precision) for phytoplankton biomass and composition samples according to the 2013 phytoplankton pigment pilot study. The results of the study

call into question whether it is appropriate to use phytoplankton data from the Ambient Lake Monitoring Program for Section 305(b) assessments or lake status/trend analyses.
- Occasionally, sample holding times are exceeded or equipment failures occur. Disruptions in sample collection and processing operations are discussed with and approved by the DNR prior to the contractor's deviation from the QAPP. Nevertheless, these situations can result in missing data which can negatively impact the program's ability to complete water quality analyses and CWA Section 305(b) assessments as planned.

Recommendations:
- Continue to collect information on the reliability and repeatability of particular parameters and methods currently included in the Ambient Lake Monitoring Program. The chlorophyll-A split sample study and phytoplankton methods comparison are recent examples of recent work in this area. Continuing this work will provide DNR with a better understanding of the methodological limitations and amount of sampling error associated with data used in lake status/trends analyses and for other purposes. A technical advisory team within the DNR could provide guidance in this area of the program.
- Continue to work with the monitoring contractor to improve QA/QC through the development and implementation of approved laboratory analysis methods, QAPPs, and SOPs for sampling and analysis.

Products and Services

Data Analysis and Interpretation

Strengths:
- The data are analyzed by DNR staff and used to support lake restoration prioritization, TMDL development, and other program functions.
- The data are analyzed and interpreted for the biennial CWA Integrated Report.
- Development of a water quality index will help utilize data collected for lake prioritization and allow for trends analysis. It will also provide a better, more simplified approach to communications with the public about lake water quality.

Weaknesses:
- The data have been used minimally for academic research and publication. As a result, the Ambient Lake Monitoring Program has limited visibility in the scientific community and has missed opportunities to validate the program's approaches and methods through the peer-review process.
- Overall, the level of data interpretation has been minimal in comparison to the potential to produce information that would be valuable to stakeholders and the general public.

Recommendations:
- Develop reports for public distribution on a regular basis (e.g., biennially with the 305(b) cycle).
- Form a technical advisory team within the DNR to work on data analysis, interpretation, and reporting on topics of interest to the scientific community, lake stakeholders, and the general public.

Fact Sheets, Reports

Strengths:
- Fact sheets are prepared annually to inform stakeholders and the public about lake water quality status and trends across the state.
- Reports and success stories are prepared for the Lake Restoration Program and the Section 319 Nonpoint Source Pollution Control Program. Reports have also been prepared for stakeholders and the public as needed.
- Interpreted monitoring results are reported in the biennial 305(b) report.

Weaknesses:
- Previous fact sheets have not provided detailed information about individual lakes, so they have not been as useful to some of the public and stakeholders who seek this type of information.

- Previous reports have not provided a complete picture of lake condition because they have lacked information about lake ecosystem components other than water quality (e.g., fish, habitat, macroinvertebrates, and vegetation).
- After 2016, the Iowa Lake Information System (ILIS) will not be supported by the monitoring contractor. ILIS is one of the main ways that stakeholders and the public access monitoring results and other information about Iowa's lakes.

Recommendations:

- Create a new internet lake information system that has similar information reporting capabilities as BioNet, the stream biological monitoring and assessment information system. The new system should be capable of providing lake stakeholders and public with access to monitoring data and interpreted water quality information for individual lakes and the monitoring network as a whole. It should also have the ability to summarize and interpret other types of monitoring data besides water quality (e.g., aquatic community and habitat).

<u>Automated Reports / Internet Applications / Websites</u>

Strengths:

- (none described)

Weaknesses:

- The DNR does not currently offer any internet applications or automated reports showcasing information from the Ambient Lake Water Monitoring Program. Monitoring results for individual lakes are available as mini-reports through the ILIS. Interpreted monitoring results with respect to CWA Section 305(b) assessments, are available in the ADBnet internet application. Other than these services, the public and stakeholders have difficultly accessing summarized and interpreted information that provides a deeper understanding of the condition of Iowa's lakes.
- It is possible to generate reports automatically by pulling data from the EQuIS water quality database; however, these capabilities have yet to be vetted by the DNR.
- The DNR Ambient Lake Monitoring Program web page is outdated.
- Internet map-based information services are non-existent.

Recommendations:

- As part of the development of a the new internet lake information system (see recommendation above) develop similar automated reporting capabilities as BioNet, the stream biological monitoring and assessment information system. The new system should be capable of providing summarized and interpreted lake monitoring results for individual lakes and the monitoring network as a whole. The system should have the ability to update reports automatically as new data are added to the system.
- GIS data has recently been completed for the monitored lakes. As funding becomes available, the DNR should couple this data with the lake water quality data to generate reports that are more meaningful to lake stakeholders and the public. This would better strengthen the monitoring program by making results more accessible providing the public with a better understanding of what water quality is like at their lake.

Program Coordination and Evaluation

<u>Monitoring Partnerships</u>

Strengths:

- The Ambient Lake Monitoring Program has a strong partnership with the DNR Lake Restoration Program, which currently provides 40% of the funds for the ambient lake monitoring contract.
- The program is engaged with other partners and stakeholders within the DNR (e.g., Fisheries Bureau, Parks Bureau, Wildlife Bureau, Section 319 Program, and TMDL Program).
- The program has a long-term relationship with the Iowa State University Limnology Laboratory.

Weaknesses:

- The program needs to do a better job of communicating and sharing information with monitoring partners and stakeholders. Better communication will contribute toward meeting the objective of providing monitoring support for federal and state water quality programs and initiatives.
- More input from technical staff of the DNR is needed to guide the monitoring program and ensure that the data and information it produces will be accessible and useful to stakeholders and the public.
- Additional input from internal and external stakeholders is needed to maximize program benefits.

Recommendations:

- Meet regularly with partner agencies to review annual monitoring plans and develop future plans.
- Develop a technical advisory team within the DNR to address department-wide goals, needs, and priorities for lake management, monitoring and assessment, and restoration. Better coordination at the technical level will help the monitoring program to better serve a variety of stakeholders and help guide the monitoring program to meet current and future objectives.

<u>Stakeholder / Technical Advisor Input</u>

Strengths:

- The program receives input from the monitoring contractor and the Lake Restoration Program on a regular basis.

Weaknesses:

- More input from technical staff of the DNR is needed to guide the monitoring program and ensure that the data and information it produces will be accessible and useful to stakeholders and the public.

Recommendations:

- Establish a technical advisory team within the DNR to address department-wide goals, needs, and priorities for lake management, monitoring, restoration, assessment, and data-sharing. This will make the program more useful to a variety of stakeholders and help guide the monitoring program to meet current and future objectives.

<u>Performance Review, Needs Assessment, Strategy Update</u>

Strengths:

- The monitoring program is evaluated and updated with each renewal of the monitoring contract.
- Several pilot projects (e.g., chlorophyll pigment study and biological indicator development) have been conducted to inform the program of potential improvements.

Weaknesses:

- A formal process for updating the program’s overall strategy does not exist. Therefore, the program lacks a regular assessment of objectives and how well they are being accomplished.
- Additional input from internal and external stakeholders is needed to maximize program benefits.

Recommendations:

- Establish a technical advisory team within the DNR to address department-wide goals, needs, and priorities for lake management, monitoring, restoration, assessment, and data-sharing. This will make the program more useful to a variety of stakeholders and help guide the monitoring program to meet current and future objectives.

Stream Biological Monitoring

Description

The Ambient Stream Biological Monitoring Program provides sampling data for benthic macroinvertebrate and fish species assemblages residing in Iowa's headwater creeks, wadeable streams, and large interior rivers. The program operates under a contractual arrangement with the State Hygienic Laboratory at the University of Iowa, which is responsible for sample collection and analysis. Providing data to support the development and implementation of biological assessment criteria and for status and trends reporting purposes are the main program objectives. Other objectives include providing the public with information about the biological diversity and health of Iowa's streams, and providing data and summary information in support of water quality programs and research studies.

In recent years, the program has employed both random and non-random sampling designs to gather data for stream biological, chemical, and physical parameters (Figure 4; Figure 5). The program maintains a network of wadeable warmwater and coldwater reference sites representing least-disturbed stream habitats in each of Iowa's major ecological regions (ecoregions). Reference sites are sampled on a four-year rotational schedule to provide current information for use in completing biological assessments.

Biological sampling is usually conducted during the summer-early fall biological index period. Biological data from at least two sampling events within five years are required to make a "monitored" biological assessment determination of the support status of aquatic life uses. Although sampling of benthic macroinvertebrate and fish populations is the main emphasis of the program, a suite of water quality and physical habitat parameters are also sampled. Additional monitoring for water quality parameters is sometimes conducted to support other program objectives. In recent years, sampling for trace metals and pesticides as well as continuous monitoring of dissolved oxygen and temperature has been conducted on a supplemental basis.

Management of data collected for the program is challenging due to the wide range of data formats represented by biological, chemical, and physical sampling parameters. Biological and physical habitat sampling data are stored on the State computer network and served to the public via BioNet, the online portal providing access to data and summarized information obtained for the Ambient Stream Biological Monitoring Program. Water quality data are entered in DNR's EQuIS database and are available to the public via IASTORET, the online water quality data retrieval portal. Water quality data collected at biological sampling sites are also conveniently available from BioNet via a direct connection with EQuIS. Other types of data and information, including continuous dissolved oxygen and temperature monitoring data, sample site photographs, field observations and other sampling metadata are stored on the State network, but are not directly accessible to the public.

Major products generated by the Ambient Stream Biological Monitoring Program include biological indexes (BMIBI, CBI, FIBI) and reference condition criteria that are applied to the benthic macroinvertebrate and fish sampling data in order to assess the support status of stream aquatic life uses for biennial Federal Clean Water Act (CWA) Integrated Report. Additional products include occasional fact sheets, the 2004 report of the stream biological assessment development project, and the 2015 physical habitat indicators report. Between 2010 and 2014, nutrient monitoring and biological monitoring data from the ambient program were used in a data analysis project that supported the development of preliminary stream nutrient criteria recommendations.

The BioNet online application not only provides access to sampling data and information, it also offers many data analysis and interpretation enhancements and features, interactive mapping capabilities, and access to documents and reports created for the program.

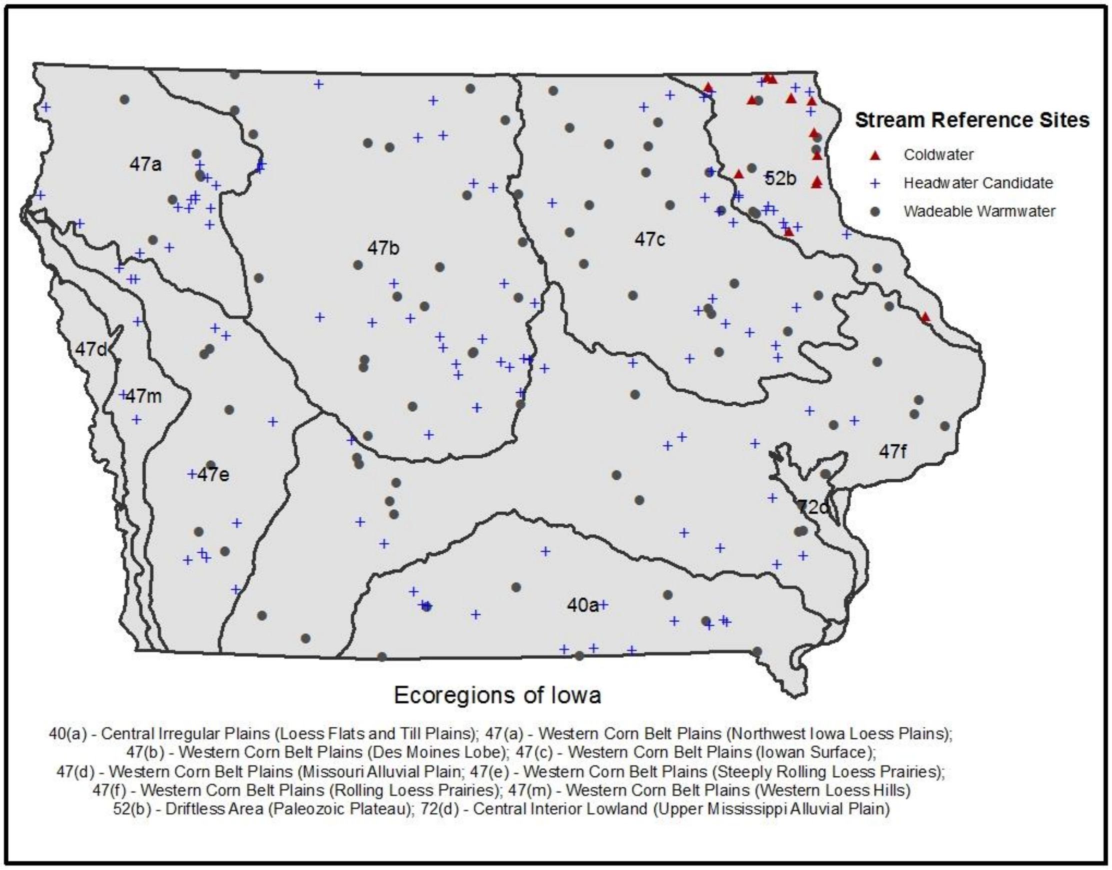

Figure 4. Locations of stream biological reference sites and headwater candidate reference sites.

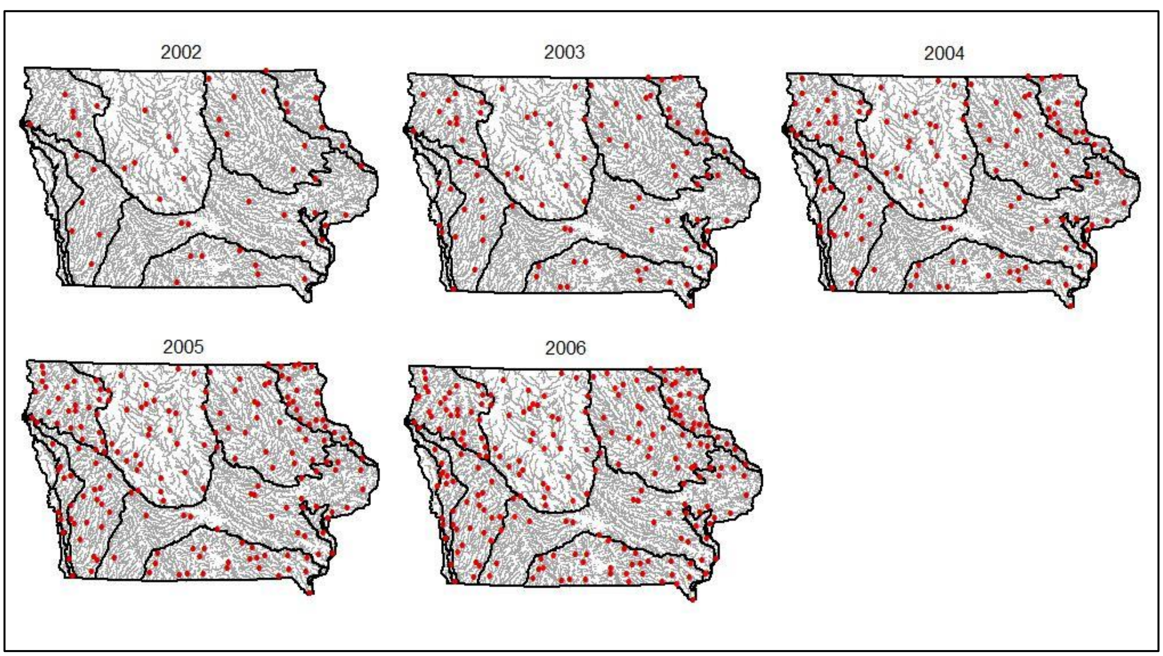

Figure 5. Annual cumulative distribution of ambient stream probabilistic sampling sites (2002-2006).

Strengths, Weaknesses, and Recommendations for Improvement

Monitoring Objectives / Questions

Strengths:

- The objectives of the Ambient Stream Biological Monitoring Program are consistent with CWA objectives, including:
    - Monitoring of status and trends;
    - Conducting CWA Section 305(b) assessments, preparing the Section 303(d) list of impaired waters, and identifying causes and sources of biological impairments;
    - Supporting the implementation of water quality programs and evaluation of program effectiveness; and
    - Supporting the development of water quality standards (e.g., biocriteria, nutrient criteria, and metals).
- The program serves a number of other important objectives, including:
    - Informing the public about the biological diversity and health of Iowa's rivers and streams;
    - Supporting local and state (non-CWA) water quality programs and initiatives; and
    - Documenting the occurrences and geographic distribution of fish and benthic macroinvertebrate species for biological conservation management and research purposes.

Weaknesses:

- Ambient stream biological monitoring objectives do not address the data needs of the DNR Water Quality Standards (WQS) Program, particularly in support of Use Attainability Analysis (UAA) determinations of site-specific designated aquatic life uses. The lack of connection between the two programs is a hindrance to the collection of data that could be used to inform the UAA process.
- Ambient stream biological monitoring objectives do not specifically address the development of a Tiered Aquatic Life Uses (TALU) framework within Iowa's Water Quality Standards (WQS). TALU is a data-driven approach recommended by the U.S. Environmental Protection Agency (USEPA) for the establishment and refinement of aquatic life use goals. Because monitoring program objectives do not currently include collecting and analyzing data to support TALU development, the DNR will continue to be limited to the current bioassessment approach which has an indirect relationship with designated aquatic life uses defined in Iowa's Water Quality Standards.

Recommendations:

- Meet periodically with the DNR water quality standards program to identify monitoring objectives that better serve WQS program needs relating to UAA and TALU development. Increased communication and coordination will be beneficial to both programs.

Sampling Design

<u>Site Network Type (e.g., census, fixed, probabilistic, reference, rotational, etc.)</u>

Strengths:

- Biological reference site networks representing coldwater (CW) streams and wadeable, warmwater (WW) streams have been established. A network of headwater (HW) stream candidate reference sites is being developed.
- A network of randomly selected sites was utilized for the 2002-2006 (REMAP) probabilistic survey of perennial rivers and streams.
- The fixed-station ambient stream water quality monitoring network is being utilized to collect benthic macroinvertebrate data for development of bioassessment criteria and nutrient stressor-response benchmarks.

Weaknesses:

- The biological reference site network is not comprehensive. Candidate reference sites representing coolwater streams and nonwadeable rivers have not been identified. The lack of a comprehensive

reference site network limits the stream bioassessment program's ability to fully develop and implement bioassessment criteria.
- The program does not currently employ a probabilistic monitoring network in order to achieve comprehensive biological monitoring of Iowa's rivers and streams. The probabilistic design is ideally suited for obtaining statistically-defensible estimates of status and trends in stream biological condition and support status of designated aquatic life uses.
- The program lacks a rotational basin monitoring design to support a watershed-based, data driven approach to CWA program implementation and to support the Nutrient Reduction Strategy.
- The program is lacking a network of sites dedicated for monitoring long-term trends in stream biological condition and climate change indicators.

Recommendations:
- Develop a rationale and criteria for choosing candidate reference sites representing coolwater streams and nonwadeable rivers. Apply the criteria to identify the locations of 10-20 candidate reference sites for each stream subclassification. The selection of candidate reference sites for coolwater streams and nonwadeable rivers is an important step toward obtaining appropriate data for the development of bioassessment criteria that apply to all stream types in Iowa.
- Develop monitoring network design specifications for a statewide (probabilistic) statistical survey of stream condition status and trends. Establish a survey design that strikes a good balance between cost and statistical power. The design will support the program's objectives for comprehensive biological condition status and trends monitoring.
- Develop design specifications for a rotating basin/watershed monitoring network. Determine the appropriate basin/watershed scale and rotation schedule. Determine the appropriate allocation of sites to achieve various monitoring objectives and data needs (e.g., basin/subwatershed outlets, random (probabilistic), targeted (for site-specific issues) and long-term trend monitoring). The monitoring design can be designed to serve objectives and data needs of other programs beyond the ambient monitoring program (e.g., Nutrient Reduction Strategy, Section 319, Wasteload Allocation, Wastewater Permitting, and Water Quality Standards).
- As funding is available, establish a network of fixed monitoring sites for long-term trend monitoring of stream biological condition and climate change indicators. Insure that the network provides adequate representation of ecoregions and stream types. A fixed network of sites that is monitored annually will significantly add to the trend monitoring capabilities provided by the current reference site network that is sampled on a four-year rotation.

<u>Number and/or Spatial Distribution of Sampling Locations</u>

Strengths:
- The number and spatial distribution of HW candidate reference sites and wadeable WW reference sites provide reasonably adequate coverage of the seven major Level IV ecoregions of the state.
- The number and spatial distribution of probabilistic sites in the 2002-2006 survey was adequate to meet statistical goals and can serve as a foundation for future surveys if needed.

Weaknesses:
- The number of warmwater reference sites is fewer than the recommended level (i.e., minimum of ten) in certain ecoregions. Two ecoregions (47c, 47f) in which coldwater streams occur in a limited extent are not represented by any CW reference sites. Inadequacies in the reference site network have a negative impact on the level of confidence placed on stream biological assessments prepared for the CWA Integrated Report.
- The program lacks a sampling strategy for large rivers including design specifications for the number and type of monitoring sites needed (e.g., free flowing, impounded, etc.). Having a strategy and appropriate sampling design would help to ensure that adequate data will be collected to support the development of biological assessment criteria and fulfillment of status and trends monitoring objectives.

- Often, biological monitoring data from multiple sampling sites are not available to assess ALU support status of stream segments that are long or diverse. The current rule-of-thumb is one sample site for every three-to-five miles of stream. In some cases, the lack of data from multiple sites may result in lower confidence in bioassessment determinations of ALU support status.
- The appropriate number and distribution of long-term biological and climate trend sites has yet to be determined. These determinations must be made before long-term trend monitoring can be initiated. A sound rationale for site selection will help to ensure the monitoring data are useful for answering trend-related questions.

Recommendations:

- Choose candidate reference sites to address deficiencies in the distribution and number of CW and WW reference sites. As funding becomes available, sample the candidate reference sites and use the data to confirm or deny reference status. Repeat the first two steps until reference site representation targets have been met. This process will lead to a stronger network of reference sites and reference condition data that will provide greater confidence in biological assessments for the CWA Integrated Report.
- Define large river bioassessment data collection needs and develop a sampling strategy to meet them. Incorporate the strategy in the bioassessment program's five-year master plan. The sampling strategy will ensure that appropriate data are collected for the development of bioassessment criteria and to fulfill status and trends monitoring objectives.
- Establish guidelines for determining the appropriate number and location of bioassessment sites to represent a stream segment or a watershed. Consistent site selection guidelines will lead to greater confidence in biological assessments for the CWA Integrated Report and will better serve the needs of DNR's water quality programs (e.g., TMDL, 319, NPDES, etc.).
- Establish a clear rationale for selecting biological and climate trend monitoring sites. The rationale needs to address considerations such as number of sites and representativeness as well logistical considerations for successful long-term data collection. For example, a minimum of approximately seven climate change monitoring sites is needed to participate in the USEPA's Regional Monitoring Network (RMN) initiative for the Region VII states of Iowa, Kansas, Missouri, and Nebraska. Determining the appropriate number and locations of sites will insure the validity and relevance of the trend monitoring data.

<u>Sampling Frequency</u>

Strengths:

- CW and WW reference sites are sampled twice in five years which provides sufficient data to generate monitored assessments and keep the reference network up-to-date.
- Incorporation of temporal sampling sites in Index of Biotic Integrity (IBI) development for HW and wadeable streams provides for the evaluation of intra- and inter-annual variation in IBI results and determination of appropriate bioassessment criteria.
- Sampling frequency is increased as needed to meet the monitoring objectives of special studies (e.g., impaired stream follow-up, nutrient impact assessment, and Stressor Identification/TMDL studies).

Weaknesses:

- The last probabilistic survey (REMAP) was completed in 2006; therefore, there are no recent statistical estimates of stream biological, chemical, and physical characteristics and ALU support status. This limits the program's ability to comprehensively report on status and trends in Iowa's rivers and streams.
- Temporal variability sampling has not been done systematically to support the development of a large river benthic macroinvertebrate IBI and biological assessment criteria.
- The frequency of monitoring at reference sites (i.e., 2X in five years) is not optimal for evaluating long-term trends among Iowa's least disturbed streams. Sampling frequency of streams needing follow-up monitoring is not always sufficient to keep CWA Section 305(b) assessments up-to-date. A minimum of two IBI samples within five years is required to be considered a monitored assessment.

- The reference site network lacks continuous monitoring for temperature and stream stage to support the analysis of long-term trends in stream condition related to variation in climate indicators.
- The typical collection of a single grab sample for chemical and physical water quality parameters is inadequate for diagnosing causes and sources of ALU biological impairment in the CWA Integrated Report. The lack of water quality data typically results in listing the cause of biological impairments as unknown which is not helpful to water quality management programs.

Recommendations:

- Develop a plan for repeating probabilistic surveys every five-to-ten years to generate statistical estimates for stream condition indicators with known statistical confidence. Implementing this plan is the only realistic way for the ambient monitoring program to report comprehensively on status and trends of Iowa's rivers and streams.
- Establish temporal monitoring sites in larger rivers. Doing so will benefit bioassessment criteria development by providing data to document seasonal variability in biological metrics and for determining the appropriate bioindex sampling period for obtaining consistent bioassessment data.
- As funding becomes available, add annual or bi-annual sampling at a proposed network of fixed trend monitoring sites. Conducting annual trend monitoring at least disturbed reference sites would complement efforts to examine trends using data obtained from randomly selected sites in probabilistic surveys completed on a 5-10 year schedule.
- Develop a climate trend monitoring plan that meets the sampling frequency requirements for participation in a (USEPA) Regional Monitoring Network. Conduct biological and climate trend monitoring at the same sites for cost savings and to enhance data analysis opportunities.
- Develop sampling frequency and duration guidelines for the assessment of biological impairment causes and sources based on the knowledge and experience gained from Stressor Identification studies. Incorporate the guidelines in the biennial 305b/303d assessment methodology and apply them to determine causes and sources of biological impairment. The guidelines will also be useful for designing future monitoring projects to provide sufficient data for these determinations.

<u>Parameters</u>

Strengths:

- The list of core monitoring parameters includes biological, chemical, and physical habitat indicators that provide a good foundation for assessing the status and trends of headwater creeks and wadeable streams.
- Supplemental monitoring parameters (e.g., diel dissolved oxygen flux, trace metals, and pesticides) are included as needed to serve other purposes such as water quality standards development, evaluation of emerging contaminants, and biological impairment stressor identification.

Weaknesses:

- Nonwadeable rivers are only sampled for one biological assemblage (i.e., benthic macroinvertebrates). Sampling of two or more biological assemblages is recommended to provide for a robust assessment of stream biological condition and ALU support status. The fish assemblage is a logical choice for large river bioassessment given the diversity of native species, including many that have been identified as Species of Greatest Conservation Need (SGCN). The lack of fish assemblage monitoring data limits the program's ability to develop bioassessment criteria and contribute data for biological conservation purposes.
- Watershed condition indicator data (e.g., basin morphometry, land use, AFOs, and WWTPs) are not routinely obtained for biological monitoring sites. The lack of readily-available, summarized data makes it difficult for the program to quantify linkages between stream biological indicators and watershed characteristics. This limitation also makes it difficult to identify stressor-response thresholds that could potentially be used to assign causes and sources of biological impairment for the CWA Integrated Report.
- The program lacks a systematic process for planning and implementing supplemental indicator monitoring. Supplemental indicators are occasionally added to the annual monitoring work plan in

response to short-term funding, rather than as part of a long-term plan. The current approach makes it difficult to set priorities and follow a logical path to address supplemental monitoring needs.

Recommendations:

- Research and determine which biological assemblages are the most useful bioindicators for each stream category (e.g., headwater, wadeable, and nonwadeable). In addition to the traditional choices of benthic macroinvertebrates and fish, additional biological assemblages such as algae, freshwater mussels, and Chironomidae (midge flies) should also be considered.
- Research and determine which watershed condition indicators are the most useful for bioassessment purposes. Define the data sources and procedures for quantifying each indicator. Develop a plan to systematically gather and analyze watershed data including an estimate of GIS technical assistance needs for updating the data in a timely manner. These steps should help to clarify watershed indicator data needs and organize the process for acquiring these data in the future.
- Identify and prioritize supplemental indicator monitoring needs. Establish a mechanism or placeholder (e.g., work plan task) for including supplemental indicator monitoring in the annual budget and work plan. These steps will elevate awareness and consideration of supplemental monitoring priorities and help the program to be more proactive and responsive to emerging issues and data needs.

Data Management

<u>Data Entry, Storage, Retrieval</u>

Strengths:

- Data entry is completed in a reasonably timely manner (a few months to less than one year) given the complex nature of biological sample collection, processing, and analysis.
- Data are housed in the BioNet and EQuIS databases residing on the State of Iowa's computer network. Biological assemblage and habitat data are accessible to the public from the BioNet internet application and water quality data are accessible via Iowa STORET, the public interface for the EQuIS database. These database applications offer the following advantages:
  - Biological sampling results for each site are linked to the DNR's Assessment Data Base (ADB) via the waterbody segment ID;
  - BioNet is able to pull in water quality data from EQuIS for any given site at which water quality samples have been collected;
  - BioNet offers many basic and advanced query capabilities; and
  - Water quality data are regularly uploaded via the Water Quality Exchange (WQX) to USEPA's national data repository (STORET).

Weaknesses:

- Contact information for private landowners and operators who have provided access to biological sampling sites has been challenging to manage and keep current. Consequently, reports and communications with landowners have not always been timely or adequate to maintain good working relationships, which can result in denied access to previously monitored sites. The ability to repeat sampling at the same site over time is critical to program objectives such as long-term trend monitoring of biological reference sites.
- Data entry, storage and retrieval capabilities are lacking for the following types of data:
  - Continuous (logger) monitoring data (e.g., DO, temperature, pH, nitrate, etc.);
  - GIS data summarized for watersheds of biological sampling sites;
  - Field data sheets and digital photographs; and
  - Water quality and flow data for all years dating back to 1994 (work in progress).
- The data are stored in various electronic files and folders located on the DNR computer network. For most efficient access and use, the data ideally should be stored in a central location and accessible from the BioNet application. The lack of easy access to all of the data collected by the program has caused much inefficiency and delays impacting the program's ability to achieve its objectives, not the least of which is providing data to stakeholders and the public.

Recommendations:

- Work with SHL to update all of the site landowner/manager information stored in BioNet. Produce and distribute a new set of letters to landowners/managers thanking them for their support and detailing where and how they can access sampling data collected on their land.
- Acquire additional staff with appropriate skills to assist with all data management needs of the stream bioassessment program. The current level of staffing does not allow for some of the routine and less time-sensitive tasks to be completed in a timely fashion or at all. When additional staffing is obtained, the bioassessment program staff will determine where and how the data (detailed above) can be made available inside and outside of the DNR. Gains in data management efficiency will translate into time savings for existing staff members and will allow them to focus more time on data analysis, interpretation, and reporting.

<u>Quality Assurance / Quality Control (QA/QC)</u>

Strengths:

- The biological sampling and habitat assessment standard operating procedure (SOP) was most recently updated in 2015. Consistent biological sampling methods have been used since the program's inception in 1994. Habitat assessment methods have also remained consistent with the exception of changes in the riparian cover and instream habitat assessment methods that were implemented in 2003.
- The Program's contractor for field and laboratory services (SHL) provides the following QA/QC measures:
    - All biological and habitat data entered in BioNet are reviewed;
    - Laboratory SOPs are maintained and QA/QC verification of water sample and biological sample analysis are performed;
    - Voucher and reference specimen collections are maintained for benthic macroinvertebrates and fish;
    - Training in field data collection tasks is provided to new staff by experienced limnologists.

Weaknesses:

- The lack of a Quality Management Plan (QMP) and/or a Quality Assurance Project Plan (QAPP) for the Ambient Biological Monitoring Program prevents the program from efficiently documenting and communicating all elements of QA/QC that are currently implemented. The document is also needed to guide QA/QC planning and development.
- Several SOPs need to be prepared or updated:
    - Rapid Bioassessment Protocol (RBP);
    - Continuous Water Quality Sensor and Data Logger Deployment;
    - Nutrient Impact Assessment;
    - Watershed Condition Indicators;
    - Sediment Impact Assessment.

  These SOP documents are needed to insure that appropriate methods and procedures are followed, thus enabling consistent and high quality data to be obtained.

Recommendations:

- Determine if the recently updated bioassessment SOP can serve as a QAPP; if not, develop a QAPP for the program.
- When annually updating the bioassessment task list, prioritize SOP development needs and develop plans and timelines to complete the highest priority SOPs. These actions will help to move the program in the direction of having a comprehensive QA/QC system that will ensure that consistent, high quality data are available to serve all program objectives.

Products and Services

Data Analysis and Interpretation

Strengths:

- Quantitative indicators are available for summarizing and interpreting biological and habitat sampling data:
- Coldwater streams: Coldwater Biotic Integrity (CBI);
- Wadeable, warmwater streams: Benthic Macroinvertebrate Index of Biotic Integrity (BMIBI), Fish Index of Biotic Integrity (FIBI); General Fish Habitat Index (GFHI); Ecoregion-adjusted Fish Habitat Index (EFHI).
- BMIBI, CBI, and FIBI scores are calculated automatically in BioNet. Qualitative and quantitative guidelines are available for the interpretation of index scores in regards to stream biological health condition.
- Biological Impairment Criteria (BICs) are available for use in determining the support status of aquatic life uses based on a comparison with BMIBI, CBI, and FIBI scores.
- Bioassessment sampling data have been used extensively in Stressor Identification studies to identify causes and sources of aquatic life use impairment, and for the analysis of nutrient stressor-response relationships and benchmarks.

Weaknesses:

- Several additional indicators need to be developed in order to convert raw sampling data into useful information. These include:
    - Coldwater stream fish IBI (Index of Biotic Integrity);
    - Headwater creek benthic macroinvertebrate and fish IBIs;
    - Large river benthic macroinvertebrate and fish IBIs; and
    - Wadeable warmwater stream benthic macroinvertebrate habitat index.

  These indicators will allow the program to expand and strengthen its bioassessment capabilities. Their lack of availability currently limits the program’s ability to report on the biological and habitat condition of Iowa’s rivers and streams and ALU support status.
- The lack of regular (e.g., annual) trend analyses for biological and habitat indicators prevents the bioassessment program from achieving the trend monitoring objective.
- Stressor-biological response relationships have not been fully analyzed for the development of IBIs and bioassessment criteria.
    - Stressor diagnosis from biological sampling data is somewhat limited by imprecise taxonomic resolution in the Chironomidae (midge) family of Aquatic Dipterans and the lack of detailed studies quantifying stressor-biological response relationships (see Midwest Biodiversity Institute (MBI) Technical Memorandum, November 22, 2010).
    - Quantitative gradients in individual and/or composite stressor indicators are needed for IBI development for headwater creeks and nonwadeable rivers.
- The lack of these analysis products negatively impacts the program’s ability to report on the status of designated aquatic life uses and the causes and sources of biological impairment for the CWA Integrated Report.

Recommendations:

- As part of the annual bioassessment task priority update (see below), continue to review and adjust the timelines for development of biological and habitat indicators and keep these projects moving forward. This work will support the program’s biocriteria development and CWA-related monitoring objectives.
- Analyze the IBI and habitat data annually for reports or fact sheets to be published on our web page. This work will benefit the trend monitoring objective.
- Plan and conduct a stressor-biological response analysis project for the specific purpose of developing and calibrating benthic macroinvertebrate and fish multi-metric indices for headwater streams. Do the same for development of a benthic macroinvertebrate index and reference biological condition criteria for large rivers. Continue the ongoing nutrient stressor-biological response analysis to support the development of nutrient assessment criteria for all stream habitat and ALU classifications. This work will

benefit the biocriteria development objective and the impairment causes and sources status reporting objective.

Fact Sheets, Reports

Strengths:

- Several reports and fact sheets available on the internet have been generated in the past fifteen years:
  - Fact sheets on topics relating to the stream biological monitoring program (2001, 2003, 2007, 2008, 2010);
  - Wadeable stream bioassessment report completed in 2004;
  - Draft report of nutrient criteria recommendations;
  - Stream waterbody-specific aquatic life use assessments for the CWA Integrated Report;
  - Wadeable stream habitat indicator report completed in 2015.

Weaknesses:

- Currently, the program lacks a mechanism for reporting on status and trends other than the DNR's Water Quality Assessment Database (ADBnet), for example:
  - Annual trend report of IBI scores and stream habitat indicators;
  - Probabilistic (REMAP) monitoring project summary reports.

Recommendations:

- Annually develop an IBI and habitat trend report and publish it on the stream biological monitoring website, either as a stand-alone web page or as a link to a fact sheet (pdf document).
- Develop a plan to complete the REMAP sampling reports and add them to the stream biological monitoring web page.

Automated Reports / Internet Applications / Websites

Strengths:

- BioNet provides many automated reporting features and a high level of functionality, including:
  - Automated reports of IBI scores and habitat summary statistics;
  - Interactive maps of sampling sites and distributions of benthic macroinvertebrate and fish;
  - Quick access to sampling data using pre-designed queries on date, stream name, county, ecoregion, watershed, site type, and other attributes;
  - Link to ADB segment containing bioassessment results;
  - Water quality data pulled into BioNet from the EQuIS database.

Weaknesses:

- While BioNet serves many of the program's needs, the DNR has not sought feedback from its customers and constituents to insure that the online database is meeting their needs.
- Automated data summarization and reporting are difficult to achieve for some types of data (e.g., in-situ continuous dissolved oxygen and temperature data logger).
- The biological monitoring web page is not updated regularly.

Recommendations:

- The next round of letters sent to landowners should include a brief questionnaire asking the following: 1) Did you look at the sampling results? 2) In which results were you most interested? 3) Is there anything else that you would like to see? and 4) Do you have any questions about the information or suggestions for improving it? A similar questionnaire could be provided to DNR staff. The responses to the questionnaires would be used to determine whether the information is useful and whether modifications in content or format are needed.
- Determine a way to summarize and distribute some of our harder to automate data we collect such as continuous DO and temperature logger data. This work will benefit the program objectives of providing data to the public and to support DNR programs.
- The biological monitoring web page should be updated annually after staff meet to update the bioassessment task priority document, and perhaps after forming and meeting with technical advisor

and stakeholder groups (see recommendations in next section). This work will benefit the program objectives of providing data to the public and to support DNR programs.

Program Coordination and Evaluation

Monitoring Partnerships

Strengths:

- The Ambient Biological Monitoring Program has collaborated with several DNR programs including Compliance and Enforcement, Fisheries Management and Research, Section 319 Nonpoint Source Pollution Control, Stressor Identification, and TMDL.
- The program has greatly benefited from a long-standing relationship with the Limnology Section of the State Hygienic Laboratory.

Weaknesses:

- The program is not actively investigating or seeking potential internal or external partnerships that might help to expand stream biological monitoring in Iowa (e.g., Internal: DNR Fisheries, Water Quality Standards, and Watershed Improvement; External: SWCD water quality projects, Water Management Authorities, USGS, Colleges and Universities, Municipalities, NGOs, private industry, and professional associations). As a result, the program might be limiting its ability to expand biological monitoring to include more streams, to potentially realize cost-efficiencies, and to connect with other groups for the purpose of achieving mutually compatible goals.

Recommendations:

- Explore monitoring partnerships through the formation of stakeholder and technical advisory committees (see recommendations below). Expand efforts toward collaboration and sharing of resources and data.

Stakeholder / Technical Advisor Input

Strengths:

- Staff participate in a Regional Bioassessment Technical Advisory Group (BTAG) sponsored by the Central Plains Center for Bioassessment and Region VII, USEPA. The BTAG has served as a useful platform for interacting and sharing information with other technical staff and scientists on a variety of biological monitoring and assessment topics relevant to the Region VII states of Iowa, Kansas, Missouri, and Nebraska.

Weaknesses:

- The program lacks a formal process for receiving technical and non-technical input. Not having this feedback process or mechanism is a threat to maintaining technical proficiency and program relevance from the standpoint of serving the needs of stakeholders and the public. Receiving technical advice and stakeholder input on a regular basis would help insure the program continues to grow in the right direction.

Recommendations:

- Assemble a bioassessment technical advisory committee comprised of individuals inside and outside of the DNR who have expertise relating to stream ecosystems and biological monitoring. Use the TAC to review and provide input on technical components and functions of the program such as development of IBIs, reference condition development, data management, analysis, and reporting.
- Assemble a stakeholder committee consisting of internal and external customers and users of biological monitoring data and information. Use the stakeholder group to receive input on non-technical issues relating to improving relevance and usefulness of stream biological monitoring products and services.

Performance Review, Needs Assessment, Strategy Update

Strengths:

- The reference site monitoring strategy is updated every year.

- The bioassessment task priority document has served as a useful planning tool and was last updated in 2013.
- A comprehensive review of the DNR stream biological monitoring and assessment program was conducted in 2008 by the Midwest Biodiversity Institute (MBI) with a grant from the USEPA. The final report including recommendations for improving program competency and effectiveness was completed in 2010.

Weaknesses:

- The bioassessment task priority document which covers the performance review, needs assessment and strategy updates is not updated regularly. Not having this document represent the most recent knowledge of program direction and needs can negatively impact the ability of staff to set short-and long-term priorities and efficiently develop appropriate annual work plans.

Recommendations:

- During the initial development of the annual stream biomonitoring work plan, normally from December to February of each year, update the bioassessment task priority document so that the work plan will reflect the current vision of bioassessment strategy, goals, and direction.

Stream Water Quality Monitoring

Description

The Ambient Stream Water Quality Program currently involves monthly monitoring at 60 fixed sites located on medium-to-large interior rivers and streams (Figure 6). The sites are geographically dispersed and provide fair coverage of most of the larger watersheds (i.e., HUC8-scale basin units) across Iowa. Sixteen of the monitoring sites have been monitored for more than thirty years and represent the best long-term record of monitoring data for trend monitoring purposes. Until 2015, the fixed monitoring network also included twenty-four sites situated upstream and downstream from ten of Iowa's largest urban areas. The upstream/downstream monitoring project was completed in 2015 and the data are currently being analyzed.

Status and trends monitoring is considered the main objective of the Ambient Stream Water Quality Program. Informing the public about stream water quality and providing data to support water programs and water quality standards development are also important objectives.

Core monitoring indicators include a suite of conventional field and laboratory water quality analytes in addition to algal chlorophyll-A, E. coli, and streamflow. Other supplemental indicators that have been monitored intermittently in recent years include: pesticides, trace metals, pharmaceuticals, benthic macroinvertebrates, and continuous (field data logger) measurements of dissolved oxygen and temperature. Water quality analyses are conducted by the State Hygienic Laboratory (SHL). Streamflow is determined from the nearest U.S. Geological Service flow gauging station or by manually taking a flow measurement.

Water quality and manual flow data are electronically transferred by SHL from the Open-ELIS database to the DNR EQuIS database which resides on the State of Iowa's computer network. The data is accessible to the public via the STORET internet application, which is accessed from the DNR's ambient water monitoring web site. The data can also be accessed from the nationwide (USEPA) WQX/STORET data repository.

Data and information products of the monitoring program include biennial water quality assessments for the Federal Clean Water Act (CWA) Integrated Report, the multi-parameter Water Quality Index (WQI), annual fact sheets containing statistical summaries of water quality parameters, and regular calculations of nitrogen and phosphorus loads.

In recent years, data and information services provided by the program include: (1) water quality data available on IASTORET and through the Water Monitoring and Watershed Atlas; (2) WQI results reported on-line by interactive map; (3) annual conferences held to update stakeholders on results from the ambient stream program; and (4) a web site describing the program and presenting data as general graphs (i.e., by site and parameter, and a comparison of upstream/downstream urban monitoring sites).

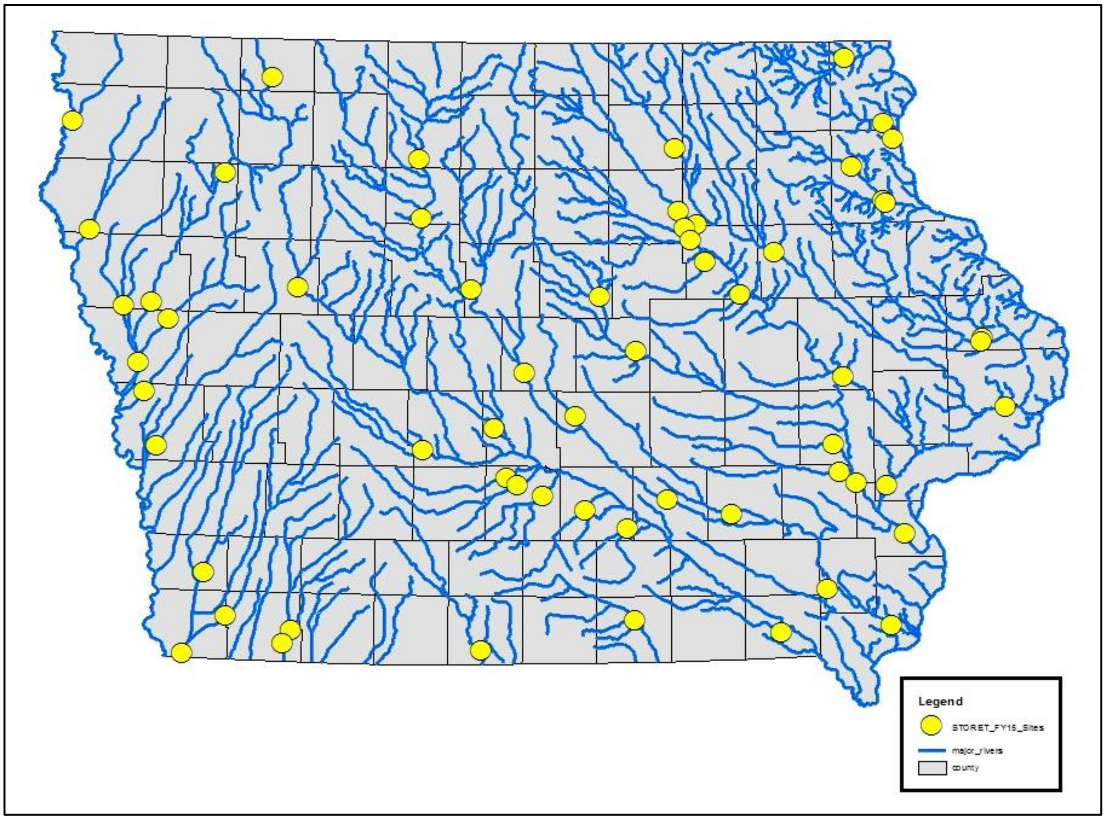

Figure 6. Active sampling locations of the Ambient Stream Water Quality Monitoring Program (2015).

Strengths, Weaknesses, and Recommendations for Improvement

Monitoring Objectives / Questions

Strengths:

- The 2000 Ambient Water Monitoring Plan and 2006 strategy update identified questions that the program should attempt to answer, and monitoring objectives were aligned with those questions. This work also served as the basis for distributing existing funds to achieve program goals.
- The status and trends monitoring objective is strongly supported by the Ambient Stream Water Quality Monitoring Program, for example:
    - o The program provides data that are useful for characterizing the overall water quality of Iowa's larger streams and rivers;
    - o The program provides a substantial data set for completion and ongoing updates of CWA Section 305(b) assessments;
    - o The long-term (30+ years) sampling of a small number of stations in the network provides valuable data needed to identify trends in water quality over time and spatially across Iowa.
- The program has provided data needed to support DNR water quality programs, including:
    - o Revision of water quality standards;
    - o Wastewater (NPDES) permit issuance and effectiveness in preventing water quality standards violations.
- The program has provided data to examine emerging environmental issues such as pesticide use.

Weaknesses:

- Over time, monitoring objectives have become less clearly defined. Cost inflation and static funding from the State have eroded the program's ability to achieve multiple goals over the past fifteen years. For example:
    - o The ambient trend monitoring objective has been weakened by occasional termination or movement of long-term monitoring stations;

- Available data are not completely sufficient for the development of water quality standards, wasteload allocations, and CWA Section 305(b) assessments. The locations of fixed ambient monitoring sites are strongly biased toward large interior rivers. Relatively little data are available to characterize water quality in small coldwater or warmwater streams, thus hindering the ability of DNR staff to develop wasteload allocations and wastewater permit limits for small streams. The program also does not conduct monitoring on the large border rivers (i.e., Big Sioux, Missouri, and Mississippi rivers). Consequently, the DNR lacks sufficient data to describe water quality of the border rivers or to assess the support status of designated uses for the CWA Integrated Report;
- The program's monitoring design limits the usefulness of the data for calculating stream nutrient loads and evaluating the effectiveness of Best Management Practices (BMPs) in support of the State Nutrient Reduction Strategy. Greater accuracy in nutrient load calculations might be achieved if the ambient program could implement additional continuous monitoring sensors for nutrient parameters or adjust sampling frequency and timing in order to capture peak flow events. The program's ability to provide useful data for evaluation of BMP effectiveness and potential water quality improvements is very limited because of the ambient monitoring network's bias toward large rivers and streams. Monitoring conducted in small watersheds would better serve the BMP effectiveness monitoring objective.

Recommendations:

- Enumerate and prioritize the monitoring objectives, other than assessment and trends and questions for the ambient streams program, and then align the monitoring design pieces to fit the objectives as additional funding is available. Work with internal and external stakeholders to prioritize the list of additional monitoring needs, questions, and objectives. Develop a strategy document that helps to define when multiple goals can be met simultaneously. Include in the strategy document a matrix of how design elements are meeting goals (e.g., which sampling sites are critical to one or more program).

Sampling Design

<u>Site Network Type (e.g., census, fixed, probabilistic, reference, rotational, etc.)</u>

Strengths:

- The fixed nature of the steam sites provides good long-term data to establish trends, particularly in light of changing precipitation patterns and land-use issues.
- The fixed-station design has remained consistent for thirty years and has served ambient monitoring objectives well. The site network was established in the early 1980s and was revised in 1986 to monitor streams and rivers with a drainage area of 1000 square miles or more. The design was intended to monitor ambient water quality and not water quality affected by wastewater dischargers.
- Post-2000, additional design features were added to the network, such as monitoring upstream and downstream of urban areas and periodic inclusion of emerging contaminants.

Weaknesses:

- The existing fixed-station monitoring network is strongly biased toward the representation of medium-to-large interior rivers and streams. Small headwater streams, coldwater streams and large border rivers, especially the Missouri and Mississippi rivers, are not represented. These deficiencies limit the program's ability to support multiple program needs and objectives, including: public information, nutrient reduction strategy support, water quality standards development, wastewater (NPDES) permitting, and CWA Integrated Reporting.
- The fixed station design combined with the lack of additional monitoring resources has meant that streams representing several regions and stream classes have remained un-monitored and are not included in the CWA Section 305(b) assessment of Iowa's water quality.
- The current fixed station network has experienced occasional termination or movement of long-term stations which has negatively impacted the trend monitoring objective.
- The fixed monitoring network's ability to provide useful data for evaluation of BMP effectiveness and potential water quality improvements is very limited because of bias toward monitoring in medium- and

large-size watersheds. Monitoring conducted in small watersheds (e.g., HUC12) would better serve the BMP effectiveness monitoring objective.

Recommendations:

- As funding becomes available, additional fixed monitoring stations should be added in coldwater streams and small warmwater streams representing all of Iowa's designated use classifications and ecological regions. This monitoring data would allow DNR to better understand, assess, and protect water quality conditions in largely un-monitored stream types. It would also provide a better understanding of regional differences in stream water quality. Monitoring of small streams designated as Outstanding Iowa Waters (OIW) would allow the DNR to determine whether these streams actually have outstanding water quality and what aspects of water quality contribute to exceptional biological integrity. Adding monitoring in these stream classes would help address the issue of comprehensive monitoring and better serve DNR water quality program objectives.
- The DNR should add monitoring sites on the Missouri River and work with the Upper Mississippi River Basin Association (UMRBA) to place monitoring stations on the Mississippi River that are consistent with the proposed water quality monitoring network. This monitoring would greatly increase the data available (from virtually none) to describe water quality in Iowa's portions of the Mississippi and Missouri rivers and assess these waterbodies for the CWA Integrated Report.
- As funding becomes available, layer a probabilistic monitoring design on-top of the existing fixed site network while maintaining the ability to detect long-term water quality trends. Probabilistic monitoring is the only defensible and realistic approach to achieving the USEPA requirement that States comprehensively monitor "all waters" within their jurisdiction. Some states utilize a rotating basin design to increase stream monitoring coverage, thus providing more support for water quality programs and better alignment with wastewater permitting issues on a large watershed scale.
- Consider establishing dedicated trend monitoring stations that are not subject to termination or movement and possibly increase the monitoring frequency at these stations. Stability in trend monitoring sites and reducing or eliminating non-detect values will positively impact the status and trends monitoring objectives.
- Develop a strategy that identifies sentinel sites that would be monitored for a more extensive list of organic chemical contaminants such as pesticides and pharmaceuticals. The purpose of sentinel sites would be to provide consistent long-term data to evaluate changes through time.
- Given the many potential alternatives for improving the ambient stream water quality network, it is not recommended that the network be altered to accommodate monitoring in small streams and watersheds for specific purposes such as evaluating the effectiveness of BMPs or progress in achieving goals for NPS pollution reduction. These purposes are not consistent with the ambient monitoring program's primary objective, status and trend monitoring, and would be better suited for targeted monitoring and research studies.

<u>Number and/or Spatial Distribution of Sampling Locations</u>

Strengths:

- The numbers and locations of fixed monitoring sites provides reasonably good spatial distribution across the landscape including representation within all the major landforms and ecological regions of the state.
- Given that the existing network is a fixed station design focused on medium-to-large interior rivers, the number of sites and their distribution in the state has provided good data to prepare the CWA Integrated Report.

Weaknesses:

- The number of locations doesn't provide coverage of all HUC8 basin outlets, and some areas of the state are under-represented.
- The ambient site network does not provide data from effluent-dominated or headwater streams needed for development of water quality standards, wasteload allocations, and wastewater permits.

Recommendations:

- As funding becomes available, add sites at un-monitored HUC8 basin outlets to allow for better spatial coverage of river miles in Iowa.
- Add monitoring stations in effluent dominated B(WW-2) and headwater streams to support water quality standards development (e.g., Copper Biotic Ligand Model); include monitoring for parameters such as CBOD5, ammonia and dissolved oxygen to support the development of wasteload allocations and wastewater discharge permits.

Sampling Frequency

Strengths:

- The sampling frequency has been kept fairly uniform for the past fifteen years, which minimizes significant data gaps and provides valuable consistency for data analysis.
- The reliance on monthly monitoring is a reasonable compromise between the cost of sampling more frequently and the ability to sample a relatively large number of sites across the state. The amount of data generated is generally sufficient for purposes of the CWA Integrated Report.

Weaknesses:

- Monthly sampling may not be frequent enough for parameters that exhibit extreme fluctuations, which is especially true of sites located on smaller, more “flashy” streams. A one-size fits all sampling frequency model doesn’t consider site variability and ignores the reality that some sites will need more frequent sampling to detect change and calculate loads.
- The monthly sampling regimen does not provide the DNR Wasteload Allocation Program with an optimal amount of water quality data representing low flow conditions.
- While monthly monitoring is sufficient for 305(b) assessments, it is not sufficient for other purposes such as nutrient load calculations for the Nutrient Reduction Strategy (NRS).

Recommendations:

- Work with monitoring partners (e.g., DNR field offices) and utilize in-situ sensor technology, as additional funding becomes available, to collect higher frequency data for priority parameters with high variability. Having field office staff/partner staff collect one additional sample for phosphorus, TSS, and other parameters greatly enhances our ability to track changes in these parameters and estimate loads.
- Investigate the use of other sensors for deployment to improve the sample frequency of certain parameters (e.g., nitrate, orthophosphate, TSS, and ammonia).
- Increase monitoring frequency during low flow conditions to provide better data for the development of wasteload allocations and wastewater permit limits.
- At sites used to calculate nutrient loads for the NRS, as additional funding becomes available, increase the sampling frequency to every two weeks or another suitable interval as determined by nutrient load models. If, however, the desired frequency is weekly or more frequent, it is unlikely the ambient monitoring program could sustain this level of sampling without utilizing in-situ sensor technology.

Parameters

Strengths:

- The ambient monitoring design includes core and supplemental monitoring indicators sampled from the statewide network of sites representing Iowa’s medium-to-large interior streams and rivers. Considered in aggregate, the design provides good coverage of core parameters monitored on an ongoing basis. Most of the expensive, priority parameters have been monitored on a supplemental basis in at least one year in the past fifteen years.
- The parameter coverage provided by the existing network works well for purposes of the CWA Integrated Report. That is, the network includes parameters needed to assess support status of water quality standards designated uses (aquatic life, recreation, and drinking water).

Weaknesses:

- The parameter list lacks a strategy to evaluate what should be included, what should be rotated on and off the list and at what frequency to answer particular questions. The parameter list tends to be driven mainly by budget and needs to be realigned to ensure that it matches the program's monitoring objectives.
- Available data are not adequate to support certain elements of the WQS triennial review and the Wasteload Allocation Program. The list of toxic parameters monitored is short and monitoring is only conducted intermittently. Toxics monitoring data available from other monitoring programs in Iowa is too limited to fill the data gap.
- A primary weakness relating to monitoring parameters is the large number of non-detects that have been reported for toxic parameters. This condition makes the data much less useful to the Water Quality Standards Program, which has sought data from other agencies and adjacent states to fill the gap. Additionally, the DNR is not able to use the metals data to assess the support status of designated aquatic life or drinking water uses due to the large number of non-detects. The existing data are also not suitable as a historical baseline for long-term trend analyses. Existing data for metals are reported at detection levels that are, in general, too high (i.e., resulting in a high percentage of non-detect results) to be of use for either water quality standards review and revision, or for Section 305(b) assessments.
- Monitoring for emerging contaminants has been sporadic in recent years.

Recommendations:

- Develop a short-term strategy to address inadequacies in the list of monitoring parameters. The strategy should evaluate the parameter list against the list of parameters for which Iowa has water quality standards then determine coverage gaps with respect to current standards and emerging parameters of concern (e.g., algal toxins and pesticides). For emerging concerns, the strategy should consider using surrogate parameters or analytical methods to contain costs. For example, the ELISA atrazine analysis method could be used rather than the more expensive laboratory methods for all pesticides.
- Add continuous temperature monitoring in coldwater streams to provide data for refinement of the coldwater designated aquatic life uses (Implementation of this recommendation will likely require more targeted site-specific UAA monitoring). The data are also needed for biological and climate trend monitoring purposes.
- As funding becomes available, enhance data collection to provide better support for Section 305(b) assessments and the Water Quality Standards Program, including metals monitoring on surface waters for both dissolved and total recoverable metals.
- Work with the monitoring contractor to implement sample collection and analysis methods that provide lower detection limits for toxic parameters and thus more useful data for (1) water quality standards development/revision, (2) CWA Integrated Report preparation, and (3) long-term trend analysis.
- Maintain the ability to monitor emerging contaminants. Such monitoring supports the goal of having a "comprehensive" monitoring program. The data are of use to the DNR Water Quality Standards Program and for informing decision makers and the public about the status of water quality.
- After identifying sentinel monitoring stations, use them as locations to implement monitoring enhancements, such as expanding the list of analytes to include pesticides and pharmaceuticals or increasing monitoring frequency to improve pollutant load estimation.

Data Management

<u>Data Entry, Storage, Retrieval</u>

Strengths:

- EQuIS provides a solid foundation with support through the third party vendor to ensure longevity of the database. EQuIS also has functionality that could be exploited to help other programs such as IOWATER manage data more effectively, while also providing some quality assurance and reporting functions.
- The data stored in EQuIS are available to the public via the IASTORET online application which is accessible from the ambient monitoring web site.

- Most of the data entered into the state database also are uploaded to the national WQX/STORET database and thus are accessible to a larger universe of data users.

Weaknesses:

- Data retrieval through IASTORET is not easy for those who are not familiar with the data they are seeking or the database structure. Success at downloading data requires some awareness of things like monitoring projects, organizations, and technical nomenclature (e.g., phosphate-phosphorus equivalence with total phosphorus).
- Accessibility is difficult for monitoring data not stored in EQuIS.
- In the past, the lag time between data receipt from SHL and entry into EQuIS has been an issue for timely preparation of the biennial CWA Integrated Report.
- Another potential “weakness” is that the 305(b)/303(d)-related data analysis is essentially a staff-limited process. One person has written the auto-calculator program that identifies and summarizes water quality standards violations for 305(b) assessments and 303(d) listings. To ensure this capability will be available into the future, some provision should be made to replicate the knowledge and skills needed to maintain and run the auto-calculator among other staff of the Ambient Water Monitoring Program.

Recommendations:

- Make monitoring data stored in databases other than EQuIS/IASTORET accessible to all DNR staff. Continue to consolidate bioassessment data in BioNet, similar to how the stream habitat data have been matched with stream flow measurements.
- Establish a QA/QC required timeline for data entry (e.g., six months from the time of receipt of the data from SHL). Continuing without a formal requirement can result in much extra work for staff who are trying to use the data and probably will result in some water quality data being missed and not included in the 305(b) assessment/303(d) listing process.
- Provide training to ensure that at least two staff of the Ambient Water Monitoring Program are able to modify and run the water quality standards violation auto-calculator.
- Continue to build data reporting capabilities within EQuIS. For example, graphs of data can be updated automatically as new data are added. This particular feature would assist staff with quality assurance work and generating monitoring reports.
- Develop a “How-to” guide that walks new and inexperienced users through the web retrieval of data including, but not limited to, information on how to find and use project codes, links to the map interface to find sites, and a cross reference guide for parameters (e.g., “Phosphate-phosphorus” = “Total Phosphorus”).
- Create a user group to provide feedback on the usability of the data retrieval functions and provide suggestions on how to make retrieval more understandable to users outside of the DNR.

<u>Quality Assurance / Quality Control (QA/QC)</u>

Strengths:

- Contracting with SHL has resulted in a long-term partnership with highly-trained staff in an organization that has strong QA/QC requirements.

Weaknesses:

- QA procedures have not been reviewed by DNR staff and updated in many years. Decisions made by field staff may not be consistent with the DNR’s preferences for QA/QC procedures.

Recommendations:

- Work with SHL to review QA/QC procedures and update them as necessary.
- Use EQuIS functions more fully to enhance QA such as graphing the data as it comes into the system to show outliers and other suspect data points.

Products and Services

Data Analysis and Interpretation

Strengths:

- Staff have more than twenty years of experience in statistics, GIS, and data analysis.
- The program does a good job of making the ambient data available via the internet and providing data when requests are received. Summarized data are also made available.

Weaknesses:

- The data are not analyzed as often or in-depth as needed. More frequent data analysis serves many purposes including identifying questionable data points, informing management or legislative actions, justifying funding needs, and highlighting situations that require follow-up actions (e.g., investigating high nitrate following drought). Previous data analyses have often involved a cursory examination of basic statistics but have lacked the depth needed to explain the reasons for observed patterns in the data and answering key monitoring questions related to, for example, water quality trends. The data reduction and QA requirements take a significant amount of time. The lack of staff time available to complete these tasks is a key limitation.
- Other than the biennial CWA Integrated Report, there has not been enough interpretation and reporting of bacterial, chemical, and physical ambient monitoring data. Such reports could be useful for responding to inquiries about the status of water quality in Iowa (e.g., Is water quality getting better or worse?) DNR staff often rely upon subjective observations and “best professional judgment” when responding these inquiries. Information prepared for the Integrated Report has not been useful for this purpose largely because of the CWA-specific reporting requirements.

Recommendations:

- Build tools to help with data reduction, QA and formatting to streamline the analysis process. Invest time in developing R scripts that can automate and expedite this process. For example, South Carolina’s Section 303(d) listing methodology is accomplished using R scripts. Continue to use GIS data visualization tools and refer to the USEPA nutrient visualization challenge for ideas.
- Complete annual assessments of water quality trends in concentrations and loads to align with the Nutrient Reduction Strategy. Examine other water quality influences such as stream flow, seasonality, land use, management actions, policies, and regulations on a less frequent basis (e.g., approximately five years) as these things tend to change more slowly.
- Increase staff training in the use of R statistical language and GIS tools. This is likely to require a combination of training opportunities such as classes, seminars, and webinars, as well as ongoing mentoring by experienced individuals within and outside the Department. For example, the National Water Quality Monitoring Council is developing an R user group to help support and build skills of state monitoring program staff.
- Require periodic (e.g., biennial) analysis and interpretation of the ambient stream water quality monitoring data. This requirement should also apply to the other ambient monitoring programs.
- Work with DNR communications staff to produce a new publication that presents DNR’s perspective on water quality in a manner that is interesting, informative, and eye-appealing. The publication would present a different perspective than the popular “open sewer” view of Iowa’s water quality. It should communicate the problem aspects of Iowa’s water quality as well as highlight the good aspects. The publication could include high quality photos of interesting subjects such as Iowa’s native fishes and benthic macroinvertebrates including freshwater mussels. It would summarize and interpret physical/chemical/bacterial data, biological data, fish & turtle tissue monitoring data, and should cover all the designated uses. The report could also include a water quality retrospective that contrasts the worst of the worst conditions from the past compared to the worst today. The piece might be publishable in the Iowa Outdoors magazine. The Integrated Report is another option; however, the reporting format would need to be changed from previous reports to make it more relatable to the general public.

Fact Sheets, Reports

Strengths:

- In the past, the production of fact sheets was a huge strength. The ambient program as a whole produced a dozen or more fact sheets a year that provided quality, relevant information to the public. Fact sheets were produced in-house, which reduced cost and were available on the web for reprinting and were used by teachers, the public, and decision-makers.
- The annual and overall fact sheet summaries of monitoring data from the ambient stream monitoring network have been very useful in terms of providing summary statistics for the water quality parameters sampled.

Weaknesses:

- Relatively few fact sheets have been produced in recent years (i.e., one data summary per year). Lack of providing consistent information from the program risks the loss of interest and enthusiasm for the program from decision-makers.
- The general lack of fact sheets on the ambient monitoring network has meant there has been less summarized information on Iowa water quality conditions available to CWA programs such as water quality standards and wasteload allocation. For example, DNR staff used the monitoring data summary statistics for the development of chloride and sulfate water quality standards criteria.
- Achievement of the objective to inform the public about water quality in Iowa is hindered by the limited amount and effectiveness of communication tools. Beyond the Water Quality Index (WQI) and other information available from the monitoring web site, the program does not have many other means of communicating with the public. Concerns have been raised about the usefulness of the Water Quality Index (WQI) that is calculated using the ambient monthly stream monitoring data. Among the concerns is the view that the WQI has relatively little relationship with the degree to which Iowa's surface waters meet water quality standards or whether biological (aquatic life use) goals are met. Some DNR staff believe that the current version of the WQI unfairly misrepresents Iowa's water quality conditions and believe that its use as a tool for communicating with the public and tracking conditions over time should be reconsidered.

Recommendations:

- Data interpretation in general, and preparation of fact sheets in particular, is difficult and time consuming. However, without them, the DNR will have little or no input on the perception of Iowans regarding the status of water quality in Iowa. Modifying the CWA Integrated Report to serve as a public education tool is a bad idea. The 305(b) and 303(d) reporting processes are far too standards-driven to be useful for communicating Iowa's water quality conditions to the public. For example, nonpoint source pollution issues such as nutrients and sediment would almost disappear, especially for streams and rivers because standards do not currently exist in Iowa for these parameters. Instead, summaries of ambient monitoring data could be prepared for the entire state, individual monitoring sites, river basins (e.g., HUC8 basins), or ecoregions. These would include summary statistics for key parameters regardless of whether they have a water quality standards criterion. Such summaries would be useful for CWA program functions including the development of wasteload allocations and water quality criteria, and most likely for other purposes.
- Annually develop a list of fact sheets to produce by the end of the year covering topics of interest. Create five fact sheets each year to achieve the goal of public information dissemination. The fact sheets should be linked to hot topics updated by DNR communications specialists.

Automated Reports / Internet Applications / Websites

Strengths:

- The mini-report for HUC8 watersheds provided consistent, timely information to the program's audiences by inserting the information directly from databases into a template report. This reduces the need for staff to prepare individual summaries as requests come in from the public. The WQI has also been a widely adopted mechanism for reporting on overall water quality for the State. The WQI is a good way of summarizing water quality for Iowa overall because it includes important pollutants for which water quality standards do not currently exist (e.g., phosphorus and total suspended solids).

- The Ambient Stream Monitoring Program web page provides a public portal to useful information about the program and links to other relevant information. Existing web sites make detailed water quality information available to the public that potentially affects human health. CWA Section 305(b) assessments and Section 303(d) listings are available via the ADBNet internet application. The Water Monitoring and Watershed Atlas application offers a map-based interface to search for monitoring sites and obtain data via the IASTORET application. These web pages and applications have been useful to DNR staff in preparing the Integrated Report and responding to water quality-related inquiries from the public.

Weaknesses:

- The HUC8 mini-report function is currently broken and staff are no longer available to fix and maintain it.
- Some of the parameters included in the WQI are no longer monitored, and the lack of data for these parameters reduces its overall usefulness.
- Automated reports and data applications such as IASTORET are weak on data summarization and interpretation (e.g., seasonal patterns and trends), thus leaving this up to the person viewing the data.

Recommendations:

- Continue to expand and improve monitoring-related internet applications. For example, a re-designed version of ADBNet (in-progress) will be more user-friendly, especially regarding interactive mapping features. The development of ambient stream water quality data summarization capabilities like those offered by the BioNet (stream bioassessment) application would be a step in the right direction.
- Work with DNR IT and GIS staff to restore the mini-report application for HUC8 watersheds.
- Finish developing template reports for priority parameters and water quality issues.
- Consider using affordable surrogate analysis methods such as the ELISA atrazine test to allow pesticide data to be collected and used again in the calculation of the WQI.

Program Coordination and Evaluation

<u>Monitoring Partnerships</u>

Strengths:

- The program has built strong partnerships with state, federal, and local entities and has collaborated on a variety of stream monitoring activities, including the development of a water quality sensor network, stream gages, and watershed-based monitoring.
- The monitoring strategy update process seeks stakeholders input and feedback and it strengthens the monitoring program.
- Given limited resources, partnering with other monitoring agencies (e.g., Iowa State/COE and USGS) allows wider monitoring coverage of the state’s surface waters.
- Interactions between monitoring agencies have been positive with a willingness to either modify monitoring protocols or cooperate to fill-in monitoring gaps.
- Non-DNR monitoring agencies have, in general, been willing to share results of monitoring, and these data have been used to increase the number of surface waters assessed for the CWA Integrated Report.

Weaknesses:

- Coordination is often done ad-hoc without an overall structure or goal. It has relied more on the individual efforts of staff rather than a strategic program coordination effort.
- Not all monitoring organizations in Iowa are willing to share their results with the DNR for purposes of the CWA Integrated Report.
- Among monitoring programs operating in Iowa there are inconsistencies regarding monitoring parameters, sampling frequency, etc., which impact the ability of each program to utilize shared data.
- Available data are not adequate to support the needs of the Water Quality Standards and Wasteload Allocation programs. More collaboration with federal water quality and land management agencies,

academic institutions, and other monitoring entities is needed to maximize the use of data collected outside of the DNR.

Recommendations:

- Consider establishing a state monitoring council that would meet periodically (e.g., once per year) for the purpose of building relationships and understanding the priorities and data needs of monitoring programs in Iowa. These efforts could lead to greater monitoring collaboration and resolution of data sharing/utilization issues.
- Develop a working group to discuss and plan coordination efforts for stream monitoring both within and outside the DNR. The working group could serve as a formalized mechanism to share information from the participating entities and may allow for collaboration and shared funding for monitoring priorities. The group could also serve to transfer knowledge on monitoring tools/techniques/ methods and identify duplication or repetitive monitoring efforts, thus allowing partners to maximize efficient use of resources.

Stakeholder / Technical Advisor Input

Strengths:

- A Technical Advisory Committee (TAC) used to meet quarterly to provide input to the ambient monitoring program. As the program matured, the need for this input was not as great and TAC meetings have not been held in recent years. Having the feedback and support of this diverse group helped to keep the monitoring program relevant to stakeholders and the public.

Weaknesses:

- The lack of a TAC or stakeholder group reduces the input of partners on monitoring goals, objectives, etc. and doesn’t allow for partners to come to the table with resources they might be willing to share for common goals.

Recommendations:

- Create a standing workgroup of technical advisors to evaluate program objectives, monitoring design and reporting issues on a yearly basis (see recommendations above relating to establishment of a monitoring coordination workgroup or council). It is unlikely that one over-arching group will achieve all of the goals (especially as it relates to sharing technical information); however, it could be used to form short-term discussion groups as necessary.

Performance Review, Needs Assessment, Strategy Update

Strengths:

- In previous years, program staff would meet with a stakeholder group at the annual monitoring conference. These meetings were a useful way of learning about stream monitoring data needs.

Weaknesses:

- Regular and systematic reviews of the program are no longer completed. Consequently, the program is more likely to become disconnected from stakeholder needs. The lack of review can also make it harder to adjust the program to address issues that periodically arise.
- The program lacks a mechanism to receive feedback for continuous improvement.

Recommendations:

- Re-establish a TAC or other advisory groups to provide for continuing assessment of monitoring needs. A TAC would help to ensure that the monitoring program remains aligned with its core functions and monitoring objectives while also ensuring that new topics, priorities, and issues are addressed in a timely manner and before they become a critical gap in need of urgent attention.
- Periodically review the ambient monitoring strategy and receive continual feedback from internal (DNR) and external stakeholders.

Wetland Monitoring

Description

The ambient wetland monitoring program has monitored prairie pothole (30 sites) and riverine (30 sites / 10 per year) wetlands in recent years. Both monitoring initiatives featured a probabilistic, random sampling design. A shallow lake monitoring program is also conducted; however, this monitoring is done primarily to serve the shallow lakes restoration initiative and not as a sustained ambient monitoring project. The ambient monitoring objectives consist of status and trends reporting, water management program support, water quality standards development, and public information.

Sampling of prairie pothole and riverine wetlands is conducted once within the designated May – September index period. The core monitoring indicators are biological assemblages (aquatic macrophytes, benthic macroinvertebrates, and fish), physical habitat indicators, and water quality parameters (field and laboratory analytes). The data are stored on DNR network drives and not currently directly available to the public via online databases. In the past year, an annual report was prepared to inform the general public about wetland monitoring and to fulfill (USEPA) grant requirements. A conference presentation on wetland monitoring was also made in the past year to further disseminate information about this new monitoring initiative.

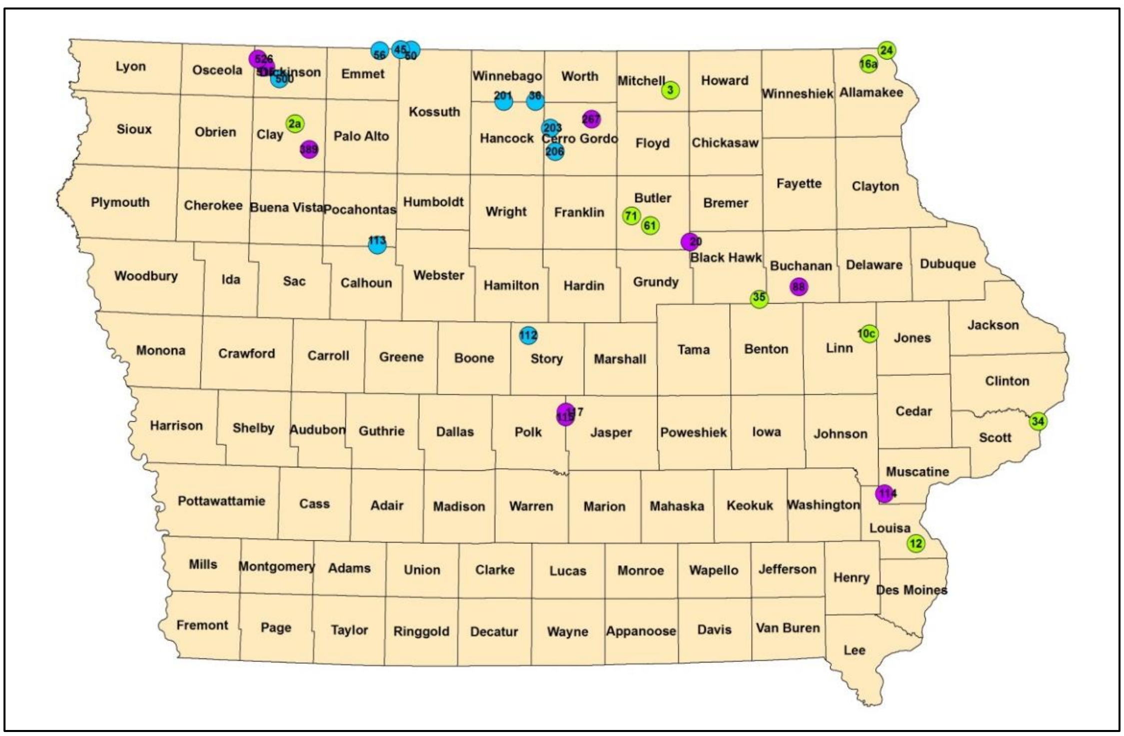

Figure 7. Ambient least disturbed reference wetland sites (2015).

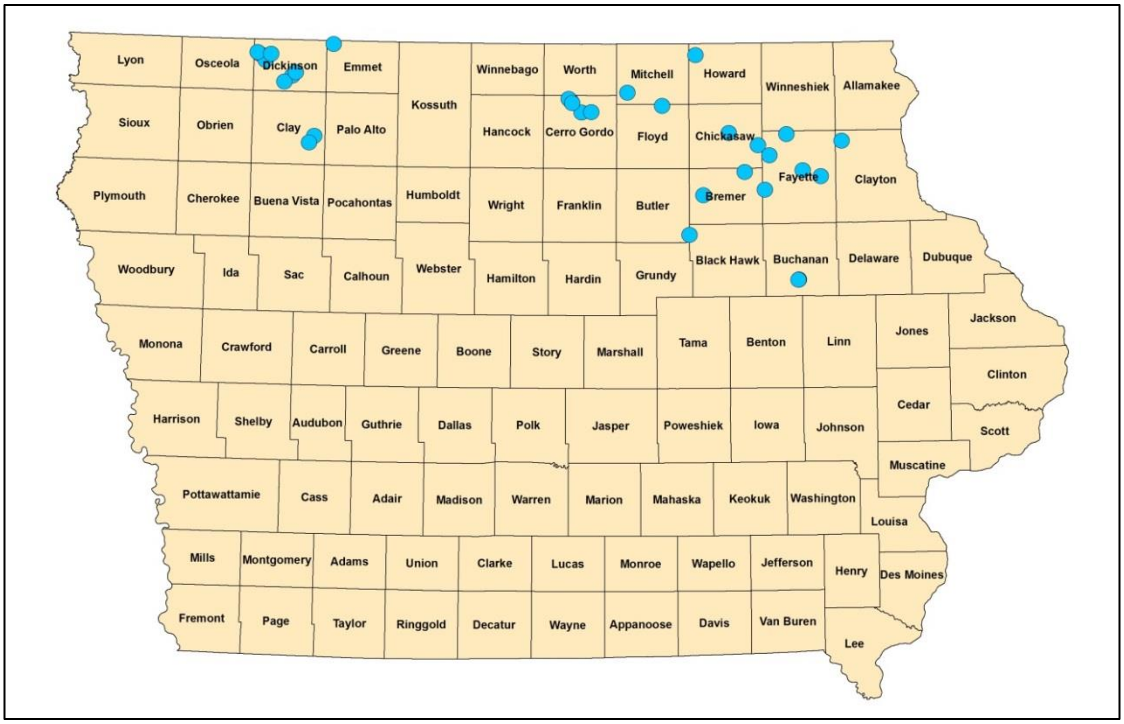

Figure 8. Ambient fen wetland sampling sites (2006).

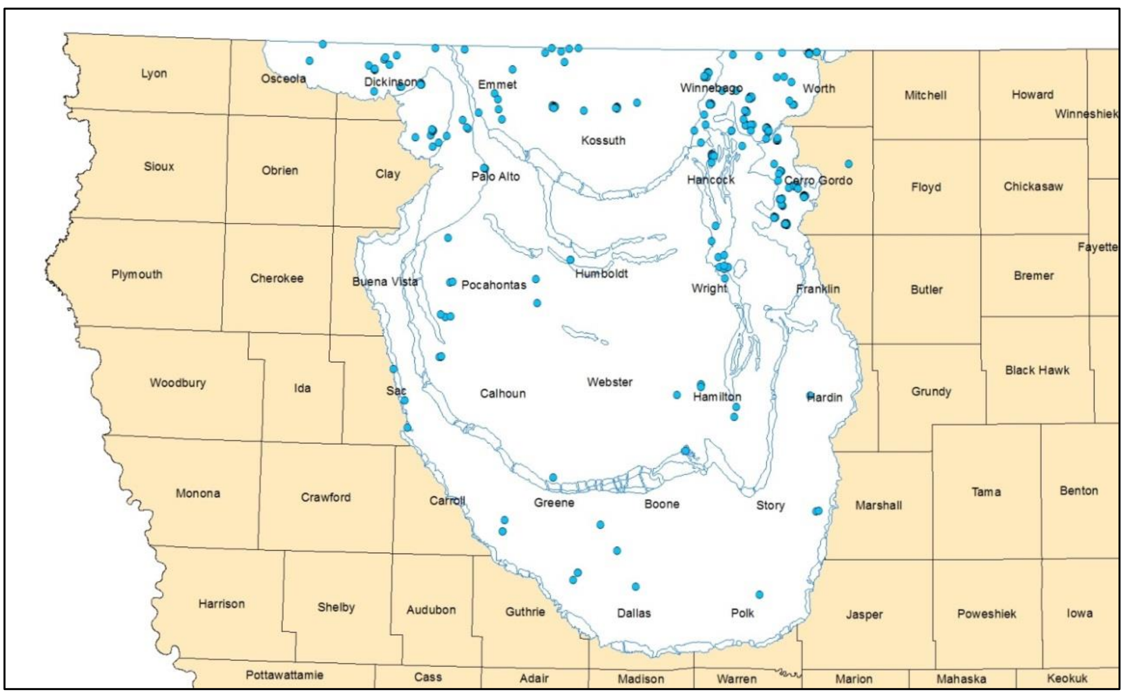

Figure 9. Ambient prairie pothole wetland probabilistic sampling sites and the Des Moines Lobe of the Wisconsinan Glacial Advance.

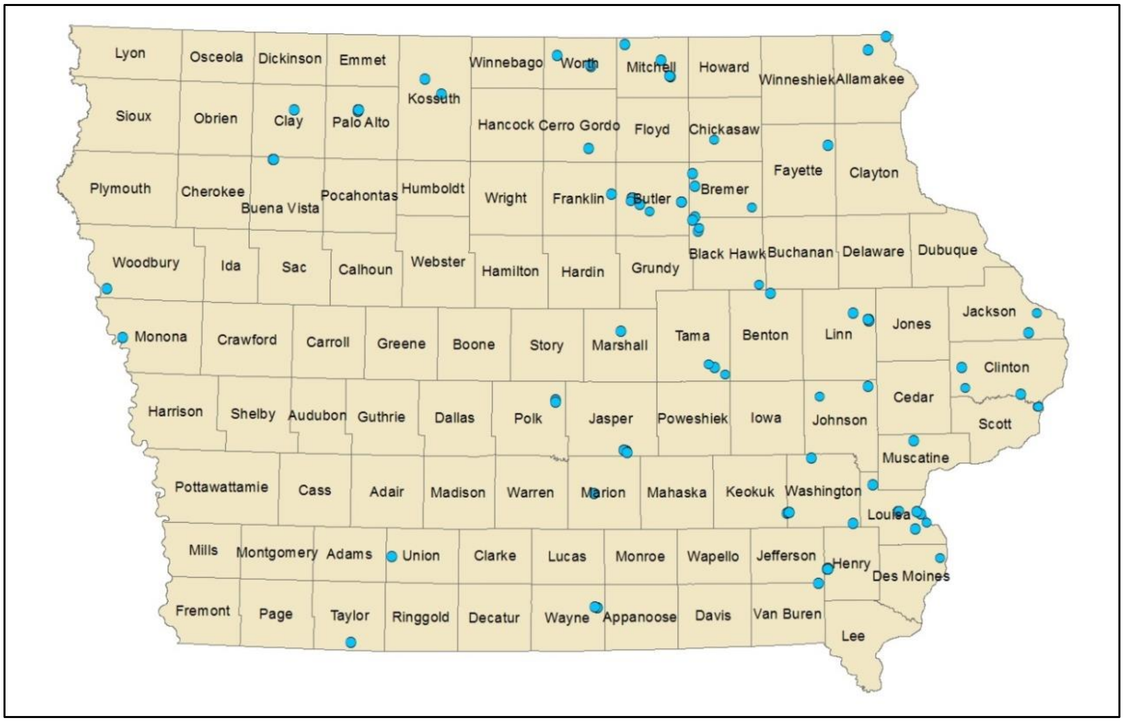

Figure 10. Ambient riverine wetland probabilistic sampling sites.

Strengths, Weaknesses, and Recommendations for Improvement

Monitoring Objectives / Questions

Strengths:

- Monitoring activities are aligned with the following objectives:
  - Collecting statewide baseline data for future establishment of water quality standards;
  - Determining water quality status and trends with a statewide reference network for fen, pothole, and riverine wetlands.

Weaknesses:

- (none noted)

Recommendations:

- Continue to track activities in other states (e.g., Missouri) to determine the protocol and parameters used in developing standards and the processes used to implement wetland standards.

Sampling Design

<u>Site Network Type (e.g., census, fixed, probabilistic, reference, rotational, etc.)</u>

Strengths:

- The monitoring network includes fixed reference sites located in fen, pothole, and riverine wetlands plus randomly selected wetland sites added annually.

Weaknesses:

- (none noted)

Recommendations:

- (none noted)

<u>Number and/or Spatial Distribution of Sampling Locations</u>

Strengths:

- The distribution of wetland reference sites is statewide by wetland type: fen, pothole, and riverine.

Weaknesses:

- The monitoring network lacks sites in Southcentral, Southwest, and Western Iowa. Consequently, it does not provide true regional or statewide representation of wetland condition.

Recommendations:

- Alleviate site distribution issues by hand-selecting sites in regions of the state where the GIS random selection process typically doesn't find any sites.

<u>Sampling Frequency</u>

Strengths:

- Water quality analytes are sampled three times at evenly-spaced intervals during the summer. Biological indicator assemblages (aquatic macrophytes, fish, and benthic macroinvertebrates) are sampled once per summer.

Weaknesses:

- (none noted)

Recommendations:

- (none noted)

<u>Parameters</u>

Strengths:

- The core monitoring parameters cover biological, chemical, and physical components of wetland ecosystems.

Weaknesses:

- Due to budget constraints, the program is unable to obtain data for emerging contaminants at all wetland monitoring sites. The data is not likely to be used to develop water quality standards; however, it would be useful to have for each monitoring site in order to effectively gage wetland condition/health.

Recommendations:

- As additional funding becomes available, choose parameters and sample emerging contaminants at each wetland monitoring site and not just a small subset of sites.

Data Management

<u>Data Entry, Storage, Retrieval</u>

Strengths:

- Some of the wetland monitoring data is entered into DNR's new EQuIS water quality database.

Weaknesses:

- Not all of the wetland data from previous monitoring years has been entered into EQuIS database, which means the data is not accessible to everyone.
- Currently, the task of entering the data into EQuIS must be shared with DNR staff outside of the wetland monitoring program. The data must also be aligned to fit a particular format for entry into EQuIS, which can place an additional burden on staffing resources.

Recommendations:

- Continue uploading wetland data sets to EQuIS. Additional seasonal staff assistance may be needed to convert the original data format to an EQuIS-compatible format.

<u>Quality Assurance / Quality Control (QA/QC)</u>

Strengths:

- Data entered by seasonal staff are checked by full-time DNR staff before being stored in EQuIS.

Weaknesses:

- Field data sheets can sometimes be very hard to read due to challenging sampling conditions, inclement weather, or poor handwriting. When field sheets are difficult to read there is a greater potential to make mistakes when transferring the data to an electronic storage format.

Recommendations:

- Only water-resistant or waterproof paper should be used for field data sheets and training provided to seasonal staff should reinforce the importance of legibility when recording field data.

Products and Services

Data Analysis and Interpretation

Strengths:

- Data analysis results and interpretation are contained in an annual report.

Weaknesses:

- The monitoring data are not currently used for determining impairments of wetland designated uses because of the lack of completed use attainability assessments (UAA) and water quality standards criteria for many wetland monitoring parameters.

Recommendations:

- Develop and implement wetland water quality standards.

Fact Sheets, Reports

Strengths:

- Annual reports are generated for wetland monitoring sites.

Weaknesses:

- Wetland monitoring reports have limited visibility and dissemination to the general public because of staffing limitations. The DNR wetlands monitoring website is the only place where the public can access the reports.

Recommendations:

- Continue to post reports on the DNR wetland monitoring website, but also utilize current and past project partners to disseminate reports for greater visibility and public awareness of wetland health.

Automated Reports / Internet Applications / Websites

Strengths:

- The wetlands monitoring program has a web page that provides information about the program and is accessible through the DNR's ambient monitoring home web page.

Weaknesses:

- The wetlands monitoring website is not updated regularly with data and reports and lacks information to inform the general public of wetland health.

Recommendations:

- Provide wetlands monitoring staff with better access to the wetland website for timely updates of data and reports. Staff need to supply more products to update the wetland website annually.

Program Coordination and Evaluation

Monitoring Partnerships

Strengths:

- Staff of the wetlands monitoring program work very closely with county, private, and state entities to collect data and disseminate the data back to the public and land managers that grant access to wetland sites.

Weaknesses:

- Access to wetland sites located on private land is becoming more challenging to obtain with changing landownership over time. Privately-owned wetlands make up a very large percentage of wetlands statewide and without being able to include them in current and future monitoring activities the program will not be able to accurately represent the overall health of Iowa's wetlands.

Recommendations:

- Seek new private landowners who are willing to work with the monitoring program to evaluate wetland health. Wetland monitoring staff should also work to build upon current relationships with private landowners who allow monitoring to occur on their land and should continue to respect the land they have been given permission to access.

<u>Stakeholder / Technical Advisor Input</u>

Strengths:

- Wetland monitoring staff communicate with individuals from Iowa State University as well as local county and state governments regarding wetland monitoring activities and data collection. The Wetland Program Plan for Iowa, developed with a grant from the USEPA, will serve as the new guidance document for monitoring Iowa wetlands.

Weaknesses:

- There needs to be more cohesiveness in data collection and sharing of data, monitoring plans and strategies amongst the wetland monitoring community. Doing so will allow for a more comprehensive impact statement of wetland health statewide and will eliminate or reduce redundancy in sampling and data collection.

Recommendations:

- Implement the new Iowa Wetland Program Plan statewide in cooperation with wetland monitoring partners and resource managers. Doing so will greatly improve collaboration for wetland monitoring and data sharing.

<u>Performance Review, Needs Assessment, Strategy Update</u>

Strengths:

- A review of monitoring program performance, protocol, data collection strategies, sites, equipment needs, etc. is conducted on an annual basis.

Weaknesses:

- Iowa State University has completed at least one project and is continuing work in a second project for the development of a wetland Index of Biotic Integrity (IBI) protocol. The monitoring program has yet to implement any of their work and recommendations to date because the protocol is still being refined. Implementation of IBI methods will likely impact monitoring protocols in the future.

Recommendations:

- Once the IBI protocol is completed, DNR staff should evaluate the potential benefits to the wetland monitoring program and decide whether the protocol should be implemented.

Recommendations and Implementation Plan

Prioritization of Monitoring Improvements

Based upon the input received from stakeholders and technical experts, along with the results of the internal program review, the strategy team developed a master list of 153 monitoring improvement recommendations. In keeping with U.S. Environmental Protection Agency (2003) guidance (see Appendix 3), the recommendations address all aspects of a comprehensive ambient monitoring program, including: 1) monitoring objectives; 2) sampling design; 3) data management; 4) data analysis and interpretation; 5) products and services; and 6) program coordination and evaluation.

A systematic process was used to identify the recommendations of highest priority for implementation. The DNR strategy development team and monitoring coordinators evaluated and rated the individual recommendations for (a) potential impact (i.e., benefit to the ambient program) and (b) implementation difficulty. The guidelines used to evaluate and rate the recommendations are listed in Appendix 3. Generally, each recommendation was rated on a scale from 1 (low) to 5 (high) for its anticipated positive impact on the ambient monitoring program and the achievement of program objectives. Implementation difficulty was rated in three separate subcategories: external costs, staffing needs, and technical complexity. Additional implementation challenges, such as the necessity to coordinate with other programs or external partners, were also rated. The impact subcategory ratings from 1 (low) to 5 (high) were then summed to obtain a total, overall difficulty rating for each recommendation.

The strategy team compared and discussed their individual ratings and arrived at a consensus rating for each recommendation. The consensus ratings were then ranked to prioritize the master list of 153 recommendations. The conceptual impact vs. difficulty matrix plot shown in Figure 11 served as a framework for establishing priorities. The DNR previously has used this matrix as a tool for continuous improvement planning. Figure 11 shows four categories or quadrants that represent different combined levels of program impact and implementation difficulty.

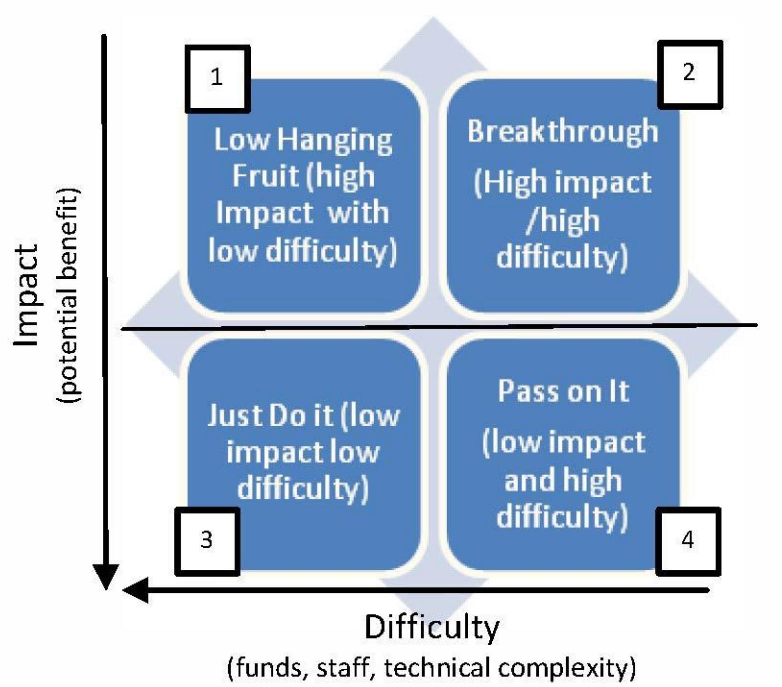

Figure 11. Conceptual matrix and quadrants used to guide the prioritization of monitoring improvement recommendations.

Figure 12 shows the results of applying the matrix to the master list of 153 recommendations. The exact positioning of the lines separating the quadrants was done keeping in mind the current availability of monitoring resources. For example, Quadrant 1 contains the first tier of recommendations which are thought to be achievable with current funding and staffing resources. Quadrant 2 was further subdivided into two parts: (2a) high impact recommendations that cannot be achieved without a significant reallocation of existing resources and/or moderate increase in monitoring resources; and (2b) high impact recommendations that cannot be achieved without a substantial increase in monitoring resources.

Below is a brief description of the quadrants and what they encompass. A full listing of the 153 recommendations including descriptions, impact/difficulty ratings, and quadrant assignments can be found in Appendix 3.

Quadrant 1 – First implementation tier at current funding and staffing levels:

- High-to-moderately high program impact and low-to-moderately low implementation difficulty;
- Criteria: Impact rating of 4 or 5, Difficulty (sum) rating of 6 or less, and Difficulty (cost) rating of 2 or 1;
- 48 recommendations match the criteria.

Quadrant 2a – Second implementation tier requiring a significant reallocation of existing resources and/or moderate additional resources:

- Moderately high-to-high program impact and moderate- to-moderately high implementation difficulty;
- Criteria: Impact rating of 4 or 5 and Difficulty (sum) rating of 8, 7, or 6 (the latter with cost rating of 3);
- 28 recommendations match the criteria.

Quadrant 2b – Third implementation tier requiring substantial additional resources:

- Moderately high-to-high program impact and moderate-to-moderately high implementation difficulty;
- Criteria: Impact rating of 4 or 5 and Difficulty (sum) rating of 9 or higher;
- 22 recommendations match the criteria; these represent high impact “breakthrough” recommendations that would become higher priorities if substantial additional resources were made available.

Quadrant 3 - Not currently a priority for implementation:

- Low-to-moderate program impact and low-to-moderately low implementation difficulty;
- Criteria: Impact rating of 3 or less, Difficulty (sum) rating of 6 or less, and Difficulty (cost) rating of 2 or 1;
- 44 recommendations currently match the criteria;
- The list of recommendations should be reviewed periodically to determine which can be easily; accomplished without impacting the implementation of higher priority recommendations.

Quadrant 4 - Not currently a priority for implementation:

- Low-to-moderate program impact and moderate-to-moderately high implementation difficulty;
- Criteria: Impact rating of 3 or less; Difficulty (sum) rating of 7 or higher;
- 11 recommendations currently match the criteria;
- The list of recommendations should be reviewed periodically to update priority status; particularly for recommendations that received ratings of “moderate” for cost and staffing.

First Tier

The first implementation tier (Figure 12; Quadrant 1) includes 48 recommendations (Table 7) that received ratings of high potential impact and low-to-moderately low implementation difficulty. The recommendations encompass the ten elements of a comprehensive monitoring program (U.S. EPA 2003; see Appendix 2) and include making improvements to all of the individual ambient monitoring projects: fish tissue (2 recommendations); groundwater (3); lake/reservoir (6); stream biological (16); stream water quality (13); and wetland (8).

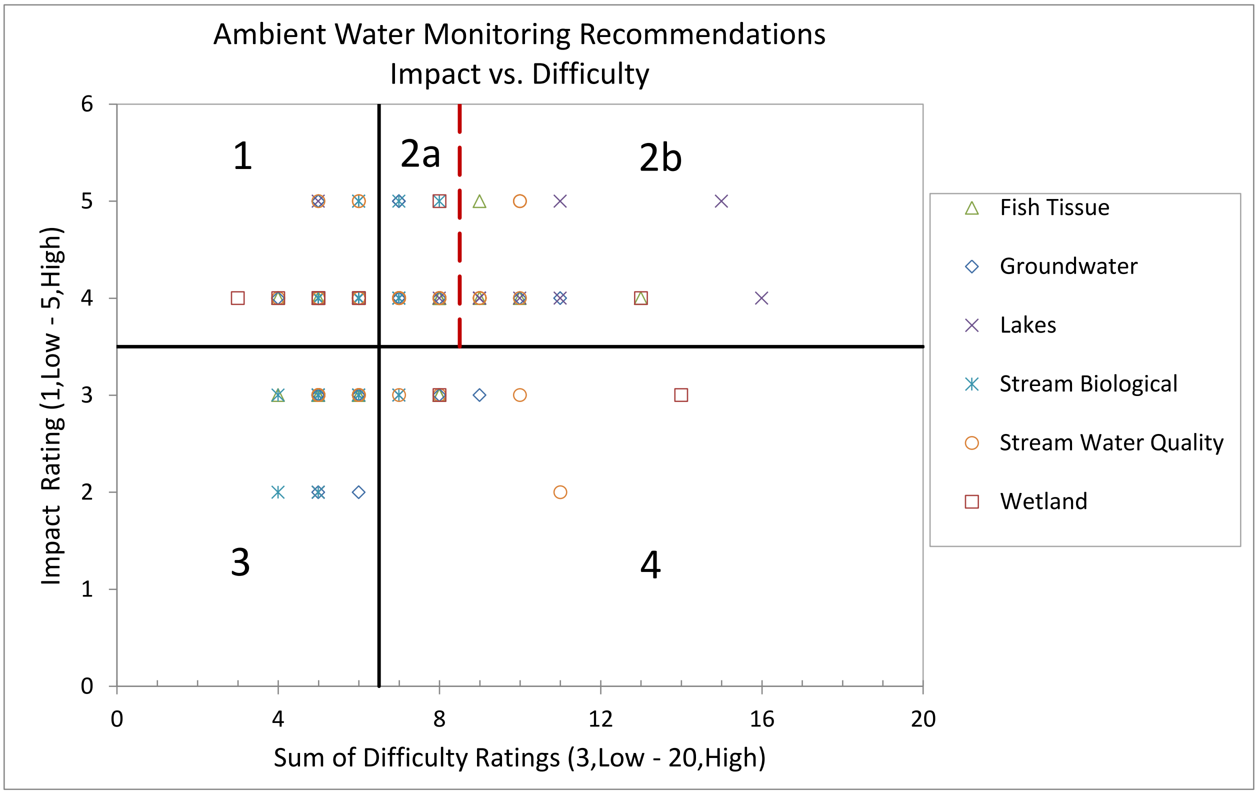

Figure 12. Distribution of ambient monitoring improvement recommendations within four quadrants of the impact vs. difficulty decision matrix (adapted from Figure 11). Quadrant 2 has been subdivided into recommendations of moderate-to-moderately high difficulty (2a) and moderately high-to-high difficulty (2b).

It is anticipated that the first tier of recommendations can be implemented within a five-year period assuming that funding and staffing resources remain at current levels. The timeline projections only include the length of time needed to fully develop and initiate the improvement. They do not include any additional period of time in which implemented tasks continue in routine operation mode, for example, ongoing trend monitoring data collection that continues indefinitely. It is also assumed that existing or unforeseen work responsibilities will not overtax the availability of monitoring staff and prevent the recommendations from being implemented.

Number of first-tier monitoring improvement recommendations (Matrix Quadrant #1) by ambient monitoring program area and anticipated implementation timeline:

Program Component	Implementation Timeline	
	One year or less	**>1-5 years**
Monitoring Objectives	2	1
Sampling Design	14	4
Data Management	8	-
Products and Services	8	5
Program Coordination and Evaluation	3	3

Most of the first tier recommendations involve work that can be completed in-house by DNR staff. The work includes tasks such as developing sampling plans, managing and analyzing data, preparing reports, and increasing program coordination and evaluation efforts. A full listing of the first-tier recommendations is provided in Table 7; several examples are provided below.

Examples:

Monitoring objectives:

- Evaluate ambient monitoring objectives and align monitoring design pieces to fit the objectives.

Sampling Design:

- Modify existing sampling designs by:
  - expanding the sampling season for fish tissue monitoring;
  - conducting annual or bi-annual sampling at stream biological trend monitoring sites.
- Develop new sampling designs, plans, or procedures for:
  - addressing inadequacies in the list of monitoring parameters;
  - collecting and assessing in-situ continuous monitoring data for lake and stream water quality parameters;
  - repeating probabilistic (statistical) stream surveys every 5 to 10 years;
  - choosing wetland monitoring sites in regions of the state where the GIS-based random selection process is not effective.

Data Management:

- Complete the upload of 2014 ambient groundwater data and future data sets into EQuIS. Assess the best methods for making historical groundwater records available both to internal DNR staff and the public.
- Develop a "How-to" guide that walks new and inexperienced users through the web retrieval of data.
- Create a user group to provide feedback on the usability of the data retrieval functions and provide suggestions on how to make retrieval more understandable to users outside of the DNR.
- Use EQuIS database functions more fully to enhance quality assurance; for example, graphing the data as it comes into the system to show outliers and other suspect data points.

Products and Services:

- Annually update the fish tissue monitoring fact sheet and make it more easily accessible from the website.
- Continue issuing regular groundwater monitoring reports.
- Develop lake monitoring reports for public distribution on a regular basis (e.g., biennially).
- Prepare summaries of ambient stream water quality monitoring data for the entire state, individual monitoring sites, river basins (e.g., HUC8 basins), or ecoregions.
- Continue to post reports on the DNR wetland monitoring website, and also utilize current and past project partners to disseminate reports for greater visibility and public awareness of wetland health.
- Program Coordination & Evaluation:
- Periodically review the ambient monitoring strategy and receive continual feedback from internal (DNR) and external stakeholders.
- Develop a technical advisory team within the DNR to address department-wide goals, needs, and priorities for lake management, monitoring and assessment, and restoration.
- Implement the new Iowa Wetland Program Plan statewide in cooperation with wetland monitoring partners and resource managers.

Second Tier

The second tier (Figure 12; Quadrant 2a) consists of 28 recommendations that received ratings of high potential impact and moderate-to-moderately high implementation difficulty. These recommendations can only be implemented if accompanied by a significant reallocation of existing funding and staffing resources and/or moderate increase of resources (Table 8). Many of the recommendations involve advanced, time-consuming technical work such as statistical data analysis or computer programming. Several recommendations would require a moderate increase in funding to support the collection of additional data.

Examples:

Sampling Design:

- Identify groundwater monitoring areas and questions for which greater statistical representation is necessary and increase the numbers of samples collected to appropriate levels.
- Periodically sample for algal toxins and emerging contaminants to allow for long-term trend analysis and to prepare for anticipated USEPA guidance and standards for algal toxins in Class A (recreational use) waters.
- Increase the number of river fish tissue trend monitoring sites by approximately fifteen to cover all the major rivers in Iowa.

Data Management:

- Refine the fish tissue database to allow easier access and use of the data. Investigate the possibility of entering Iowa's ambient fish tissue data into a national database (e.g., STORET, WQX) so that it can be included in regional and national studies of tissue contaminant levels.
- Continue to build data reporting capabilities within the EQuIS database. For example, graphs of data can be updated automatically as new data are added. This particular feature would assist staff with quality assurance work and generating monitoring reports for stakeholders and the public.

Products and Services:

- Complete annual assessments of water quality trends in concentrations and loads to align with the Nutrient Reduction Strategy. Examine other water quality influences such as stream flow, seasonality, land use, management actions, policies, and regulations on a less frequent basis (e.g., approximately five years) as these things tend to change more slowly.
- Continue to expand and improve monitoring-related internet applications. For example, a re-designed version of ADBNet (in-progress) will be more user-friendly, especially regarding interactive mapping features. The development of ambient stream water quality data summarization capabilities like those offered by the BioNet (stream bioassessment) application would be a step in the right direction.

Third Tier

The third tier contains 22 recommendations (Figure 12; Quadrant 2b) that were given ratings of high potential impact and moderately high-to-high difficulty. These recommendations can only be implemented with a substantial increase in monitoring resources as indicated in Table 8. Some of the recommendations involve work that requires specialized skills that are not widely available among DNR staff (e.g., development of an online database), or they involve significant new sampling costs associated with increases in site coverage, monitoring parameters, or sampling frequency.

Examples:

Sampling Design:
- Add fixed monitoring stations in coldwater streams and small warmwater streams representing all of Iowa's designated use classifications and ecological regions. This monitoring data would allow DNR to better understand, assess, and protect water quality conditions in largely un-monitored stream types.
- Extend monitoring to multiple locations within many lakes on a rotational basis. This will provide data needed to understand how the arms of impoundment lakes may function differently than in the main basin where monitoring usually occurs.
- Designate sentinel stream monitoring stations and use them to implement monitoring enhancements, such as expanding the list of monitoring parameters to include pesticides and pharmaceuticals or increasing sampling frequency to improve pollutant load estimation.
- Increase the inventory of wells for future groundwater sampling efforts by working with small community water supplies including state parks, county conservation areas, industrial users, and private well users.

Products and Services:
- Create a new online lake information system capable of providing lake stakeholders and public with access to monitoring data and interpreted water quality information for individual lakes and the monitoring network as a whole.
- Develop and implement wetland water quality standards.

Create a web-based interactive map providing access to fish tissue contaminant monitoring data and consumption advisory information. Further expand access to the data/information by developing an application for smartphones.

Table 7. First tier of recommendations to be implemented with current funding and staffing resources (Figure 12; Quadrant #1).

Rcmd. #	Program	Category	Recommendation	Impact Rating	Difficulty Rating	Implementation Timeline
FT-6	Fish Tissue	Sampling Design	• Expand the sampling season earlier (April and May) to include the collection of seasonally highly consumed fish (e.g., White Bass). This will allow the program to provide fish consumption advice to a potentially at risk population.	4	4	<1 yr.
FT-16	Fish Tissue	Prod. & Services	• Annually update the fact sheet (or produce something similar) and make it more easily accessible from the IFTMP website.	4	5	<1 yr.
GW-9	Ground Water	Data Mgmt.	• Complete the upload of 2014/2015 data and future data sets into EQuIS. Assess the best methods for making historical records available both to internal DNR staff and the public.	5	5	<1 yr.
GW-16	Ground Water	Prod. & Services	• Continue issuing regular reports.	5	5	<1 yr.
GW-19	Ground Water	Prod. & Services	• Regularly review the DNR groundwater website to ensure that web links are functional and all other information is up-to-date. Work with partner organizations to direct the public to this resource by posting links on their websites.	4	4	<1 yr.
LR-8	Lake & Resrv.	Sampling Design	• Biological components – Form an interdepartmental technical advisory team to evaluate needs and identify existing sources of data (e.g., Fisheries Bureau monitoring) that could be used to address weaknesses. Develop sampling procedures and a methodology for assessing biological condition and habitat. Incorporate them in the Ambient Lake Monitoring Program over time.	5	5	<1 yr.
LR-11	Lake & Resrv.	Sampling Design	• Continuous monitoring data – With the assistance of a technical advisory team, develop a framework for incorporating in-situ continuous monitoring data into lake water quality analyses and designated use assessments. The framework will help the program efficiently manage and utilize this type of data as its availability is expected to increase in the future.	4	6	>1 - 5 yrs.
LR-17	Lake & Resrv.	Prod. & Services	• Develop reports for public distribution on a regular basis (e.g., biennially with the 305(b) cycle).	4	6	>1 - 5 yrs.
LR-18	Lake & Resrv.	Prod. & Services	• Form a technical advisory team within the DNR to work on data analysis, interpretation, and reporting on topics of interest to the scientific community, lake stakeholders, and the general public.	4	6	>1 - 5 yrs.
LR-21	Lake & Resrv.	Pgrm. Coord. & Eval.	• Meet regularly with partner agencies to review annual monitoring plans and develop future plans.	4	5	<1 yr.

Table 7. First tier of recommendations to be implemented with current funding and staffing resources (Figure 12; Quadrant #1).

Rcmd. #	Program	Category	Recommendation	Impact Rating	Difficulty Rating	Implementation Timeline
LR-22	Lake & Resrv.	Pgrm. Coord. & Eval.	• Develop a technical advisory team within the DNR to address department-wide goals, needs, and priorities for lake management, monitoring and assessment, and restoration. Better coordination at the technical level will help the monitoring program to better serve a variety of stakeholders and help guide the monitoring program to meet current and future objectives.	4	6	>1 - 5 yrs.
SB-1	Stream Biolog.	Monitor. Objectv.	• Meet periodically with the DNR water quality standards program to identify monitoring objectives that better serve WQS program needs relating to UAA and TALU development. Increased communication and coordination will be beneficial to both programs.	4	5	<1 yr.
SB-2	Stream Biolog.	Sampling Design	• Develop a rationale and criteria for choosing candidate reference sites representing coolwater streams and nonwadeable rivers. Apply the criteria to identify the locations of 10-20 candidate reference sites for each stream subclassification. The selection of candidate reference sites for coolwater streams and nonwadeable rivers is an important step toward obtaining appropriate data for the development of bioassessment criteria that apply to all stream types in Iowa.	4	6	<1 yr.
SB-5	Stream Biolog.	Sampling Design	• As funding is available, establish a network of fixed monitoring sites for long-term trend monitoring of stream biological condition and climate change indicators. Insure that the network provides adequate representation of ecoregions and stream types. A fixed network of sites that is monitored annually will significantly add to the trend monitoring capabilities provided by the current reference site network that is sampled on a four-year rotation.	4	5	<1 yr.
SB-6	Stream Biolog.	Sampling Design	• Choose candidate reference sites to address deficiencies in the distribution and number of CW and WW reference sites. As funding becomes available, sample the candidate reference sites and use the data to confirm or deny reference status. Repeat the first two steps until reference site representation targets have been met. This process will lead to a stronger network of reference sites and reference condition data that will provide greater confidence in biological assessments for the CWA Integrated Report.	4	6	>1 - 5 yrs.
SB-7	Stream Biolog.	Sampling Design	• Define large river bioassessment data collection needs and develop a sampling strategy to meet them. Incorporate the strategy in the bioassessment program’s five-year master plan. The sampling strategy will ensure that appropriate data are collected for the development of bioassessment criteria and to fulfill status and trends monitoring objectives.	5	6	<1 yr.
SB-8	Stream Biolog.	Sampling Design	• Establish guidelines for determining the appropriate number and location of bioassessment sites to represent a stream segment or a watershed. Consistent site selection guidelines will lead to greater confidence in biological assessments for the CWA Integrated Report and will better serve the needs of DNR’s water quality programs (e.g., TMDL, 319, and NPDES).	4	5	<1 yr.

Table 7. First tier of recommendations to be implemented with current funding and staffing resources (Figure 12; Quadrant #1).

Rcmd. #	Program	Category	Recommendation	Impact Rating	Difficulty Rating	Implementation Timeline
SB-9	Stream Biolog.	Sampling Design	• Establish a clear rationale for selecting biological and climate trend monitoring sites. The rationale needs to address considerations such as number of sites and representativeness as well logistical considerations for successful long-term data collection. For example, a minimum of approximately seven climate change monitoring sites is needed to participate in the USEPA's Regional Monitoring Network (RMN) initiative for the Region VII states of Iowa, Kansas, Missouri, and Nebraska. Determining the appropriate number and locations of sites will insure the validity and relevance of the trend monitoring data.	4	6	<1 yr.
SB-10	Stream Biolog.	Sampling Design	• Develop a plan for repeating probabilistic surveys every five-to-ten years to generate statistical estimates for stream condition indicators with known statistical confidence. Implementing this plan is the only realistic way for the ambient monitoring program to report comprehensively on status and trends of Iowa's rivers and streams.	5	6	<1 yr.
SB-11	Stream Biolog.	Sampling Design	• Establish temporal monitoring sites in larger rivers. Doing so will benefit bioassessment criteria development by providing data to document seasonal variability in biological metrics and for determining the appropriate bioindex sampling period for obtaining consistent bioassessment data.	4	5	>1 - 5 yrs.
SB-12	Stream Biolog.	Sampling Design	• As funding becomes available, add annual or bi-annual sampling at a proposed network of fixed trend monitoring sites. Conducting annual trend monitoring at least disturbed reference sites would complement efforts to examine trends using data obtained from randomly selected sites in probabilistic surveys completed on a 5-10 year schedule.	4	6	<1 yr.
SB-13	Stream Biolog.	Sampling Design	• Develop a climate trend monitoring plan that meets the sampling frequency requirements for participation in a (USEPA) Regional Monitoring Network. Conduct biological and climate trend monitoring at the same sites for cost savings and to enhance data analysis opportunities.	4	6	>1 - 5 yrs.
SB-16	Stream Biolog.	Sampling Design	• Research and determine which watershed condition indicators are the most useful for bioassessment purposes. Define the data sources and procedures for quantifying each indicator. Develop a plan to systematically gather and analyze watershed data including an estimate of GIS technical assistance needs for updating the data in a timely manner. These steps should help to clarify watershed indicator data needs and organize the process for acquiring these data in the future.	4	6	<1 yr.
SB-20	Stream Biolog.	Data Mgmt.	• Determine if the recently updated bioassessment SOP can serve as a QAPP; if not, develop a QAPP for the program.	4	5	<1 yr.
SB-23	Stream Biolog.	Prod. & Services	• Analyze the IBI and habitat data annually for reports or fact sheets to be published on our web page. This work will benefit the trend monitoring objective.	4	5	<1 yr.
SB-25	Stream	Prod. &	• Annually develop an IBI and habitat trend report and publish it on the stream biological monitoring	4	6	<1 yr.

Table 7. First tier of recommendations to be implemented with current funding and staffing resources (Figure 12; Quadrant #1).

Rcmd. #	Program	Category	Recommendation	Impact Rating	Difficulty Rating	Implementation Timeline
	Biolog.	Services	website, either as a stand-alone web page or as a link to a fact sheet (pdf document).			
SB-33	Stream Biolog.	Pgrm. Coord. & Eval.	• During the initial development of the annual stream biomonitoring work plan, from December to February of each year, update the bioassessment task priority document so that the work plan will reflect the current vision of bioassessment strategy, goals, and direction.	4	5	<1 yr.
SWQ-1	Stream WQ	Monitor. Objectv.	• Enumerate and prioritize the monitoring objectives, other than assessment and trends and questions for the ambient streams program, and then align the monitoring design pieces to fit the objectives as additional funding is available. Work with internal and external stakeholders to prioritize the list of additional monitoring needs, questions, and objectives. Develop a strategy document that helps to define when multiple goals can be met simultaneously. Include in the strategy document a matrix of how design elements are meeting goals (e.g., which sampling sites are critical to one or more program).	4	6	>1 - 5 yrs.
SWQ-5	Stream WQ	Sampling Design	• Consider establishing dedicated trend monitoring stations that are not subject to termination or movement and possibly increase the monitoring frequency at these stations. Stability in trend monitoring sites and reducing or eliminating non-detect values will positively impact the status and trends monitoring objectives.	5	6	<1 yr.
SWQ-6	Stream WQ	Sampling Design	• Develop a strategy that identifies sentinel sites that would be monitored for a more extensive list of organic chemical contaminants such as pesticides and pharmaceuticals. The purpose of sentinel sites would be to provide consistent long-term data to evaluate changes through time.	4	5	<1 yr.
SWQ-14	Stream WQ	Sampling Design	• Develop a short-term strategy to address inadequacies in the list of monitoring parameters. The strategy should evaluate the parameter list against the list of parameters for which Iowa has water quality standards then determine coverage gaps with respect to current standards and emerging parameters of concern (e.g., algal toxins and pesticides). For emerging concerns, the strategy should consider using surrogate parameters or analytical methods to contain costs. For example, the ELISA atrazine analysis method could be used rather than the more expensive methods for all pesticides.	5	5	<1 yr.
SWQ-21	Stream WQ	Data Mgmt.	• Establish a QA/QC required timeline for data entry (e.g., six months from the time of receipt of the data from SHL). Continuing without a formal requirement can result in much extra work for staff who are trying to use the data and (2) probably will result in some water quality data being missed and not included in the 305(b) assessment/303(d) listing process.	4	5	<1 yr.

Table 7. First tier of recommendations to be implemented with current funding and staffing resources (Figure 12; Quadrant #1).

Rcmd. #	Program	Category	Recommendation	Impact Rating	Difficulty Rating	Implementation Timeline
SWQ-24	Stream WQ	Data Mgmt.	• Develop a "How-to" guide that walks new and inexperienced users through the web retrieval of data including, but not limited to, information on how to find and use project codes, links to the map interface to find sites, and a cross reference guide for parameters (e.g., "Phosphate-phosphorus" = "Total Phosphorus"). Create a user group to provide feedback on the usability of the data retrieval functions and provide suggestions on how to make retrieval more understandable to users outside of the DNR.	4	4	<1 yr.
SWQ-25	Stream WQ	Data Mgmt.	• Create a user group to provide feedback on the usability of the data retrieval functions and provide suggestions on how to make retrieval more understandable to users outside of the DNR.	4	5	<1 yr.
SWQ-27	Stream WQ	Data Mgmt.	• Use EQuIS functions more fully to enhance QA such as graphing the data as it comes into the system to show outliers and other suspect data points.	4	6	<1 yr.
SWQ-30	Stream WQ	Prod. & Services	• Increase staff training in the use of R statistical language and GIS tools. This is likely to require a combination of training opportunities such as classes, seminars, and webinars, as well as ongoing mentoring by experienced individuals within and outside the Department. For example, the National Water Quality Monitoring Council is developing an R user group to help support and build skills of state monitoring program staff.	5	6	>1 - 5 yrs.
SWQ-32	Stream WQ	Prod. & Services	• Work with DNR communications staff to produce a new publication that presents DNR's perspective on water quality in a manner that is interesting, informative, and eye-appealing. The publication would present a different perspective than the popular "open sewer" view of Iowa's water quality. It should communicate the problem aspects of Iowa's water quality as well as highlight the good aspects. The publication could include high quality photos of interesting subjects such as Iowa's native fishes and mussels. It would summarize and interpret physical/chemical/bacterial data, biological data, fish & turtle tissue monitoring data, and should cover all the designated uses. The report could also include a water quality retrospective that contrasts the worst of the worst conditions from the past compared to the worst today. The piece might be publishable in the Iowa Outdoors magazine. The Integrated Report is another option; however, the reporting format would need to be changed from previous reports to make it more relatable to the general public.	4	6	>1 - 5 yrs.

Table 7. First tier of recommendations to be implemented with current funding and staffing resources (Figure 12; Quadrant #1).

Rcmd. #	Program	Category	Recommendation	Impact Rating	Difficulty Rating	Implementation Timeline
SWQ-33	Stream WQ	Prod. & Services	• Data interpretation in general, and preparation of fact sheets in particular is difficult and time consuming. However, without them, the DNR will have little or no input on the perception of Iowans regarding the status of water quality in Iowa. Modifying the CWA Integrated Report to serve as a public education tool is a bad idea. The 305(b) and 303(d) reporting processes are far too standards-driven to be useful for communicating Iowa's water quality conditions to the public. For example, nonpoint source pollution issues such as nutrients and sediment would almost disappear, especially for streams and rivers because standards do not currently exist in Iowa for these parameters. Instead, summaries of ambient monitoring data could be prepared for the entire state, individual monitoring sites, river basins (e.g., HUC8-scale), or ecoregions. These would include summary statistics for key parameters regardless of whether they have a water quality standards criterion. Such summaries would be useful for CWA program functions including the development of wasteload allocations and water quality criteria, and most likely other purposes.	4	6	>1 - 5 yrs.
SWQ-34	Stream WQ	Prod. & Services	• Annually develop a list of fact sheets to produce by the end of the year covering topics of interest. Create five fact sheets each year to achieve the goal of public information dissemination. The fact sheets should be linked to hot topics updated by DNR communications specialists.	4	6	<1 yr.
SWQ-43	Stream WQ	Pgrm. Coord. & Eval.	• Periodically review the ambient monitoring strategy and receive continual feedback from internal (DNR) and external stakeholders.	4	5	<1 yr.
WE-1	Wetland	Monitor. Objectv.	• Continue to track activities in other states (e.g., Missouri) to determine the protocol and parameters used in developing standards and the processes used to implement wetland standards.	4	4	<1 yr.
WE-2	Wetland	Sampling Design	• Alleviate site distribution issues by hand-selecting sites in regions of the state where the GIS random selection process typically doesn't find any sites.	4	6	<1 yr.
WE-4	Wetland	Data Mgmt.	• Continue uploading wetland data sets to EQuIS. Additional seasonal staff assistance may be needed to convert the original data format to an EQuIS-compatible format.	4	5	<1 yr.
WE-5	Wetland	Data Mgmt.	• Only water-resistant or waterproof paper should be used for field data sheets and training provided to seasonal staff should reinforce the importance of legibility when recording field data.	4	3	<1 yr.
WE-7	Wetland	Prod. & Services	• Continue to post reports on the DNR wetland monitoring website, but also utilize current and past project partners to disseminate reports for greater visibility and public awareness of wetland health.	4	6	<1 yr.
WE-8	Wetland	Prod. & Services	• Provide wetlands monitoring staff with better access to the wetland website for timely updates of data and reports. Staff need to supply more products to update the wetland website annually.	4	5	<1 yr.

Table 7. First tier of recommendations to be implemented with current funding and staffing resources (Figure 12; Quadrant #1).

Rcmd. #	Program	Category	Recommendation	Impact Rating	Difficulty Rating	Implementation Timeline
WE-9	Wetland	Pgrm. Coord. & Eval.	• Seek new private landowners who are willing to work with the monitoring program to evaluate wetland health. Wetland monitoring staff should also work to build upon current relationships with private landowners who allow monitoring to occur on their land and should continue to respect the land they have been given permission to access.	5	4	>1 - 5 yrs.
WE-10	Wetland	Pgrm. Coord. & Eval.	• Implement the new Iowa Wetland Program Plan statewide in cooperation with wetland monitoring partners and resource managers. Doing so will greatly improve collaboration for wetland monitoring and data sharing.	4	5	>1 - 5 yrs.

Resources Needed to Implement Monitoring Improvements

Rough estimates of funding and staffing resources needed to fully implement the recommendations within each tier are provided below for initial planning purposes. More precise cost information will need to be gathered before decisions about the feasibility of any particular recommendation can be made. The cost and staffing estimates are not cumulative; they only represent resource needs to implement recommendations in a given tier. It is anticipated that funding requirements for completing the list of first tier recommendations can be met by adjusting current funding allocations; therefore, no additional funding will be necessary. Additional funding would be required to implement the second and third tiers of recommendations.

Table 8. Estimated additional resources needed to implement ambient water monitoring strategy recommendations within the 2016-2021 strategy period.

Implementation Tier (*)	Total # of Recommendations	Additional Annual External Costs	Additional Annual Internal Staffing (FTE**)
First (1)	48	no additional resources needed (assumes current resource allocations remain the same)	
Second (2a)	28	$433,160 - $848,683	1.3-2.7
Third (2b)	22	$959,622 - $2,099,458	1.7-2.8

*Tier number refers to the quadrant in the Impact/difficulty matrix plot (see Figure 12; "Strategy Recommendations and Implementation.")
**FTE, Full-Time Equivalent

New sample collection and laboratory analysis work represents the largest component of external cost projections. Other costs might include things like equipment purchases or contracted information technology services. As the table shows, projected external costs increase significantly as implementation efforts move from the first tier to the second and third tiers. For example, just 37 percent of the first tier recommendations include external costs compared with 54 and 95 percent of the second and third tiers, respectively.

As with funding, it is anticipated that staffing requirements for the first tier of recommendations can be met by adjusting current staffing allocations within the Water Quality Monitoring and Assessment Section of the DNR; therefore, no additional staffing-related costs are anticipated at this level. Full implementation of the second and third tiers of recommendations, however, would require management approval and new funding to add staff at the estimated levels on top of existing levels.

Additional Considerations

Three specific monitoring considerations were raised at the onset of the ambient monitoring strategy development project: 1) impaired waters; 2) nutrient reduction strategy; and 3) rotational basin monitoring. Based on the results of the comprehensive program review, the following recommendations speak to the ability of the ambient monitoring program to effectively address these monitoring issues.

Impaired Waters

Iowa's list of impaired waters, required under Section 303(d) of the Federal Clean Water Act, includes several hundred waterbodies and impairments of many types. Designing and executing a program that would comprehensively monitor the status of impaired waters and provide data for the development of watershed improvement plans or Total Maximum Daily Loads (TMDLs) is beyond the scope of the Ambient Water Monitoring Program.

The ambient program will continue pursuing ways to improve the data and information available to support the impaired waters program. However, any significant redirection of ambient monitoring resources into impaired waters monitoring would hinder the ambient program's ability to achieve its primary objective of status and trends monitoring, and therefore is not recommended.

Nutrient Reduction Strategy

The ambient monitoring program is currently developing nutrient load calculations in support of Iowa's Nutrient Reduction Strategy. The strategy team is also evaluating ways to improve the quality and quantity of nutrient data available for load calculation purposes. It is anticipated that some monitoring improvements can be made without jeopardizing the ambient program's ability to achieve its objectives.

The ambient program is not designed to monitor nutrient loads in small watersheds (e.g., HUC12 scale) where reductions are first likely to be observed following the implementation of nutrient management practices and technologies. Any significant redirection of currently-available ambient monitoring resources into monitoring of implementation effectiveness in small watersheds would severely hinder the ambient program's ability to achieve its objectives, and therefore is not recommended.

Rotational Basin Monitoring

Many states have adopted a rotational drainage basin or watershed monitoring design to provide more comprehensive monitoring coverage and improve monitoring support for water management and regulatory programs. Many states have established a five-year rotation in which all medium-to-large basins are monitored within one cycle. There are various designs, however, the monitoring site network often includes some combination of fixed trend sites, probabilistic (random) sites, and targeted sites focused on specific concerns or management needs within the basin.

Implementation of a statewide rotational basin monitoring design would require a significant redirection of existing ambient monitoring resources or a substantial investment of new resources. Lacking sufficient funding and a clear expression of support for rotational basin monitoring from DNR programs (e.g., Fisheries, Lake Restoration, Nonpoint Source/319, TMDL, and Wastewater Permitting) and other stakeholders, the implementation of a rotational basin monitoring design is not recommended at this time.

References

Ausness, RC. 1978. Water Use Permits in a Riparian State: Problems and Proposals. Kentucky Law Journal (66) 191-265.

Hines, NW. 1967. A Decade of Experience Under the Iowa Permit System-Part One. Natural Resources Journal, Vol.7, P. 499-554.

USEPA 2003. Elements of a State Water Monitoring and Assessment Program. Assessment and Watershed Protection Division, Office of Wetlands, Oceans and Watershed, U.S. Environmental Protection Agency. EPA 841-B-03-003.

Appendices

Appendix 1. Monitoring Program Input Received from DNR Staff, External Stakeholders, and Technical Experts

Between January and May of 2015, the Iowa DNR held five stakeholder listening sessions and one technical expert group meeting. The purpose was to receive feedback on the current Ambient Water Monitoring Program and suggestions for improving the program's effectiveness going forward. The meetings were intentionally held prior to the DNR completing its internal review of the program so that stakeholder and expert input would be available to inform the strategy development process.

Three listening sessions were held with DNR staff and two with outside stakeholders. Meeting notes are provided later in this section. Below are the DNR program and outside stakeholder organization contacts invited to participate in a listening session. Representatives from 20 DNR programs and 42 external organizations were invited to participate in the sessions. External stakeholders representing the following interests were contacted: academic/research, agribusiness, environmental/conservation, governmental, legislative, municipal/water utility, and professional association.

Thirty-three individuals (nineteen DNR staff and fourteen external stakeholders) representing a broad cross-section of interests and uses of monitoring products and services participated in the sessions. Detailed notes were taken from which a list of 132 response items was compiled below.
Invitees and Participants of DNR and External Stakeholder Listening Sessions

Iowa DNR programs invited to attend one of three internal monitoring stakeholder listening sessions in 2015 (participating programs are shown in bold, italicized text).

Environmental Services Division	Conservation and Recreation Division	Director's Office
Contaminated Sites	Engineering Land/Waters	Communications
Field Services & Compliance	Fisheries Management	
Geographic Information Systems	***Fisheries Research***	
Solid Waste	***Forestry***	
Underground Storage Tanks	Lake Restoration	
Wastewater Engineering	Law Enforcement	
Wastewater Permitting	Outreach / Education	
Water Supply Engineering	***Parks***	
Water Supply Operations	Wildlife	
Watershed Improvement/TMDL		

Organizations invited to attend one of two external monitoring stakeholder listening sessions in 2015 (participating programs are shown in bold, italicized text).

Agriculture's Clean Water Alliance	Iowa State Association of Counties
American Council of Engineering Companies of Iowa	***Iowa State University Center for Agricultural and Rural Development***
Black Hawk County SWCD Board of Supervisors	***Iowa State University Extension***
Boone County SWCD Board of Supervisors	Iowa Water Center
Cedar Rapids Water Division	***Iowa Water Environment Association***
Center for Health Effects of Environmental	IOWATER Citizen Monitoring

Contamination, University of Iowa	
Conservation Districts of Iowa	Izaak Walton League of Iowa
Environmental Working Group	***Johnson County Conservation Board***
Iowa Association of Water Agencies	Leopold Center for Sustainable Agriculture
Iowa Conservation Education Coalition	National Laboratory for Agriculture and the Environment – ARS, Iowa State University
Iowa Department of Agriculture and Land Stewardship	Natural Resources Committee (Iowa House)
Iowa Department of Health	Natural Resources and Environment Committee (Iowa Senate)
Iowa Department of Transportation	Raccoon River Watershed Association
Iowa Engineering Society	Rathbun Rural Water Association
Iowa Environmental Council	Sierra Club, Iowa Chapter
Iowa Farm Bureau	Soil and Water Conservation Society
Iowa Groundwater Association	The Nature Conservancy Iowa
Iowa League of Cities	***Turkey River Watershed Management Authority***
Iowa Rivers Revival	***USDA Natural Resources Conservation Service***
Iowa Rural Water Association	USEPA Region 7
Iowa Soybean Association	USFW Rock Island Field Office

Listening Session Question Responses from DNR and External Stakeholders.

Stakeholder Group X=external; I=DNR	Question

1. What water monitoring data or information do you use and how do you use it?

I	Groundwater data used in contaminated site reviews; responding to public comments related to permit issuance
I	Municipal well data used in LUST site review
X	Groundwater nitrate data
I	lake data and/or summary information used to evaluate restoration priorities & feasibility; provide general background information to public; develop TMDLs for lake water quality impairments
I	Fish assemblage data and IBIs used to compare and supplement research data; developing sampling plans
X	Stream flow
X	Nutrient data used for load calculation, research, stakeholder engagement
I	Ambient stream water quality data used to prepare nutrient load calculations; develop TMDL for stream water quality impairments; develop NPDES wastewater permits
X	Benthic macroinvertebrates, aquatic plants, phosphorus, nitrogen, pH, temperature, water clarity, DO used to evaluate condition of local waters
I	Tissue contaminant interpreted information used to respond to public comments related to wastewater permit issuance
X	Water quality assessments CWA Sections 305(b)/303(d) used for statewide review of data completeness/quality, designated use impairments
I	303d water quality assessment information used in the development of funding grant applications;

X	Bacteria and microcystin data used to evaluate human health risk
X	Ammonia
X	Water quality data (unspecified) used for environmental education, evaluation of BMP effectiveness, basis for land management decisions

2. How/where do you access monitoring data/information?

I	Private colleges and state universities
I	Des Moines Waterworks
X / I	ADBnet, the CWA 305(b) Water Quality Assessment database
I	Beach Monitoring web page
I	BioNet, the on-line data portal for DNR's stream bioassessment program
X / I	IASTORET, the on-line database repository for ground water and surface water quality monitoring data from Iowa
I	DNR staff person-to-person request for assistance
I	Iowa Lakes Information System, the on-line web site and database maintained by the ISU Limnology Laboratory in cooperation with DNR
I	Iowa State Mesonet
X	Iowa State University
I	County Sanitarians
X	Commodity Groups
I	Iowa Soybean Association
I	Other states
X	State of Minnesota
X / I	Iowa Flood Information System (IFIS)
I	Iowa Geological Survey
I	Published literature
X / I	U.S. Corps of Engineers
I	U.S. Environmental Protection Agency
X	U.S. Geological Survey Water Science web site
I	U.S. Geological Survey

3. What other types of data, information, or services would be useful in your work?

I	Arsenic sampling data
X	Real-time sensors for nutrient parameters throughout the state
I	Better flow data: non-gaged streams and storm hydrographs
I	Municipal well data; MTBE data
I	Data from additional lake sampling points and seasons
I	Qualitative habitat data/assessment for Iowa lakes - analogous to Ohio EPA stream QHEI
I	Petroleum analytes in state-owned lakes
X	More data at (local) scale that is useful to NRCS field staff working with private landowners
X	Dissolved metals
X	More/better data for nutrient load estimation; monthly not good enough; bioavailable P would be useful

X	More data from small watersheds (e.g., HUC12, WQI watersheds)
I	Specific information on stream reaches in Iowa such as drainage area, stream order, sinuosity, gradient, land use, etc.
X	Data to evaluate suitability of freshwater mussel habitat
I	Receiving stream data
X	GIS map of private and public wells
I	Automated or regular reports on water quality as it impacts park users (e.g., cyanobacteria blooms)
I	Information on beach and lake water quality status
I	Comprehensive list of data available in Department
I	Internal information resources listed on DNR monitoring website or revised database informing people where to find WQ data/information
I	Information to evaluate outside data: quality, source, and methods used
I	“How to” guide for IASTORET
I	Access to fishkill information caused by “bends” below Red Rock
I	Simple summary of lake condition and impairment status for public consumption
I	Information on lake trends pre- and post-restoration
I	Trends in nutrient loads
I	Beach monitoring information/status linked to parks reservation system
I	Access to special projects data and data collected by IGS, now that is not part of agency
X	Increased availability of data from other organizations (e.g., Iowa Soybean Association)
I	Centralized resource to find all data
I	Mechanism to submit questions to monitoring staff

4. Do you have any other suggestions for improving monitoring?

X	Provide access for all DNR staff to pull any DNR data from SHL database (open ELIS)
X	Link up more data to Facility Explorer
X	Show trends in water quality
X	Data interpretation needs to be more helpful in informing the general public about water quality
X	Needs to be more interpretation and education related to risk; the public needs to understand the risk associated with the water quality
X	Develop ability to locate and capture groundwater data from other sources (e.g., Contaminated Sites data stored in PDF documents)
X	Resolve data quality issues so that DNR can use volunteer data and watershed monitoring data
X	Emphasize education aspects of monitoring (e.g., AWARE and IOWATER)
X	Provide more training support for volunteer monitors
X	Need monitoring of nitrate levels in wells where detectable levels were not historically seen
X	Need monitoring information related to drinking water quantity
X	Need more monitoring of manure impacts on water quality
X	Do a better job of integrating stormwater sampling data
X	Important to continue monitoring the best quality aquatic resources for long-term trend purposes

X	Continue biological monitoring; the data connect with the public (e.g., status of fish)
I	Potential overlap in monitoring programs should be examined
I	Utilize municipal water treatment facilities to collect samples (e.g., members of IAWEA have expressed interest)
I	Have WQMA staff attend Contaminated Sites staff meeting (and possibly other DNR staff meetings too)
I	Watershed project plans should require monitoring
I	Develop a rotating basin monitoring system to provide an assessment of water quality at the basin level at least every ten years

5. What questions would you like monitoring to answer?

X	What data are available on border waters?
X	What is role of BG algae in “natural” fishkills?
X	How can nutrient data be normalized relative to its release from different sources?
X	What do monitoring data mean in my specific area of interest (e.g., Indian Creek Watershed)?
X	What are the water quality “trigger” levels of concern?
X	What is the status of emerging contaminants?
X	Has any monitoring of emerging contaminants been done?
X	Why is the Field Office seeing these non-targeted fish kills?
X	How much of the surface water is from groundwater versus run off or tile flow?
X	Is the water safe to drink, swim, and consume fish?
X	What is the water quality in a specific location where a person/family wants to recreate?
X	Which tributary of a particular state lake is contributing the most nutrients?
X	Is surrounding land use correlated with water quality?
I	What is the quality of the water coming off managed versus unmanaged forest land?
I	How is land use along the stream affecting water quality?
I	How is the monitoring system integrated and are there gaps?
I	What are the nutrient levels leaving the state and how do levels vary from year-to-year?
I	How much N & P are leaving the state?
I	Is there is a difference in bio-available phosphorus versus phosphorus found in sediment arising from bed and bank loads?
I	How can water quality monitoring fit (overlay) with other programs (e.g., Watershed Management Authorities and 319 projects)?
I	What is water quality like along Iowa’s water trails?
I	What is the water quality of the entire state at a HUC8 watershed scale?
I	How do bio-solids that are applied to the cropland and the phosphorus in the tile lines affect the Nutrient Reduction Strategy?
I	How do we fix “it” (frequently asked at TMDL meetings?
I	What is the level of impairment beyond determining if it is impaired or not impaired (e.g., trends in water quality)?
I	Where are the good places and what makes them good?
I	How do we separate the impairment from what is making the waterbody good?
I	Is water quality getting better or worse?

I	What are the long-term trends in water quality? (Not necessarily to be interpreted by DNR)
I	Is water quality improving in my lifetime?
	6. How can we best present monitoring data to the public?
X	Web site updates and regular newsletters informing public about what is happening
X	Develop a one-pager explaining what information the monitoring program is collecting and how this may be helpful to others
X	Allow presentation of data using a moving date range
X	Automated reporting
X	Do a better job of marketing the Water Atlas as a starting point to learn about what monitoring has been done
I	Develop a one-stop place to learn where data is available including links to outside resources
I	Look at Turkey River Watershed monitoring program as a model
I	Very important to present success stories
	Other Comments / Concerns
X	Important that DNR show how their monitoring program connects to other programs
X	Future water quality issues include pharmaceuticals and personal care products in groundwater
X	DNR needs to get out ahead of the risk of cyanotoxins to water supplies in Iowa
X	Coordination of nutrient reduction strategy monitoring among Mississippi River Basin states is needed
X	Focus on reducing point source toxic contaminant levels might be not warranted if habitat is limiting to mussels
X	Potential for large increase in water use for crop irrigation

DNR Stakeholder Listening Sessions Notes

Ambient Water Monitoring Strategy – DNR Stakeholder Listening Session
9:00 a.m.-12:00 p.m., January 15, 2015
Wallace Building, Conference Room 2N
Meeting Summary

Introductions and Meeting Objectives – Roger Bruner
The objectives of the listening sessions with stakeholders to learn how DNR staff are using the products and services of the Ambient Water Monitoring program and to identify improvements that can be made.

Overview of Ambient Monitoring Program and Strategy Update – Tom Wilton
Current program components are groundwater aquifers, lakes & reservoirs, fish & turtle flesh, stream water quality, stream biological assessment, wetlands and a cooperative project with USGS supporting stream gages and real time nitrate monitoring.

Steps for updating the strategy will be to evaluate the current program and identify monitoring gaps, needs and weaknesses. There will be several listening sessions to obtain stakeholder input. Evaluation and prioritization of any improvements will be made. Recommendations will be finalized and the strategy document will be updated. Once the document is updated, recommendations will be implemented.

Facilitated Discussion – Tim Hall
Questions for DNR Water Monitoring Stakeholders:

- What DNR water monitoring data or information do you use and how do you use it?
  Forestry uses the 303D impaired waters list. They use this when applying for grants to make the case for why they are interested in focusing on a specific region. They are just interested in the product that is produced not necessarily the data at this point.

  Fisheries Research – They are using the raw data from lake monitoring for the lakes restoration program. They use this to prioritize the projects. They wish there were more points within a lake. They might like to see more of a geographical points within a lake and possible sampled at different times (seasonality). They also use the data to try to determine the feasibility of the restoration. They need to be able to determine what is internal versus external loading of the lake.

  Parks is primarily using the information side. It’s usually something that is used in the background not necessarily in the forefront. They are struggling right now with a project with NRCS about identifying which tributary is contributing the most nutrients.

  Question was asked to whether there is data regarding the land use surrounding the monitoring points to make a correlation with the water quality data that is collected. Forestry would like to be able to see how forested areas are impacting the water quality.

  There is some land use data collected but depending on how it is stored in STORET, staff may not be able to see that data.

  Suggestion was made that there needs to be mechanism similar to Communications as to being able to submit your question that needs to be answered to the monitoring staff – Q/A method, how do we get the information or get the questions from staff that need to be answered.

- Where do you access DNR water monitoring data or information?
  Fisheries Research (Rachel) goes directly to Michelle. Generally avoids STORET because they are not familiar with how to use it. Maybe a "How to Guide" would be useful?

  Peer to peer is useful to know what protocols were used when collecting the data or being able to explain how you are using the data. They sometimes are able to say that this data set is better to answer the question.

  Forestry usually goes to the DNR website but has also used other states data to be able to make some generalities. If they can't find it on the DNR website, then they go to Kathryne Clark in GIS. Then they get a specific map for the project.

  Need to figure out how to bridge the gap between staff knowing what data is available and what questions that staff have about the data – chicken and the egg effect. "We don't know what to ask for because we don't know what data is available" "We can't answer your questions unless you ask them?"

  Parks would like to see something that is a little more automated or regular reports as opposed to staff having to know who to ask, when and what they are asking for. Example was used in regards to beach monitoring at campgrounds. If there is high cyanobacteria, they don't want a bunch of people to come to the campground and be upset that they can't use the beach.

  Forestry – What is the quality of the water coming on of managed versus unmanaged forest land? The answers to this question may lead to making Department decisions on how we manage or don't manage our own properties.

  If we are able to use the program location information to overlay on the water data, we would then we able to know how to modify the monitoring strategy.

  Fisheries Research would love to do Qualitative Habitat Collection for lakes similar to what is collected for streams. It would be helpful for them to be able to compare their biological data and the habitat data to their lake quality data. There are very few people collecting Habitat data in addition to their biological and water data.

- Do you use monitoring data/information from other sources?
- What other types of data, information, or services would be useful in your work?
  Parks would be able to provide the information on the Reservation System regarding Beach Monitoring information.

  Beach Monitoring and Lake Restoration need help on how to link the data / information to the public. How to get them the information they need to be able to get the public involved in the projects.

  Do you have suggestions for improving the ambient monitoring program to serve your needs?

  Parks would like to see what the trends were prior to a lake restoration to after the renovation. That information would be useful to be able to finish the story when talking to stakeholders and legislators.

  Ambient has always been described as status and trends of statewide water quality. They wanted to separate the research type questions versus TMDL issues. They aren't opposed to doing specific research monitoring projects but they want to be able to take the data to make more broad generalizations for the entire state. A lot of times narrow questions can be answered with the broad data but the monitoring staff are usually missing the question that needs to be answered.

What product would you need (presentations, maps, spreadsheets, etc.)? In a lot of programs, it the basic information of efforts that are being done (why it's done, how it's done, when it's done and what you can do with the data when it's done).

We need to have the ability to have more automation in the data analysis, be able to throw flags when something is going on outside of the regularly scheduled analysis. A lot of times the data is getting pushed into a database and spikes/drops are missed until the report is written or the request for data is made. We need to make sure we know what are 'red flags' are for the specific program areas and get that information out to the programs.

Meeting Wrap-up
This process is going to go on for the next couple weeks/months. Feel free if any other questions, suggestions, etc. that come up to contact Tim, Roger or the Ambient Monitoring Staff.

Also provide any suggestions on how to improve these listening sessions would be greatly appreciated.

Meeting Attendees		
Name	Program	Email
Tim Hall	Hydro Resources	Tim.Hall@dnr.iowa.gov
Michelle Balmer	WMAS – WQB	Michelle.Balmer@dnr.iowa.gov
Brandon Harland	WQB	Brandon.Harland@dnr.iowa.gov
George Scholten	Fisheries	George.Scholten@dnr.iowa.gov
Rebecca Krogman	Fisheries	Rebecca.Krogman@dnr.iowa.gov
Chad Kelchen	Parks	Chad.Kelchen@dnr.iowa.gov
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Paul Tauke	Forestry	Paul.Tauke@dnr.iowa.gov
John Olson	WQB	John.Olson@dnr.iowa.gov
Connie Dou	WQB	Connie.Dou@dnr.iowa.gov
Angie Clark	LQB	Angie.Clark@dnr.iowa.gov
Todd Coffelt	Parks	Todd.Coffelt@dnr.iowa.gov

Ambient Water Monitoring Strategy – DNR Stakeholder Listening Session
9:00 a.m.-12:00 p.m., January 27, 2015
Wallace Building, Conference Room 2N
Meeting Summary

Introductions and Meeting Objectives – Roger Bruner
The objectives of the listening sessions with stakeholders to learn how DNR staff are using the products and services of the Ambient Water Monitoring program and to identify improvements that can be made.

Overview of Ambient Monitoring Program and Strategy Update – Tom Wilton
Current program components are groundwater aquifers, lakes & reservoirs, fish & turtle flesh, stream water quality, stream biological assessment, wetlands and a cooperative project with USGS supporting stream gages and real time nitrate monitoring.

Steps for updating the strategy will be to evaluate the current program and identify monitoring gaps, needs and weaknesses. There will be several listening sessions to obtain stakeholder input. Evaluation and prioritization of any improvements will be made. Recommendations will be finalized and the strategy document will be updated. Once the document is updated, recommendations will be implemented.

The funding for ambient monitoring has been stable since 2001 at $2.95 million, which is state funded through the infrastructure fund. It was a little lower in 2000 at $1.4 million. The program also gets some of the leftover PPG money and some 106 funding but the vast majority of the program activities is from the $2.95 million.

Question was asked as to whether there has been an analysis of what the $2.95 million equates to in today's real dollars.

Facilitated Discussion – Tim Hall
Questions for DNR Water Monitoring Stakeholders:

- What DNR water monitoring data or information do you use and how do you use it?
  Mindy Buyck stated that for the TMDLs she uses the raw data, the interpretation of the data and needs access to it – she wants anything that she can get. She hasn't used the tissue or the wetland data. There are times when things are missing, other times there is extra stuff, but most of the time they don't know what they need until they need it.

  Courtney Cswerko hasn't used the data very often but has used it for a permit that was issued near the Cedar River.

  Wendy Hieb has used it to respond to comments related to a permit. They don't always know what data they will need until they get a public comment to a public notice that they need to respond to. She has used the groundwater data in its raw form. Wendy has received fish tissue data from the Fisheries Bureau. They have always interpreted the information when requested. Some Environmental Groups have been taking their own samples and trying to make the case for why a permit can't be issued. It would be nice to be able to bracket the Environmental Groups data to get a better picture holistically. NPDES doesn't always know when they are going to have to respond to a comment so it might be as easy to schedule sampling in the needed area.

  Calvin Wolter has been using the data for the Nutrient Reduction Strategy to try to determine different loads. It has been helpful to have sampling data over long periods of time (older sites dating back to 1997). It is also helpful to be able to cover the whole state. Currently sampling covers about 82% of the state. He would like to see a little more data in SE Iowa. It would be helpful to know how much of the surface water is from groundwater versus run off or tile flow.

Question was raised about sampling for isotopes. That would be helpful to determine baseflow better.

Allen Bonini has had trouble with the scaling. The scaling issue doesn't seem to be able to provide us with the data they need so they have been doing some supplemental sampling to fill in the gaps. Most sediments flow with storm events and if the sampling is taken at a random time each month, it's not very likely that it is going to catch that information.

It would be helpful to be able to sample at the entrances of the major tributaries as opposed to just along the stream. It may be an access issue but something to look at. It would be nice to see how land use is affecting the water quality in the area. What is the time frame for planning for sampling and what data is needed? Maybe look at 3 to 5 year sampling plan.

NPDES typically knows when the large permits are being renewed to be able to get ahead of comments and be able to better respond.

Several states use a rotating basin for their sampling schedule, which would do more intense sampling in the designated basin that year. For a TMDL scenario, they can't use probabilistic scenarios.

The group felt it would be nice to be able to have at least one or two high flow samples per year. It is easier to collect the low flow because they typically last longer. They also feel that the transition from high to low flow is also important.

Allen stated that when he worked in Illinois, that the USGS used to hire local residents that lived adjacent to the stream to do the sampling. It takes a little time to get it set up and get people trained but they were able to get a lot more sampling done.

- Where do you access DNR water monitoring data or information?
  NPDES has contacted Fisheries for tissue data. It's good to get the data from Fisheries to respond to a comment, it gives more validity to the interpretation / data.

  DNR website – water monitoring and STORET

  Emails to Ambient Monitoring Staff – peer to peer contact

  NPDES has coordinated with Connie to get the information

  Iowa Lakes website or from Michelle or has had Michelle QC the data that is received from outside sources

- Do you use monitoring data/information from other sources?
  - Other states STORET
  - EPA
  - USGS
  - Field Offices
  - Corp of Engineers
  - Iowa Geological Survey
  - Private Colleges and State Universities
  - Water Works Facilities

- Soybean Association

- What other types of data, information, or services would be useful in your work?
  We need to do a better job on knowing what internal data resources that is available. Maybe look at the revamping the database page on the website or creating a page that would point people in the right direction when staff get Records requests.

  It would be helpful to get the information that was collected on special projects. This data seems to be harder to find.

  How do we get the data from the Iowa Geological Survey data now that they are no longer part of the DNR? There is no process in place currently to get the data from them.

  The Watershed Monitoring Atlas is a good place to start when trying to find what data is available.

  There has been a struggle in the past on to evaluate the quality of the outside data – need to know who collected it, how it was collected, and the quality of the samples / data.

  At a minimum, we need a comprehensive list of data that is available with the Department.

  "We have successfully leveraged our ignorance on data." Quote by Adam Schnieders

  Better flow data on non-gaged streams. Better storm hydrographs

  We need more than one data point for lakes: maybe shallow, deep, each arm would be great, and more time references. We would need to look at the Water Quality standards before we start collecting multiple points because we would probably impair most of the lakes.

  Is there a way to more automate what we do to free up the resources for the things that we can't automate.

  Would be helpful to have more data around un-sewered communities

  Would be helpful to be able to figure the nutrient export calculations to be able to show how water quality monitoring shows success of the Nutrient Reduction Strategy. Be able to show trends.

  Public might find information on the condition of our Lakes helpful. Maybe a summary of the trends or interpretation over time and how they can make the lake better, similar to the ADBNet. Would be helpful on the ADBNet (303D listing) l to say this lake is impaired because of X, Y and Z reasons instead of the long, very technical narrative. Technical staff can understand what that means but EPA / general public doesn't necessarily know what it means.

  EPA's OIG Report was trying to come up with a report that would lay out a barebones up to a Cadillac ambient monitoring network for each impaired water. WRCC meeting will probably focus on figuring out who is collecting what and trying to come up with a list.

- What questions would you like monitoring to answer?
  Where is the data? Create a centralized location for where to find all the data.

  Where are the good places? We talk about where the places are bad but we don't talk about the good places and how to make sure they stay that way. We also need to find out what makes it that way.

How much nitrogen and phosphorus (or enter any contaminant) is leaving the state?

"How do we fix it?" is one of the most common questions that is asked in the TMDL meetings.

We need to be able to separate the "impairment" from what is making that water body good.

Is there is a difference in bio-phosphorus versus phosphorus found in sediment versus bed and bank load phosphorus concentrations?

Emerging contaminants – USGS was doing a study on emerging contaminants at a plant in Ankeny and a place in Colorado.

How do the bio-solids that are applied to the cropland and the phosphorus in the tile lines affect the Nutrient Reduction Strategy?

What data is available on border waters?

Do you have any other suggestions for improving monitoring?

Meeting Wrap-up

This process is going to go on for the next couple weeks/months. Feel free if any other questions, suggestions, etc. that come up to contact Tim, Roger or the Ambient Monitoring Staff.

Also provide any suggestions on how to improve these listening sessions would be greatly appreciated.

Meeting Attendees		
Name	Program	Email
Tim Hall	Hydro Resources	Tim.Hall@dnr.iowa.gov
Michelle Balmer	WMAS – WQB	Michelle.Balmer@dnr.iowa.gov
John Olson	WQB	John.Olson@dnr.iowa.gov
Tom Wilton	WQMA – WQB	Tom.Wilton@dnr.iowa.gov
Roger Bruner	WQMA – WQB	Roger.Bruner@dnr.iowa.gov
Connie Dou	WQB	Connie.Dou@dnr.iowa.gov
Angie Clark	LQB	Angie.Clark@dnr.iowa.gov
Calvin Wolter	GIS – LQB	Calvin.Wolter@dnr.iowa.gov
Tesfay Russell	GIS – LQB	Tesfay.Russell@dnr.iowa.gov
Emy Liu	WES – WQB	Emy.Liu@dnr.iowa.gov
Nichelle Anderson	WES – WQB	Nichelle.Anderson@dnr.iowa.gov
Wendy Hieb	NPDES – WQB	Wendy.Hieb@dnr.iowa.gov
Eric Wiklund	NPDES – WQB	Eric.Wiklund@dnr.iowa.gov
Adam Schnieders	NPDES – WQB	Adam.Schnieders@dnr.iowa.gov
Courtney Cswerko	NPDES – WQB	Courtney.Cswerko@dnr.iowa.gov
Mindy Buyck	WIS – WQB	Mindy.Buyck@dnr.iowa.gov
Allen Bonini	WIS / WSO – WQB	Allen.Bonini@dnr.iowa.gov

Ambient Water Monitoring Strategy – DNR Stakeholder Listening Session
9:00 a.m.-12:00 p.m., February 17, 2015
Wallace Building, Conference Room 2N
Meeting Summary

Introductions and Meeting Objectives – Roger Bruner
The objectives of the listening sessions with stakeholders to learn how DNR staff are using the products and services of the Ambient Water Monitoring program and to identify improvements that can be made.

Overview of Ambient Monitoring Program and Strategy Update – Tom Wilton
Current program components are groundwater aquifers, lakes & reservoirs, fish & turtle flesh, stream water quality, stream biological assessment, wetlands and a cooperative project with USGS supporting stream gages and real time nitrate monitoring.

Steps for updating the strategy will be to evaluate the current program and identify monitoring gaps, needs and weaknesses. There will be several listening sessions to obtain stakeholder input. Evaluation and prioritization of any improvements will be made. Recommendations will be finalized and the strategy document will be updated. Once the document is updated, recommendations will be implemented.

The funding for ambient monitoring has been stable since 2001 at $2.95 million, which is state funded through the infrastructure fund. It was a little lower in 2000 at $1.4 million. The program also gets some of the leftover PPG money and some 106 funding but the vast majority of the program activities is from the $2.95 million.

Question was asked as to whether there has been an analysis of what the $2.95 million equates to in today's real dollars.

Facilitated Discussion – Tim Hall
Questions for DNR Water Monitoring Stakeholders:

- What DNR water monitoring data or information do you use and how do you use it?
  Greg Fuhrmann usually goes to Claire if he needs something. Greg would like to know more of what is being monitored for and then he could better determine how to better use the data. He would be more interested in the groundwater information as opposed to the surface water information.

  He could see Becky Ohrtman's Source Water Program using this information for determining nitrate levels. Greg thought this program would look at data every time they have a new site.

  Greg stated that data is reviewed on a very site specific instance, looking at very specific contaminants. They don't generally do any regional review or analysis.

  The general consensus from UST Section was that they didn't know that the ambient monitoring existed and was curious on what was collected. UST has used the municipal well sampling information in the past, possibly look at restoring that sampling.

- Where do you access DNR water monitoring data or information?
  Greg usually goes to Claire if he needs something. Claire has been interested in getting the Contaminated Sites data into the WQ system. Greg would say that they aren't familiar enough on what is collected to be able to ask for it.

Connie asked 'How does the public know what data we collect? How are we communicating this now?' Maybe it would be helpful to have a one pager explaining what information we are collecting and how this may be helpful to people. Maybe can do a better job of marketing the Water Atlas as a starting point.

Ambient information might be helpful to better determine if a constituent is naturally occurring or if it is coming from a point source.

- Do you use monitoring data/information from other sources?
  Greg has brought in sanitarian results into ArcMap. They have also used the UST database as well as EPA's information.

  UST & ConSites have looked at other states as to what they are doing but not from a data perspective.

  Have used Iowa State Mesonet, which is climate data - https://mesonet.agron.iastate.edu/

- What other types of data, information, or services would be useful in your work?
  Arsenic sampling might be helpful to add to be able to better determine background levels or naturally occurring for Contaminated Sites. May also want to talk to Solid Waste to determine if there are other metals that could be added for background levels versus what is coming out through the leachate.

  UST & ConSites generally are interested in groundwater data, very rarely using surface water data.

  UST would be interested to compare lake data to the groundwater data collected when reviewing LUST sites at State Owned Lakes. This would help when determining cleanup extent and who is contributing to what.

  Field Office has been struggling with fish kills when there isn't a chemical indicator, some they have been able to attribute to blue-green algae. There have also been a couple instances of fish kills at Red Rock. The FO found that the Corp of Engineer was doing a lot of research on this and contributed it to 'The Bends'.

- What questions would you like monitoring to answer?
  Why is the Field Office seeing these non-targeted fish kills?
  The Field Offices have been getting more calls from the public in regards to water quality before families go on an outing (i.e. family canoe trip).
  UST finds the municipal well data very helpful. UST collects data on MTBE but it is mainly available on paper.
  Has there been any monitoring on emerging contaminants or pharmaceuticals?

- Do you have any other suggestions for improving monitoring?
  USGS and University of Iowa stream gage data is available on IFIS (Iowa Flood Information System) website. The gages are usually found in or near urban areas because they were meant to be a flood warning system.

  Field Office feels that we could do a better job of integrating our storm water sampling data. ** The monitoring staff has been bouncing around the idea of working with the National Weather Service in regards to predicting storm events and high flow.

  Claire has been working with ConSites to get their data out so people can use it. Currently ConSites scans and uploads all the documents but doesn't have a good way to be able to search the documents. Database doesn't store the data in tables.

  There is a potential for Monitoring staff to pull all data from the SHL database regardless of what program requested the sampling.

- How can we best present monitoring data to the public?
  It would be helpful if there is a one stop place to go to know what data is available even if it is only available on paper. Also include other outside resources that are helpful to monitoring staff as well as program staff.

  There are several data mining companies that ask for site data every quarter.

  UST has 2 types of users – one would be the ones that are conducting the Phase 1 / 2 analysis and can interpret the data themselves. Then there are the ones that find the data and ask for an interpretation.

  There was a suggestion on tying more data in to Facility Explorer.

  Greg thought it might be helpful to have one of the monitoring staff attend a ConSites staff meeting to give an overview on what is collected.

Meeting Wrap-up
This process is going to go on for the next couple weeks/months. Feel free if any other questions, suggestions, etc. that come up to contact Tim, Roger or the Ambient Monitoring Staff.

Also provide any suggestions on how to improve these listening sessions would be greatly appreciated.

Meeting Attendees		
Name	Program	Email
Tim Hall	Hydro Resources	Tim.Hall@dnr.iowa.gov
Michelle Balmer	WMAS – WQB	Michelle.Balmer@dnr.iowa.gov
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Tom Wilton	WQMA – WQB	Tom.Wilton@dnr.iowa.gov
Roger Bruner	WQMA – WQB	Roger.Bruner@dnr.iowa.gov
Connie Dou	WQB	Connie.Dou@dnr.iowa.gov
Mary Skopec	WQB	Mary.Skopec@dnr.iowa.gov
Angie Clark	LQB	Angie.Clark@dnr.iowa.gov
Greg Fuhrmann	LQB – ConSites	Greg.Fuhrmann@dnr.iowa.gov
Kate Meyer	LQB – UST	Kate.Meyer@dnr.iowa.gov
Dave Perry	FO 5	David.Perry@dnr.iowa.gov

External Stakeholder Listening Sessions Notes

Ambient Water Monitoring Strategy –External Stakeholder Listening Session
9:00 a.m.-12:00 p.m., March 26, 2015
Wallace Building, Conference Room 2N
Meeting Summary
(Notes taken by Angie Clark and edited by Tom Wilton)

Introductions and Meeting Objectives – Tom Wilton

Meeting Attendees*		
Name	Program	Email
Tim Hall	Hydro Resources	Tim.Hall@dnr.iowa.gov
Tom Wilton	WQMA – WQB	Tom.Wilton@dnr.iowa.gov
Roger Bruner	WQMA – WQB	Roger.Bruner@dnr.iowa.gov
Angie Clark	LQB	Angie.Clark@dnr.iowa.gov
Laurel Foreman	NRCS	laurel.foreman@ia.usda.gov
Jerry Peckumn	Iowa River Revival	jpeckumn@netins.net
Jake Hansen	IDALS – DCS	jake.hansen@iowaagriculture.gov
Maria Gonzales	CARD – ISU	majimena@iastate.edu
Chris Jones	IA Soybean	cjones@iasoybeans.com
Linda Kinman	IAWA	iawa.icwf@gmail.com

*Eric Hurley, NRCS provided comments via email.

The objectives of the listening sessions with stakeholders to learn how external stakeholders are using products and services of the Ambient Water Monitoring program and to identify improvements that can be made.

Overview of Ambient Monitoring Program and Strategy Update – Tom Wilton
Current program components are groundwater aquifers, lakes & reservoirs, fish & turtle flesh, stream water quality, stream biological assessment, wetlands and a cooperative project with USGS supporting stream gages and real time nitrate monitoring.

In the late 70s, early 80s the stream monitoring was initiated at several fixed monitoring locations. In 1987, there was a substantial increase in coverage in the ambient stream monitoring network. In 1994 was when stream biological monitoring initiated. In 2000, the state funding was enhanced and in 2006 was when the strategy was last updated.

Steps for updating the strategy will be to evaluate the current program and identify monitoring gaps, needs and weaknesses. There will be several listening sessions to obtain stakeholder input. Evaluation and prioritization of any improvements will be made. Recommendations will be finalized and the strategy document will be updated. Once the document is updated, recommendations will be implemented.

Note: Jerry Peckumn asked about funding. Roger said funding for ambient monitoring has been stable since 2001 at $2.95 million, which is state funded through the infrastructure fund. It was a little lower in 2000 at $1.4 million. The program also gets some of the leftover PPG money and some 106 funding but the vast majority of the program activities is from the $2.95 million. Jerry commented that with adjustments for inflation, funding has probably effectively decreased 25-30% in comparison to 2001 dollars.

Facilitated Discussion – Tim Hall
Questions for DNR Water Monitoring Stakeholders:

- What DNR water monitoring data or information do you use and how do you use it?
  Chris Jones uses the nutrient data.

  Laurel Foreman has used the Source Water Protection data – groundwater data with nitrate levels. She provided a copy of an email from Eric Hurley (NRCS Nutrient Management Specialist) with his responses (attached to the end of this document). Laurel said that Eric would like well test data for nitrates.

  Linda Kinman mentioned that CHEEC at University of Iowa has done periodic statewide sampling of private wells and this data are available.

  Jerry Peckumn said that he uses flow data and usually goes to the USGS site to get it. He said they (Iowa Rivers Revival) would like to know how safe the water is for human recreation. Also IRR is interested in the ecological health of rivers. He asked if bacteria levels were monitored in rivers? Tom Wilton said E. coli was monitored as part of the ambient stream monitoring program. The data can be found in IASTORET.

  Tim Hall mentioned IFIS as a resource to access flow data collected by multiple agencies/organizations.

  For the Nutrient Reduction Strategy annual report, Jake Hansen said that IDALS is trying to create an inventory of all the sampling that is taking place – i.e., how often is it collected, where it's collected, how it's collected and what is being tested. Ambient data is a piece of the puzzle. He gets questions about what testing is being done. He would like to give credit for all that is being done and avoid duplication in monitoring.

  Tim asked Chris Jones about Iowa Soybean Association monitoring – i.e., how much is being done, how accessible is the data? Chris said ISA has collected data since about 1999 data at about 140 sites from the Raccoon, Des Moines & Boone watersheds. They have tried to be transparent with this data. The data are available upon request, and he is not aware of any request that was denied. Some producer/members collect data from their farms, but the ISA does not provide these data; sometimes the producer will release the data themselves.

- Where do you access DNR water monitoring data or information?
  Chris said he accesses DNR nutrient data directly from IASTORET. Tim asked whether DNR should focus more on data interpretation. Chris said that for some monitoring it is necessary – e.g., beaches. Otherwise it can be a "deep hole" as far as the amount of time needed to do it.

  Linda doesn't think the data is easy to retrieve from the online system (IASTORET). A good goal would be to have one site to list all the available places that collect data (central clearinghouse - List the organization, type, quantity, how to access). We may find that we are duplicating monitoring in certain areas and that we are missing data in other areas.

  Chris remarked the idea of a central clearinghouse for data has often been talked about, but it is not feasible.

  Tim commented that perhaps a central place that listed all the monitoring data that are being collected would be a good start.

- Do you use monitoring data/information from other sources?
  Chris also gets data from the USGS website and the COE for the Des Moines River Water Quality Network.

  Also mentioned were:
  - IFIS – Flood Center
  - Corp of Engineers
  - Commodity groups
  - Iowa State University

- What other types of data, information, or services would be useful in your work?
  GIS layers for locations of private and public wells would be helpful for NRCS field staff. Roger commented that the Department of Homeland Security prevents showing the well locations.

- What questions would you like monitoring to answer?

(The discussion under this question also included additional monitoring the stakeholders would like to see)

Tim asked if the end goal is to determine if water quality has improved?

Jake said yes, but he would also like to know nutrient levels leaving the state and how levels vary from year-to-year. Toward this end, he suggested (half joking) establishing real time sensors everywhere. Chris agreed there is no doubt that sensor technology is the wave of the future and added that USGS is already using them extensively. Tim asked which sensors are reliable. Chris said nitrate and turbidity are pretty good.

Chris said ISA would like to see more monitoring in the smaller watershed basins (e.g., HUC 12) – this is a gap needing to be filled. He suggested that WQI watersheds would be a good place to start. The big rivers are going to be monitored because there is a lot of interest in knowing what is leaving the state as well as what is going on within the state.

Laurel referred to Eric Hurley's written comments and said that monitoring data is needed at a scale that is useful for NRCS field staff working with individual landowners.

Linda said that when watershed projects are being planned, a certain percentage of that project should be set aside to do the monitoring.

Jerry emphasized maintaining long term monitoring at legacy stations.

Linda said the State needs to do more monitoring of manure impacts on water quality. She added that it is not necessarily the manure, but problems arising from handling, hauling and spreading it.

Linda also mentioned the need for information related to drinking water quantity, and to address nitrate detections in wells where these levels have not been seen before.

Jerry said trend setters in farming are looking at irrigating to increase corn yields. Chris agreed and added that Iowa is on the cusp of a lot a irrigating in places that we haven't seen it before. He said there is a lot of interest among farmers looking into impounding tile water and using that for irrigation.

Linda commented that Iowa needs to look more at drinking water availability and added that the State does not have a holistic planning approach and needs to do a better job of looking at water use as a whole.

Linda said some of the future issues are the pharmaceuticals and personal care products in the groundwater.

Chris thinks that the cyanotoxins should be monitored in more places before testing for pharmaceuticals. He referred to the Lake Erie / Toledo water supply problem and said DNR needs to get out ahead of the risk of cyanotoxins to water supplies in Iowa.

Roger asked whether the focus of cyanotoxin monitoring should be on surface water withdrawals or a broader ambient focus. Chris said he would look closely at the water supply angle.

Linda said cyanotoxin monitoring is needed in rivers, not just lakes/beaches, because cyanobacteria occur there also.

Linda said there needs to be more interpretation and education related to risk. She used an example of parents who allow their diapered child to play in the water at the beach. Data interpretation needs to be more helpful in informing the general public about water quality. The public needs to understand the risk associated with the water quality. Suggestion was made as to inform the public on what actions can be taken to reduce the risk or reduce the water quality issue in the first place.

- Do you have any other suggestions for improving monitoring?
  Laurel suggested it would be helpful to have a GIS map of the all the private / public wells. Roger said this is prohibited by Homeland Security. Tim commented that it was ironic that at one time DNR was being paid to collect well location data at the same time that requirements were in effect prohibiting access to this information.

  Jerry emphasized education; he said their organization is a big advocate of AWARE and IOWATER. He asked whether they were included in the monitoring budget. Roger indicated they are.

  Laurel said it would be helpful if the monitoring data could show trends in water quality.

  Chris mentioned that biological monitoring is important and needs to continue; it provides a connection with the public – e.g., status of fish.

Meeting Wrap-up
This process is going to go on for the next couple weeks/months. Feel free if any other questions, suggestions, etc. that come up to contact Tim, Roger or the Ambient Monitoring Staff.

Also provide any suggestions on how to improve these listening sessions would be greatly appreciated.

Laurel asked that Eric Hurley, NRCS be included in future sessions.

Written comments provided by Eric Hurley, NRCS Nutrient Management Specialist

- What monitoring data or summarized information do you use?
  At this time we are only beginning to systematically use ground water data. We have the well source water protection areas identified (DNR maps) and tied to public well reports assessing the risk of contamination and, to some limited degree, the actual contamination. Unfortunately, we do not yet have well test nitrate-N numbers. We do have finished water numbers which are helpful to conservation planning.

- Where do you access monitoring data/information?
  DNR reports. We, or at least I, am at a loss as to how to best access monitoring data/information for our field offices (NRCS and SWCD) to access to discuss with our clients.

- What other types of products or services would be useful?
- What questions would you like the DNR monitoring program to answer?
- How can we best present monitoring data to the public?
  I would love to get water quality monitoring data directly into the hands of our field office staff. The goal would be to be able to tie the management of a field directly to. water quality data downstream, to educate produces about the potential direct effects of their land management.

  This is what I would like to be the use. (NRCS and SWCD staff) experience to be:

  > When we are working with a producer and have ArcMAP open with the fields/tracts identified we would be able to have a GIS watershed layer with information that would link them directly to downstream water quality reports at varying resolutions (e.g. HUC12 (if available), HUCS, etc., to the Mississippi as a whole) which provides data on nitrate-N, P (total and dissolved), sediments, etc. including trends and an analysis of problems associated with this contamination at various scales (e.g. lake/reservoir algal blooms, drinking water contamination, Gulf hypoxia).

  We would need help with the interpretation. The purpose is to assist our staff to talk with producers about specific resource concerns downstream from their farm and, therefore, the potential need to address the issues on the farm with a conservation system.

  Our water quality resource concerns are:
  1. WATER QUALITY DEGRADATION -Excess nutrient in surface and ground water
  2. WATER QUALITY DEGRADATION -Pesticides transported to surface and ground waters
  3. WATER QUALITY DEGRADATION -Excess pathogens and chemicals from manure, bio-solids or compost applications
  4. WATER QUALITY DEGRADATION -Petroleum, heavy metals and other pollutants transported to receiving waters
  5. WATER QUALITY DEGRADATION -Excessive sediment in surface waters
  6. WATER QUALITY DEGRADATION -Elevated water temperature

  So any geolocated data that would assist us to provide concrete numbers covering this would help.

  Ideally we would like a:
  - GIS layer of the watersheds
  - An associated data set with live links to printable reports of a common format
  - Watershed reports periodically updated
  - Value-added would be a link to real time water quality data. This can be especially useful in the spring when tile lines are running and runoff is occurring.

- Do you have any other suggestions to improve monitoring effectiveness?
  Provide municipal well test data, not just the well system finished water data (after blending and/or treatment). Report on wells closed due to contamination. Another useful GIS layer would be all wells in the state, private and public. We would use this in conservation planning.

Wallace Building, Conference Room 2N
Meeting Summary

Introductions and Meeting Objectives – Tom Wilton

Meeting Attendees			
Initials	Name	Organization/Program	Email
LF	Lora Friest	NEIA RC&D	lorafriest@northeastiowarcd.org
SH	Susan Heathcote	Iowa Environ. Council	heathcote@iaenvironment.org
MK	Mike Kuntz	City of Cedar Rapids	m.kuntz@cedar-rapids.org
GS	Greg Sindt	IAWEA / Bolton &Menk	gregsi@bolton-menk.com
JB	Jamie Benning	ISU Extension	benning@iastate.edu
LG	Larry Gullet	Johnson CCB	lgullet@co.johnson.ia.us
JL	John Lawrence	ISU CALMS / Extension	Jdlaw@iastate.edu
TH	Tim Hall	Hydro Resources	Tim.Hall@dnr.iowa.gov
MS	Mary Skopec	WQMA – WQB	Mary.Skopec@dnr.iowa.gov
MB	Michelle Balmer	WQMA – WQB	Michelle.Balmer@dnr.iowa.gov
TW	Tom Wilton	WQMA – WQB	Tom.Wilton@dnr.iowa.gov
RB	Roger Bruner	WQMA – WQB	Roger.Bruner@dnr.iowa.gov
JO	John Olson	WQMA – WQB	John.Olson@dnr.iowa.gov

The objectives of the listening sessions with stakeholders to learn how external stakeholders are using products and services of the Ambient Water Monitoring program and to identify improvements that can be made.

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In the late 70s, early 80s the stream monitoring was initiated at several fixed monitoring locations. In 1987, there was a substantial increase in coverage in the ambient stream monitoring network. In 1994 was when stream biological monitoring initiated. In 2000, the state funding was enhanced and in 2006 was when the strategy was last updated.

Steps for updating the strategy will be to evaluate the current program and identify monitoring gaps, needs and weaknesses. There will be several listening sessions to obtain stakeholder input. Evaluation and prioritization of any improvements will be made. Recommendations will be finalized and the strategy document will be updated. Once the document is updated, recommendations will be implemented.

Tom Wilton (TW) asked if there were any questions. Susan Heathcote (SH) asked if discussion was to be limited to ambient monitoring, or other types of monitoring like beach monitoring or TMDL monitoring. Roger Bruner (RB) indicated that all monitoring is open for discussion.

Greg Sindt (GS) asked for a brief overview of the lake and stream monitoring (i.e., number of sites, parameters, etc.). DNR staff provided sampling details for lake and stream monitoring. SH requested details on beach monitoring and biological monitoring.

Facilitated Discussion – Tim Hall
Questions for DNR Water Monitoring Stakeholders:

- What DNR water monitoring data or information do you use and how do you use it?
  Johnson CCB uses the data for six different purposes: (1) evaluate biological health of Clear Creek; (2) evaluate effectiveness of BMPs around Kent Park Lake; (3) use data to prescribe management in the KPL watershed (Johnson Co. owns/manages most of the watershed); (4) evaluate human health risk based on bacteria and microcystin levels; (5) environmental education; and (6) inventory biological health in surface waters. He is interested in knowing how DNR monitoring can be leveraged to fit their local needs.

  Lora Friest (LF) indicated that the Northeast Iowa RC&D uses local, county, and state monitoring data for a dozen uses. They build monitoring partnerships around HUC8 basins like the Upper Iowa and Turkey Basins. They always start with a logical monitoring plan and use it to gain trust and buy-in from watershed stakeholders. They try to apply the data analytically to show where water quality is good and present the data in a way that makes sense to people. It is important that monitoring be able to point out places that have good water quality, not just where it is bad.

  Jamie Benning (JB) indicated that ISU Extension primarily is using nutrient monitoring data and uses it as a foundation to engage stakeholders. They need better user-friendly ways to present data that make sense to stakeholders.

  John Lawrence (JL) mostly uses nutrient data for research purposes. It is important to understand the data from a standpoint of quality, strengths and weaknesses, and that this information is disclosed.

  Mike Kuntz (MK) indicated that their focus is very local – i.e., smaller than the HUC12 watershed to answer questions of about progress made in small subwatersheds.

  Susan Heathcote (SH) uses all the data in her work. The most important thing is for the data to be consistent, impartial and reliable. She reviews the 305b/303d report assessments carefully and looks to see if enough data are available to do a good job. SH stressed the importance of having monitoring ability to identify where problems are. Without this step, it is not possible to know where management efforts need to focus. Long-term monitoring is essential to provide a larger data set and context for comparison with local water quality conditions. SH also stressed that biological monitoring is very key to long-term monitoring of aquatic ecosystem health and is something that is very relatable to the public. Biological data was used to identify a few warmwater streams for Outstanding Iowa Waters (OIW) anti-degradation. She commented that will be important to continue monitoring the best quality aquatic resources for long-term trend purposes.

  LF agreed about connecting biological monitoring with the public. She related that people in her watersheds have responded favorable to information about increasing trends in the number of reproducing trout streams.

  Larry Gullet (LG) indicated that Johnson County Conservation Board uses the following types of monitoring data: biological (i.e., benthic macroinvertebrates and aquatic plants), phosphorus, nitrogen, pH, temperature, water clarity, DO, and microcystin.

  Lora Friest added that they also use ammonia data.

- Where do you access DNR water monitoring data or information?
- Do you use monitoring data/information from other sources?

MK obtains data from IASTORET as does JB.

LF indicated their samples are collected through an EPA-approved QAPP, analyzed by SHL and uploaded to IASTORET. The RC&D then downloads the data from IASTORET and puts the data in their database where it is presented using their GIS based system. SH often gets data from the USGS Water Science web site. She also accesses data through IASTORET and the water quality assessment database (ADBnet).

LF also accesses data from the State of Minnesota, and likes the Iowa Flood Information Center (IFIS) as a "one-stop" location for hydrological data.

- What other types of data, information, or services would be useful in your work?
  Greg Sindt (GS) commented that monitoring is not providing good data for nutrient load estimation. Once a month is not good enough. He would specifically like to see more data to calculate mass loads and bioavailable P. John Lawrence (JL) asked if samples are concentration or volume based. Roger Bruner (RB) indicated that the samples are concentration based, but often tied to a flow gage measurement. Tim Hall (TH) remarked that sensor technology was improving and nitrate sensors are providing measurements at 30 – 60 minute intervals. GS said this doesn't help with phosphorus loads. Mary Skopec (MS) added that development of affordable sensors is a priority of the EPA and that orthophosphate sensor technology is getting better.

  GS also said that dissolved metals data are needed. He also would like to see data relating to freshwater mussel habitat needs. He wonders if habitat is more a limiting factor than levels of water contaminants such as ammonia. He thinks there can be tunnel vision focus on ratcheting-down contaminant levels to acceptable levels for mussels, when they might not be able to live in streams due to habitat problems.

- What questions would you like monitoring to answer?

- Do you have any other suggestions for improving monitoring?

Meeting Wrap-up
This process is going to go on for the next couple weeks/months. Feel free if any other questions, suggestions, etc. that come up to contact Tim, Roger or the Ambient Monitoring Staff.

Also provide any suggestions on how to improve these listening sessions would be greatly appreciated.

Technical Expert Meeting Notes

Ambient Water Monitoring Strategy –Technical Expert Meeting
10:00 AM – 12:30 PM, May 21, 2015
Conference Room 2N, Wallace Building, Des Moines
Meeting Summary
(Notes compiled by John Olson and Tom Wilton, DNR Water Quality Monitoring and Assessment Section)

Agenda
- ☐ Introductions and Meeting Objectives
- ☐ Background - DNR Ambient Monitoring Program and Strategy Update
- ☐ Summary of Stakeholder Input
- ☐ Group Discussion – Innovations/Changes to Improve Monitoring Effectiveness
- ☐ Next Steps
- ☐ Adjourn

ATTENDEES			
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Introductions and Meeting Objectives
Roger Bruner opened the meeting shortly after 10:00 AM. Attendees were asked to introduce themselves and briefly describe their involvement with water monitoring. Tom Wilton provided a short overview of the meeting agenda and objectives. The first objective of the meeting was to receive feedback from technical advisors from outside of the DNR concerning the ambient monitoring program and the input received at recent stakeholder listening sessions. A second objective was to identify potential innovations to improve effectiveness of the ambient monitoring program.

Background - DNR Ambient Monitoring Program and Strategy Update
Wilton gave a PowerPoint slide overview of the ambient monitoring program and showed a screen shot of the program's home web page. He reviewed the web page statement of program purpose and emphasized that the focus of the monitoring strategy update is on ambient monitoring as opposed to targeted monitoring, which tends to have a narrower focus.

Wilton showed a PP slide listing several milestones in Iowa's water monitoring history and pointed out that the last monitoring strategy update was completed in 2006. The group reviewed a one-page spreadsheet summary of recent monitoring activities. The spreadsheet listed the types of water resources monitored (i.e., groundwater, lakes, streams, wetlands), network of sampling locations, sampling frequency, and monitoring parameters.

At this point, Bruner suggested opening up the discussion for questions from the technical advisory group.

Donna Lutz questioned the lack of a definition for the code "ME" on the monitoring summary spreadsheet. Wilton indicated the abbreviation stands for [trace] metals and that he would correct the mistake on the spreadsheet.

Dave Jensen asked about monitoring and assessment (e.g., 303(d) listings) of interstate waters such as the Missouri River, and he suggested that a discussion on interstate coordination of monitoring efforts would be beneficial.

Regarding other monitoring activities in Iowa, Mary Skopec mentioned that the EPA's national aquatic probabilistic surveys are an additional way to monitor and assess water quality. The surveys of lakes, streams, and wetlands conducted so far have included randomly selected sites in Iowa. Surveys are being repeated in a rotation.

Michelle Soupir asked for clarification regarding the difference between field and lab analytes. Wilton explained that field analytes include water temperature, pH, DO, and turbidity. Bruner added that instantaneous flow measurements are also taken at some stream sampling locations.

Leo Keller asked about the status of the DNR's upstream/downstream monitoring program and specifically whether the Des Moines and Raccoon rivers were monitored upriver and downriver from the City of Des Moines. Skopec responded that upstream/downstream monitoring had been conducted for 14 years; however, this monitoring recently had been suspended. This raised the issue of how long a monitoring program should commit to a particular monitoring design (e.g., rotating basins).

Jensen expressed that he views the upstream/downstream monitoring at urban areas as targeted monitoring, not ambient monitoring, and that requirements for such monitoring could be put into NPDES permits. Skopec added that the DNR upstream/downstream monitoring was more than just permit-based monitoring. It integrated all the urban impacts, not just those from permitted discharges.

Steve Kalkhoff asked about groundwater monitoring. Bruner responded that the "core 90" groundwater stations were revisited in 2013 and this monitoring will continue.

To further familiarize the group with the DNR's ambient monitoring program, Wilton showed a series of slides showing the geographic distribution of ambient monitoring sites in lakes and streams. The first slide showed a map of Iowa's 138 significant publicly-owned lakes and monitoring locations for the current ambient lakes monitoring project. Next was a map of the DNR fixed stream/river water quality monitoring sites. Wilton stated that the DNR's monitoring program covers approximately 80% of the state's area for the purpose of estimating nutrient loads. A recent focus has been to explore methods of calculating loads, most recently for phosphorus.

Wilton showed a slide related to the DNR biological monitoring program and talked about the ecoregion-based design and the monitoring of least-disturbed sites to determine reference conditions. He mentioned that the biomonitoring program is now focusing on headwater streams and plans to identify the least disturbed of these sites as reference sites. Jensen asked whether WQ data was collected at biological monitoring sites. Wilton responded that a WQ grab sample is normally collected in conjunction with biological monitoring. Connie Dou asked how the reference site candidates were selected. Wilton responded that watershed land use characteristics and other factors such as presence of livestock facilities and stream channel alterations were evaluated. A total of 11 different factors are considered.

Next was a slide of probabilistic stream sampling sites that were monitored from 2002 through 2006 (total of 225 sites); Wilton said that sampling was completed in two or three visits per site. He added that fish tissue monitoring was conducted at some sites as was sediment contaminant monitoring. Jensen asked whether the DNR used the results of probabilistic monitoring for 305(b) assessments; Wilton responded that yes, the DNR did.

The final PP slide showed the steps involved in developing the ambient monitoring strategy. Wilton indicated that the strategy team has been gathering stakeholder input and evaluating the current program, and that now the team is beginning to look for improvement alternatives. He indicated that the team will produce a draft strategy for review. The strategy will be finalized, made public, and the DNR will begin implementing it. Bruner suggested that the strategy document will be used for establishing monitoring priorities.

Summary of Stakeholder Input

Wilton showed a slide listing the six questions asked of DNR and external (non-DNR) stakeholders:

- What monitoring data or summarized information do you use?
- How do you access monitoring data/information?
- What other types of data, information, or services would be useful?
- Do you have any suggestions to improve monitoring effectiveness?
- What questions would you like the DNR monitoring program to answer?
- How can we best present monitoring data to the public?

These questions formed the basis for facilitated discussions at a series of stakeholder meetings. Wilton noted that discussions were open to stakeholder experiences with any form of water monitoring, not just "ambient" monitoring. This was done to avoid constraining stakeholder input. He added that 132 individual responses were received and the monitoring strategy team is now trying to identify the ones that are most applicable to the strategy.

The technical advisors then were asked for their thoughts on the stakeholder input. Jensen suggested that, from a broad view, the most important issue is to identify the questions the DNR would like monitoring to answer. The questions to be answered need to be listed and prioritized; then the DNR needs to determine what type of monitoring data and monitoring frequencies are needed to answer these questions. Wilton mentioned the strategy team was making an effort to look at monitoring questions and objectives.

Lutz asked whether we have enough WQ data and the monitoring frequency to evaluate trends in water quality. For example, Iowa lakes are monitored three times per summer; streams and rivers are monitored monthly. Bruner asked Lutz her view on what frequency is more appropriate? Lutz suggested maybe weekly monitoring in the summer with some event sampling with monthly monitoring in winter. She provided examples of the variability of the data for flow, nitrate, and E. coli within the month of July 2014. She questioned the influence of storm events on load estimation. Skopec said the number of samples needed to detect changes in WQ can be calculated. Stream size also matters because of differences in variation of WQ parameters. Lutz asked if monitoring is done on a fixed schedule. Mike Schueller noted that the State Hygienic Laboratory has a set schedule with ambient river/stream monitoring usually occurring during the first week or week and a half of the month. Lutz questioned whether sampling occurred at the same time of day, and Schueller responded that, yes, samples are generally collected at approximately the same time of day. Lutz questioned whether the DNR has evaluated the flows typically sampled during ambient monitoring. Skopec said the monitoring data are biased low, because sampling is not intentionally done at peak flow. John Olson added that dating back to the 1970s up until 2000, the DNR's ambient monitoring protocols explicitly prohibited sampling during storm runoff events.

Jensen asked if the DNR had any success with flow targeting. Skopec said yes, that can be done on Big River monitoring, because you can watch the storm hydrograph and know when to sample. Kalkhoff agreed that the USGS is able to make adjustments based on real-time flow data. Jensen then asked whether the DNR was looking at load trends or just concentration. Bruner responded that nutrient concentration data had been coupled with USGS flow data in order to estimate loads for the State Nutrient Reduction Strategy (NRS). Wilton noted that the DNR recognized a need to sample during storm events and to obtain better flow data; he mentioned TMDL projects using automated samplers and stage flow recorders for this purpose. Jensen asked about data for ungauged watersheds. Greg Nalley indicated that predicted stream flow statistics for ungauged streams are available through StreamEst and StreamStats. Wilton asked where this information could be accessed. Nalley said there was a Beta site for StreamStats and he could provide the internet link for the group (http://water.usgs.gov/osw/streamstats/iowa.html).

Michelle Soupir said the catchment (local) scale is better for evaluating whether water quality is improving. Tony Seeman agreed that scaling down to the local level is needed. Discussion continued about the issue of scale in relation to being able to detect trends. Skopec said that the EPA has gone to the population-based approach for trend monitoring in the national surveys.

Soupir noted that the summary of stakeholder input included several comments about whether water quality is improving over time. She asked whether the DNR had looked at trends. Skopec responded that flow-weighted data have been analyzed for changes in nutrient levels, and added that it would be good to look at long-term trends to be able to contribute to the national discussion on nutrients. Lutz noted that it is difficult to show trends. There was discussion regarding the use of statistics for trend analysis (e.g., data transformations and use of nonparametric statistics). Skopec suggested that log transformation can be used to normalize WQ data, and in terms of WQ trends in Iowa, the Iowa River looks better and western Iowa looks worse.

Soupir indicated that trend detection is easier at the catchment scale. Seeman agreed that monitoring at the local scale is very important for evaluating BMP effectiveness. Soupir mentioned that monitoring at Lyons Creek—a relatively small watershed—has yielded valuable data. Skopec noted that Section 319 monitoring in the Yellow River watershed has shown improvements in water quality. Wilton noted that the monitoring team was discussing WQ monitoring at a smaller scale and trying to determine what part of the DNR needs this data. He added that a rotating basin approach, which might include monitoring at something like the HUC-12 scale, is being considered. The problem is that the rotating basin design is a relatively short-term monitoring cycle that is not ideal for trend monitoring purposes. Skopec suggested that instead of looking at site-specific trends, the DNR could look at trends in populations of waters (e.g., wadeable streams) to evaluate if conditions are getting better or worse. EPA likes this approach as it address a WQ status/305(b) question [i.e., the assessment of ALL waters].

Group Discussion – Innovations/Changes to Improve Monitoring Effectiveness

Bruner asked the technical advisors for their ideas on better approaches to monitoring. Jensen suggested that, for example, the DNR could look at percent impairment within river basins such as the Raccoon River basin versus another river basin. He noted, however, this approach does not specifically identify where impairments occur and is not particularly useful for public communication. Olson noted that a probabilistic design gives the percentage of waters that meet or exceed a threshold. Kalkhoff suggested that a probabilistic design might overwhelm small changes in water quality. Soupir suggested that a probabilistic design is better suited to characterizing water quality on a larger scale, but the catchment scale may be better for identifying WQ trends. Jensen questioned whether, for example, BMP effectiveness monitoring could answer the question of whether WQ is improving. He emphasized that we need a trend monitoring approach but ambient monitoring is conducted at the wrong scale. It is a paradox that ambient monitoring is important but it can't answer some important questions.

Soupir remarked that what the public wants to know is whether BMP implementation is working. She suggested that either the number of acres with BMPs or WQ monitoring data also can be used to determine trends. Seeman stated that flow variability is a problem and that pre-project monitoring is needed to show improvement. Michelle Balmer asked about the placement and the number of sites. Seeman remarked that those questions are related to the scale of monitoring. Nalley said that the USGS has done this type of pre-project monitoring; that is, tracking responses in a watershed and looking at changes in WQ downstream. Wilton asked Nalley how difficult it was to follow this response in a watershed. Nalley referred to a 10-year study in Texas that included pre-project monitoring before implementing BMPs in subwatersheds. Kalkhoff noted that the USGS could provide links to the report for this study [i.e., the Seco Creek watershed study in south-central Texas: http://pubs.usgs.gov/of/1998/ofr98-627/].

The discussion about trend monitoring continued. Wilton mentioned that the EPA is working with states to establish Regional Monitoring Networks for climate change monitoring. He also mentioned that intensive trend monitoring of a small group of lakes had been discussed many years ago but it was not adopted by the DNR. Olson asked about the status of USGS long-term trend monitoring sites. Kalkhoff indicated that budget cuts had impacted the network. Wilton added that he thought Iowa might have a few sites belonging to a network of long-term (WQ trend) sites; for example, the USDA/ARS sites on Walnut Creek in Poweshiek County and the South Fork Iowa River sites in Hardin County.

Wilton shifted the discussion to two specific topics related to monitoring innovations: emerging contaminants and water quality sensors. Soupir noted that different methods such as passive sampling technology (e.g., POCIS) are useful for monitoring of emerging contaminants. She referred to a sampling project in the South Fork Iowa River where this technology had been used to monitor for specific types of antibiotics used in the livestock industry. She said that she would provide this information to Bruner and Lutz. Seeman added that the devices have also been used to detect microbiological contaminants.

Wilton mentioned the increasing trend toward deployment of sensors for continuous monitoring of water quality parameters. He added that sensor technology (e.g., air and water temperature, flow stage) is being used in the EPA's climate change monitoring network. Nitrate sensors are already widely in-use, but sensors to measure phosphorus are still under development. Skopec noted that the EPA is holding a contest to develop an inexpensive, accurate sensor to measure phosphorus in water. Kalkhoff noted that the USGS has installed nitrate sensors on the Upper Mississippi River at Clinton and they have used a different sensor than HACH. The group—both the Omaha and Rock Island Corp representatives (Jensen and Keller) and SHL (Schueller)—expressed much interest in sensor-based monitoring. Kalkhoff noted some problems with bio-fouling of the sensor at Clinton and remarked that about a four-week maintenance schedule was needed to keep the sensor producing useful data. Nalley noted that the type of mounting/affixing of the sensor is very important to prevent theft or loss of the sensor. Lutz asked about how to find out where sensors were operating in the state. Kalkhoff said that the information could be obtained from the USGS National Water Information System (NWIS) web interface for Iowa.

Wilton raised the issue of challenges in managing and storing the sensor-generated (i.e., continuous) monitoring data. Kalkhoff said that the USGS uses the NWIS database, but also uses the Aquarius software. ACOE-Rock Island also has the problem of managing continuous monitoring data. Wilton said he is familiar with Aquarius and that it looks like a good choice for continuous data. Bruner noted that the DNR's current database, EQuiS, can handle continuous data with the purchase of another module.

Wilton opened the discussion for additional comments. Jensen had a question regarding the issues with monitoring phosphorus. Bruner responded that monitoring frequency is insufficient for accurate load estimations. Wilton added that sensor technology is not there yet. Lutz noted that levels of phosphorus tend to be very high in sediment, and she asked whether anyone has monitored sediment concentrations of phosphorus? No one responded affirmatively to this question. Jensen noted that creation of shallow water habitats along the Missouri River has involved discharging of excavated sediment to the main channel of the river. From a permitting standpoint, phosphorus associated with the sediment has been an issue for the State of Iowa, which has asked for data showing the background levels of phosphorus. Jensen suggested that it would be good to know the phosphorus loads in the Missouri River so they could show how much is coming down the river compared with the amount in dredged sediment.

Bruner asked each of the attendees (excluding the DNR strategy team members) the following question: What is the one thing that could be done to improve Iowa's WQ monitoring network? The following were the responses:

Schueller: Look at increasing monitoring frequency.

Seeman: Broaden the scale covered by monitoring to include small and large scales.

Lutz: Use a tiered approach with more frequency for long term trend purposes and monitoring at the catchment scale to evaluate effectiveness of BMPs.

Jensen: Clearly define monitoring objectives and clearly state the questions that need to be answered. He added that nutrient loading is a priority.

Bruns: Focus monitoring on issues of public interest, such as nutrients. Also, monitoring for the long-term is important; be prepared to show results of monitoring to keep the programs viable.

Keller: Look at whether sampling frequency is adequate. For example, he questioned if three times a year and no winter sampling was enough for lakes. He also mentioned that Army Corps park managers look to the DNR for direction on monitoring. That is, if the DNR monitors three times per year at Iowa lakes, then the managers will feel that three times per year is sufficient and that more frequent monitoring at Corps lakes is unnecessary. Balmer mentioned that the 2005 Scientific Initiatives Report addressed lake sampling frequency. Lutz had a question regarding the issues of cyanotoxin sampling at beaches; i.e., sampling water vs. sampling scums. Balmer agreed that cyanotoxin monitoring is challenging. Keller added that coordination of monitoring has become important for the Corps, especially from the standpoint of dealing with reductions in monitoring budgets. He suggested that the DNR should also look more at increasing coordination and development of monitoring partnerships. He suggested that perhaps this monitoring group could meet occasionally.

Soupir: Monitor to identify long-term trends in water quality and look into statistical analysis tools for trend analysis. Also, implement small watershed scale monitoring to answer questions about the effectiveness of BMP implementation.

Nalley: Monitor to quantify BMP effectiveness using a monitoring design that includes both near and far field monitoring within the same watershed.

Kalkhoff: Emphasize getting consistent data for long-term trend analysis. He also suggested that the DNR could establish a series of index sites that are dedicated to long-term monitoring, and stated that missing data is a problem to be avoided.

Next Steps

Wilton indicated that the monitoring team is continuing to review the program and will be moving toward developing priorities and alternatives for improving the program. The strategy will address setting priorities within the current budget, but also prioritization of monitoring needs that could be addressed if funding is increased. The strategy will be completed later this year and it will become a public document. The technical advisors will be offered the opportunity to review the draft strategy.

Bruner asked whether the group is interested in a face-to-face meeting to review the draft strategy. Some interest was expressed in having such a meeting, and potentially also meeting occasionally in the future to share monitoring knowledge and experience.

Adjourn

The meeting was adjourned at 12:30 PM.

Appendix 2. U.S. EPA Monitoring Elements Guidance

The DNR completed an evaluation of strengths and weaknesses in Iowa's current ambient water monitoring program following the "Elements of a Water Monitoring Program" guidance prepared by the U.S. Environmental Protection Agency (USEPA 2003). The list and descriptions of monitoring elements provides useful context for evaluating the current program and for developing recommendations and strategies to improve the program.

<u>Elements of a Water Monitoring Program</u>

A. Monitoring Program Strategy
B. Monitoring Objectives
C. Monitoring Design
D. Core and Supplemental Water Quality Indicators
E. Quality Assurance
F. Data Management
G. Data Analysis/Assessment
H. Reporting
I. Programmatic Evaluation
J. General Support and Infrastructure Planning

Monitoring Program Strategy

"The State has a comprehensive monitoring program strategy that serves its water quality management needs and addresses all State waters, including streams, rivers, lakes, the Great Lakes, reservoirs, estuaries, coastal areas, wetlands, and groundwater. The strategy should contain or reference a description of how the State plans to address each of the remaining nine elements. The monitoring program strategy is a long-term implementation plan and should include a timeline, not to exceed ten years for completing implementation of the strategy. EPA believes that state monitoring programs can be upgraded to include all of the elements described below within the next 10 years. It is important that the strategy be comprehensive in scope and identify the technical issues and resource needs that are currently impediments to an adequate monitoring program." (USEPA 2003)

Monitoring Objectives

"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. For example, monitoring objectives could include helping establish water quality standards, determining water quality status and trends, identifying impaired waters, identifying causes and sources of water quality problems, implementing water quality management programs, and evaluating program effectiveness" (USEPA 2003).

Monitoring Design

"The State has an approach and rationale for selection of monitoring designs and sample sites that best serve its monitoring objectives. The State monitoring program will likely integrate several monitoring designs (e.g., fixed station, intensive and screening-level monitoring, rotating basin, judgmental and probability design) to meet the full range of decision needs. The State monitoring design should include a probability-based network for making statistically valid inferences about the condition of all State water types, over time. EPA expects the State to use the most efficient combination of monitoring designs to meet its objectives." (USEPA 2003)

Core and Supplemental Indicators

"The State uses a tiered approach to monitoring that includes core indicators selected to represent each applicable designated use, plus supplemental indicators selected according to site-specific or project-specific decision criteria. Core indicators for each water resource type include physical/habitat, chemical/toxicological, and biological/ecological endpoints as appropriate, and can be used routinely to assess attainment with applicable water quality standards throughout the State. Supplemental indicators are used when there is a reasonable expectation that a specific pollutant may be present in a watershed, when core indicators indicate impairment, or to support a special study such as screening for potential pollutants of concern." (USEPA 2003)

Quality Assurance
"Quality management plans and quality assurance program/project plans are established, maintained, and peer reviewed in accordance with EPA policy to ensure the scientific validity of monitoring and laboratory activities, and to ensure that State reporting requirements are met". (USEPA 2003)

Data Management
"The State 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. In the future, EPA will require all States to directly or indirectly make their monitoring data available through the new STORET system. For States that do not currently operate STORET, their monitoring strategies should provide for use of STORET as soon as is practicable. For the 2004 305(b) reports and 303(d) lists, EPA strongly recommends that all States store assessment information using the EPA Assessment Database or an equivalent relational database and define the geographic location of assessment units using the National Hydrography Dataset (NHD)." (USEPA 2003)

Data Analysis and Assessment
"The State has a methodology for assessing attainment of water quality standards based on analysis of various types of data (chemical, physical, biological, land use) from various sources, for all waterbody types and all State waters. The methodology includes criteria for compiling, analyzing, and integrating all readily available and existing information (e.g., volunteer monitoring data, discharge monitoring reports)." (USEPA 2003)

Reporting
"The State produces timely and complete water quality reports and lists called for under Sections 305(b), 303(d), 314, and 319 of the Clean Water Act and Section 406 of the Beaches Act. EPA issued "2002 Integrated Water Quality Monitoring and Assessment Report Guidance" on November 19, 2001, to encourage integration and consistency in the development and submission of Section 305(b) water quality reports and Section 303(d) impaired waters lists. EPA will continue to support the use of this integrated reporting framework for future reporting cycles.

Under current regulations, Section 303(d) lists and Section 305(b) reports are due no later than April 1 of even-numbered years. To remain eligible for Section 106 grants, the State also must submit annual updates of water quality information. This requirement may be satisfied by annually updating 305(b) assessment information or by annually uploading monitoring data to the national STORET warehouse." (USEPA 2003)

Programmatic Evaluation
"The State, in consultation with its EPA Region, conducts periodic reviews of each aspect of its monitoring program to determine how well the program serves its water quality decision needs for all State waters, including all waterbody types. This should involve evaluating the monitoring program to determine how well each of the elements is addressed and determining how needed changes and additions are incorporated into future monitoring cycles." (USEPA 2003)

General Support and Infrastructure Planning
"The State identifies current and future monitoring resources it needs to fully implement its monitoring program strategy. As part of an ongoing integrated planning process, the following needs (staff and training, laboratory resources, and funding) should be assessed, considering current conditions and planned improvements, and discussed with the Regions during negotiation for Section 106 grants and PPGs that include Section 106 funds (Note: States may rely on workload models to assess needs).

Staff and Training: The State should identify the required number of staff needed for a State monitoring program, as well as needed training for field, laboratory, data management, and data assessment staff, and should document adequacies and shortfalls. States should also address staff and staff training needs for unassessed waterbody types.

Laboratory Resources: The State should identify needed laboratory support (and should document adequacies and shortfalls) to satisfy scientifically appropriate documented methods, such as methods listed in 40 CFR Part 136, published in Standard Methods for the Examination of Water and Wastewater, or published by the U.S. Geological Survey. U.S. EPA also encourages the use of performance-based methods (i.e., scientifically appropriate methods that meet established criteria for accuracy, sensitivity, bias, and precision and comply with specified data quality needs or requirements).

Funding: The State should identify required funding (e.g., for salaries, training, travel, equipment, laboratory analysis) for a State monitoring program, along with anticipated sources and amounts of funding and the effects of any shortfalls." (USEPA 2003)

Appendix 3. Monitoring Improvement Recommendations

Below are the directions provided to DNR ambient water monitoring program coordinators and other DNR staff for the purpose of evaluating and numerically rating the potential impact and implementation difficulty of each recommendation that was identified in the program strengths and weaknesses evaluation process.

Definitions and Instructions

Each recommendation will be evaluated and rated within the following categories:
- Program Impact (Benefit / Need)
- Implementation Difficulty
- Timeline

When evaluating an individual recommendation, it is important to consider only what is specifically required to implement the recommendation. For example, a recommendation might call for the development of a monitoring plan for long-term trend monitoring. In this case, the evaluator should only evaluate the impact, difficulty, and timeline associated with developing the plan, and not everything involved in conducting trend monitoring, which would obviously involve additional program resources and a timeline to be determined by the plan.

Program Impact:
Rate from 1 (lowest) to 5 (highest) the positive impact that implementing the recommendation will have on the monitoring program in terms of addressing a specific need and further allowing the program to achieve its objectives. This evaluation should be completed independently of considerations of implementation difficulty and time requirement. At this point in the evaluation process, no assumptions should be made about the availability of program resources (e.g., funding, staffing, and technology) needed to fully implement the recommendation.

It is assumed that each recommendation if fully implemented can have a positive impact on the ambient monitoring program. Therefore, it will be helpful to keep in mind the program objectives when rating each recommendation. Recommendations assigned a value of 4 or 5 are expected to provide the greatest benefit because they eliminate or significantly reduce a major program deficiency or gap that interferes with the achievement of monitoring objectives. Conversely, recommendations rated 2 or below are expected to provide a relatively lower benefit because the overall impact on the program is somewhat smaller or less direct. This is not to say, however, that recommendations assigned a lower rating are not important or cannot become priorities.

Implementation Difficulty:
Rate the anticipated difficulty of implementing the recommendation based on three factors: Cost, Staffing, and Technical Complexity. Assign a difficulty rating between 1 (low) and 5 (high) to each factor.

Any additional implementation difficulties that are not covered by these categories can be described and rated in the “Other” column provided on the worksheet. Examples of additional difficulties that are worthy of rating include: developing a cooperative agreement with another agency or organization; coordinating sampling activities as part of a monitoring partnership; and developing administrative rules in support of new or revised water quality standards.
Rating implementation difficulty due to ***Cost*** involves considering the amount of funds needed for: (a) contracts or other paid service arrangements - e.g., sample collection, laboratory analysis, (b) travel expenses, and (c) equipment, supplies, computer technology, lab space, storage, etc. Generally, the total anticipated cost of implementing the recommendation can be considered high (rating of 5) when it represents a substantial proportion (>35%) of the current budget for a given monitoring program. A moderately high cost (4) represents

approximately 25-35%; moderate cost (3) is 15-25%; moderately low cost (2) is 5-15%; and low cost (1) is <5% of the current budget.

Rating implementation difficulty due to ***Staffing*** involves estimating the level of involvement that would be required of staff currently working in the DNR's water quality monitoring and assessment (WQMA) program. The potential involvement of DNR staff working in other programs such as wasteload allocation, UAA/water quality standards, watershed improvement, and fisheries is not being considered at this time.

The amount of staffing from the monitoring and assessment program that will be needed to fully implement the recommendation should be considered. This includes development and initial implementation, but does not include a maintenance phase beyond initial implementation. Generally, staffing difficulty can be considered high (rating of 5) when it is represented by >1 additional full-time equivalent (FTE) position. A moderately high staffing level (4) represents 75% - <100% FTE; moderate staffing (3) is 50-75%; moderately low staffing is 25-50%; and low staffing level is <25% FTE.

The evaluation of implementation difficulty due to ***Technical Complexity*** includes the consideration of factors such as the complexity of issues and tasks, and the level of specialized knowledge, skills, or technology needed to implement the recommendation.

The completion of recommendations involving work of high complexity (rating of 4 or 5) will require a commitment of one or more workers having specialized skills and knowledge over a significant period of time (e.g., 6 months or longer). Examples of high complexity work include developing an internet application and performing advanced data analysis of available data. The skills needed to perform this work might currently exist among staff within the WQMA program; however, availability of these individuals is likely to be limited due to current work obligations. Therefore, the implementation of highly complex recommendations is likely to require the reassignment of DNR staff or acquisition of services from outside contract employees.

Work of moderate complexity is consistent with most of the routine technical work conducted in the WQMA Section. The work might involve some research or skill development; however, the work can be completed by most technical staff, not just those having specialized technical knowledge or skills. After this initial development period, the ongoing implementation work can be carried out with fairly small amounts of technical input. Examples include preparing a fact sheet or developing standard monitoring work plans.

Lower complexity work (rated 1 or 2) is that which requires relatively little commitment of current WQMA technical staff and/or the work can be completed by appropriately trained technicians or temporary workers under the supervision of the monitoring project leader. Examples include performing data entry or collecting grab water samples.

Timeline:
Rate the time required to fully implement the recommendation as one of the following:

- Short (one year or less)
- Medium (>1-5 yr.)
- Long (> 5 yr.)

The timeline should include the time required to research, plan, and fully implement the recommendation. The estimate should not include the time required to collect sufficient data for analysis, just the amount for planning and implementation through first collection of samples.

Ratings Key

Benefit	Cost (% budget)	Staffing (%FTE)	Technical Complexity	Timeline
5-High	5-High (>35%)	5-High (>100% FTE)	5-High	Short (<1 yr.)
4-Mod. High	4-Mod. High (25-35%)	4-Mod. High (75-100%)	4-Mod. High	Medium (>1-5 yr.)
3-Moderate	3-Moderate (15-25%)	3-Moderate (50-75%)	3-Moderate	Long (>5 yr.)
2-Mod. Low	2-Mod. Low (5-15%)	2-Mod. Low (25-50%)	2-Mod. Low	
1-Low	1-Low(<5%)	1-Low (<25%)	1-Low	

Quadrant 1 – First implementation tier at current funding and staffing levels:
- High-to-moderately high program impact and low-to-moderately low implementation difficulty;
- Criteria: Impact rating of 4 or 5, Difficulty (sum) rating of 6 or less, and Difficulty (cost) rating of 2 or 1;
- 48 recommendations match the criteria.

Quadrant 2a – Second implementation tier requiring a significant reallocation of existing resources and/or moderate additional resources:
- Moderately high-to-high program impact and moderate- to-moderately high implementation difficulty;
- Criteria: Impact rating of 4 or 5 and Difficulty (sum) rating of 8, 7, or 6 (the latter with cost rating of 3);
- 28 recommendations match the criteria.

Quadrant 2b – Third implementation tier requiring substantial additional resources:
- Moderately high-to-high program impact and moderate-to-moderately high implementation difficulty;
- Criteria: Impact rating of 4 or 5 and Difficulty (sum) rating of 9 or higher;
- 22 recommendations match the criteria; these represent high impact “breakthrough” recommendations that would become higher priorities if substantial additional resources were made available.

Quadrant 3 - Not currently a priority for implementation:
- Low-to-moderate program impact and low-to-moderately low implementation difficulty;
- Criteria: Impact rating of 3 or less, Difficulty (sum) rating of 6 or less, and Difficulty (cost) rating of 2 or 1;
- 44 recommendations currently match the criteria;
- The list of recommendations should be reviewed periodically to determine which can be easily; accomplished without impacting the implementation of higher priority recommendations.

Quadrant 4 - Not currently a priority for implementation:
- Low-to-moderate program impact and moderate-to-moderately high implementation difficulty;
- Criteria: Impact rating of 3 or less; Difficulty (sum) rating of 7 or higher;
- 11 recommendations currently match the criteria;
- The list of recommendations should be reviewed periodically to update priority status; particularly for recommendations that received ratings of “moderate” for cost and staffing.

Fish Tissue Monitoring

R#	Category	Issue	Recommendation	Priority Matrix Quadrant	Impact (Program Benefit)	Sum of Difficulty Ratings	Difficulty (Cost)	Difficulty (Staff FTE)	Difficulty (Technical)	Difficulty (Other)	Implement Timeline (Yrs.)
FT-1	Monitoring Objectives	• Because of limitations in the monitoring network design, the program is unable to achieve the objective of a comprehensive status assessment of the fish tissue resource to satisfy CWA Section 305(b) requirements.	• Expand the consumption advisory objective to include issuance of more general (statewide) consumption advice (in progress).	2b	5	9	4	2	3		>1-5
FT-2	Sampling Design	• The sampling network has missed some of the Significant Publically Owned Lakes (SPOLs) and high use river segments that support important recreational fisheries. This represents a small, but significant shortfall in monitoring coverage and limits the ability to develop site-specific fish consumption advisories for all recreationally important waters as needed.	• Continue to incorporate all of the SPOLs and high-use rivers and streams as new sites are established. This will allow the DNR to sample more Iowa waterbodies and allow the DNR to provide more complete consumption advice to recreational fishers.	2a	4	8	3	1	2	2	<=1
FT-3	Sampling Design	• The network design does not include a probabilistic sampling component. The lack of a probabilistic sampling component doesn't allow the program to comprehensively report on the support status of the human health fish consumption designated use in accordance with CWA Section 305(b).	• Incorporate a probabilistic design either as part of the annual monitoring effort or on a periodic basis (e.g., every 3rd or 5th year). This design would include ponds (farm/urban) in addition to the large rivers and SPOLs. This will allow the DNR to report statistically valid estimates of the attainment of fish consumption uses for the CWA Section 305(b) report.	2b	4	10	4	2	4		>1-5
FT-4	Sampling Design	• The network does not include sites located in recreational fisheries of lower significance (e.g., small streams, farm ponds, and city lakes/ponds). The lack of sampling in these waters prevents the DNR from determining contaminant levels and providing consumption advice to recreational fishers of all waters from which caught fish are consumed.	• The IFTMP could also work with the Ambient Stream Biological Monitoring Program to sample the small streams and rivers when that program encounters game fish or larger bottom feeders. This will provide more data from an underrepresented group of waterbodies and more comprehensive consumption advice to recreational fishers.	3	3	5	2	1	2		<=1

R#	Category	Issue	Recommendation	Priority Matrix Quadrant	Impact (Program Benefit)	Sum of Difficulty Ratings	Difficulty (Cost)	Difficulty (Staff FTE)	Difficulty (Technical)	Difficulty (Other)	Implement Timeline (Yrs.)
FT-5	Sampling Design	• The network does not specifically target locations frequented by subsistence fishers or locations where fish are seasonally harvested in great numbers (e.g., White Bass in the spring) by recreational fishers. The lack of this type of targeted monitoring potentially puts the health of subsistence fishers and other seasonally-high fish consumers at risk.	• Devote one or two years of the IFTMP monitoring resources to the identification of potential health issues related to fish consumption by subsistence fishers. Follow-up the initial sampling by incorporating such periodic sampling into the program. This will allow the program to provide fish consumption advice to a potentially at risk population.	2b	4	13	4	2	3	4	>1-5
FT-6	Sampling Design	see description above	• Expand the sampling season earlier (April and May) to include the collection of seasonally highly consumed fish (e.g., White Bass). This will allow the program to provide fish consumption advice to a potentially at risk population.	1	4	4	1	1	2		<=1
FT-7	Sampling Design	• The number of sample sites/year is constrained by time demands on the DNR Fisheries biologists responsible for collecting the samples. This limits the program's ability to identify waterbodies with high contaminant levels and provide that information to the general public.	• Consider having DNR staff other than fisheries biologists collect samples in order to (1) increase the total number of sample sites and (2) increase the number of sites on small streams or in other locations having difficult access or other logistical issues. This will increase the program's ability to detect waterbodies with high contaminant levels and provide more complete information to the public.	4	3	8	3	2	3		<=1
FT-8	Sampling Design	• Access or other sampling issues (e.g., non-boatable waterbodies) have resulted in failure to sample some types of streams and lakes. This limits the program's ability to detect waterbodies with high contaminant levels and provide that information to the general public.	• Increase the number of river trend sites by approximately fifteen to cover all the major rivers in Iowa.	2a	4	8	4	1	3		<=1
FT-9	Sampling Design	• The number of fixed trend monitoring sites is small, not well distributed geographically, and does not include lakes.	• Incorporate 5-10 lake trend sites and sample them every other year opposite of the river trend sites.	2a	4	8	4	1	3		<=1

R#	Category	Issue	Recommendation	Priority Matrix Quadrant	Impact (Program Benefit)	Sum of Difficulty Ratings	Difficulty (Cost)	Difficulty (Staff FTE)	Difficulty (Technical)	Difficulty (Other)	Implement Timeline (Yrs.)
FT-10	Sampling Design	• The timing of advisory-related (follow-up) sampling and availability of results (data) may be more of an issue than sample frequency. That is, follow-up data may be received too late in the year (late fall/winter) to be able to include any new consumption advisories in the DNR "Fishing Regulations" booklet (the primary means of advisory communication to the public).	• Either conduct advisory-related (follow-up) sampling earlier in the year or conduct the entire program earlier in the year (e.g., begin in May and end in June as opposed to beginning in August and ending in September).	3	3	4	1	1	2		<=1
FT-11	Sampling Design	• The IFTMP parameter list is static (fixed) and, while it includes a reasonable list of core indicators, it does not include monitoring for supplemental indicators such as emerging contaminants in fish tissue (e.g., perfluorocarbons (PFCs)) or contaminants of interest to US EPA, DNR, and other stakeholders (e.g., selenium). The lack of baseline/background data on emerging contaminants or other contaminants of interest doesn't allow comparison to any future data and doesn't allow the program to inform the general public of other potentially harmful contaminants in fish.	• Provide the ability to look for contaminants of concern beyond the few parameters currently monitored. Sampling additional emerging contaminants and other contaminants of interest will provide better baseline/background data for use by the IFTMP and other programs, and will also improve the program's ability to provide more comprehensive and relevant information to the general public.	4	3	8	4	1	3		<=1
FT-12	Data Management	• The IFTMP database is not easily accessible to the public and requires knowledge of MS-Access to use. Iowa's fish tissue data are not entered into any national database; therefore, the data are not readily available to interested parties across the country for inclusion in regional or national studies.	• Refine the fish tissue database to allow easier access and use of the database. Investigate the possibility of entering IFTMP fish tissue data into a national database (e.g., STORET, WQX) so that Iowa's data can be included in regional and national studies of tissue contaminant levels.	2a	4	8	1	3	4		>1-5
FT-13	Data Management	• IFTMP doesn't have an approved Standard Operating Procedure (SOP) or Quality Assurance Project Plan (QAPP) covering data management for fish/turtle tissue contaminant monitoring. Data management procedures are currently addressed in the annual work plan.	• Consider converting the annual work plan into an approved SOP or QAPP document.	3	3	5	1	1	3		<=1

R#	Category	Issue	Recommendation	Priority Matrix Quadrant	Impact (Program Benefit)	Sum of Difficulty Ratings	Difficulty (Cost)	Difficulty (Staff FTE)	Difficulty (Technical)	Difficulty (Other)	Implement Timeline (Yrs.)
FT-14	Products & Services	• The long-term data set is only analyzed intermittently thereby hindering staff from determining if changes to IFTMP can be made that will allow the program to better utilize limited monitoring resources.	• Analyze all IFTMP data on an annual basis. Annually analyzing the long-term data set, will provide information to support program decisions and changes that will better enable the IFTMP to utilize limited monitoring resources.	3	3	5	1	1	3		<=1
FT-15	Products & Services	• The issuance of consumption advisories is sometimes delayed and not very well broadcast to the general public.	• Move the responsibility of consumption advisory issuance to the Iowa Department of Public Health (IDPH). Because IDPH deals with the health of Iowans in many areas, it is logical that this agency would also assume the role of informing Iowans about the risks, or lack thereof, of eating fish caught in Iowa. When merged with other related health information delivered by IDPH, fish consumption advisory information is likely to reach and resound with more Iowans.	2a	4	8	1	1	2	4	>1-5
FT-16	Products & Services	• The fact sheet is outdated and is no longer easily accessible from the IFTMP website.	• Annually update the fact sheet (or produce something similar) and make it more easily accessible from the IFTMP website.	1	4	5	1	1	3		<=1
FT-17	Products & Services	• The program does not offer an internet-based interactive map from which fish tissue contaminant monitoring data and consumption advisory information can be queried.	• Create an internet-based interactive map providing access to fish tissue contaminant monitoring data and consumption advisory information. Further expand access to the data/information by developing an application for smartphones.	2b	4	9	2	3	4		>1-5
FT-18	Program Coordination & Evaluation	• Coordination and collaboration among the IFTMP and other agencies that conduct fish tissue contaminant monitoring in Iowa is lacking. The lack of coordination on things such as sampling parameters limits each program's ability to utilize fish tissue contaminant data from other agencies to suit their own objectives.	• Expand efforts to coordinate and build monitoring partnerships with state and federal agencies (e.g., USGS and ACOE) and with other DNR programs. Improved coordination and establishment of monitoring partnerships would provide a more consistent fish tissue contaminant data set and allow all of the partners to utilize the data for their objectives and make better use of limited monitoring resources.	3	3	6	1	2	3		>1-5

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FT-19	Pgrm. Coord. & Eval.	• The IFTMP does not have a mechanism to receive input from monitoring stakeholders or technical experts. Because programs/agencies sometimes operate in an information vacuum, there is potential for counterproductive program objectives and sampling inefficiencies to exist.	• Develop a stakeholder/technical advisory panel to possibly include USGS, ACOE, IDPH, DNR Fisheries, DNR Lake Restoration, DNR Air Quality, and IDALS. The panel would allow for the development of an overall fish tissue sampling strategy for Iowa and the sharing of resources and data.	3	3	6	1	2	3		>1-5
FT-20	Pgrm. Coord. & Eval.	• The IFTMP does not conduct performance reviews, needs assessment or strategy updates in a formal manner. Performance reviews (needs assessments, strategy updates) should be a part of every ambient monitoring program to avoid systematic errors and to protect the integrity of the resulting data.	• Develop a process to regularly review or assess the program after forming a stakeholder/technical advisory panel (see above Stakeholder / Technical Advisor Input recommendation).	3	3	5	1	1	3		<=1

Groundwater Monitoring

R#	Category	Issue	Recommendation	Priority Matrix Quadrant	Impact (Program Benefit)	Sum of Difficulty Ratings	Difficulty (Cost)	Difficulty (Staff FTE)	Difficulty (Technical)	Difficulty (Other)	Implement Timeline (Yrs.)
GW-1	Monitoring Objectives	• The lack of specificity in the objectives leave them open to interpretation. • Questions of "cause-and-effect" are not specifically addressed and cannot generally be answered by an ambient program. • Aquifers with high temporal and spatial variability, especially alluvial aquifers, are difficult to represent accurately. This data set is not helpful for addressing localized issues.	• Support efforts by other, more targeted programs (e.g., IIHR, Source Water Program and others) to answer specific questions about the impacts of land-use practices and effectiveness of protection strategies on groundwater resources.	3	2	6	1	1	4		>1-5
GW-2	Sampling Design	• Small sample sizes reduce statistical "strength" of analyses, especially when results are subdivided by aquifer. Although the sampling network represents all major aquifers, it cannot be stated with high confidence that the results are representative of the entire population. Although probabilistic sampling could improve confidence in the ability to represent each aquifer system, detailed geologic records for all public wells are not available; therefore, the universe of available wells is greatly limited for probabilistic sampling.	• Identify monitoring areas and questions for which greater statistical representation is necessary and increase the numbers of samples collected to appropriate levels.	2a	4	7	1	2	4		<=1
GW-3	Sampling Design	see issue statement for R# 21	• Consider increasing the inventory of wells for future sampling efforts by working with small community water supplies including state parks, county conservation areas, industrial users, and private well users.	2b	4	10	5	2	3		>1-5

R#	Category	Issue	Recommendation	Priority Matrix Quadrant	Impact (Program Benefit)	Sum of Difficulty Ratings	Difficulty (Cost)	Difficulty (Staff FTE)	Difficulty (Technical)	Difficulty (Other)	Implement Timeline (Yrs.)
GW-4	Sampling Design	• The current network is made up exclusively of public supply wells. Public water supply wells often are screened (open) to large sections of an aquifer or even multiple aquifers, although the focus is single-aquifer wells. Additionally, the act of pumping can alter groundwater flow directions and alter chemical conditions within the aquifer. To determine whether groundwater quality variations are the result of differences in background conditions or the result of conditions resulting from the well, samples should be drawn from wells with shorter well screens that are not routinely pumped.	• In order to more accurately assess the potential levels of exposures to all of Iowa's citizens, private well sampling should be considered. Discussions with public health department staff and others should be continued to determine whether there is a need for additional sampling of private wells, and how best to meet these needs given the available resources.	3	3	5	1	1	3		>1-5
GW-5	Sampling Design	• Dedicated well nests, designed to represent un-pumped, ambient groundwater quality are available but have not been maintained or sampled since 2007. In addition to being pumped at lower rates, private well water quality may also be different than public water supply quality for other reasons. For example, since drinking-water standards do not apply to private wells, private wells may not be sited or constructed with as much attention to water quality standards.	• Assess the condition of existing dedicated well nests, develop a preliminary monitoring design, and collaborate with IIHR (for water levels), USGS, state parks, county conservation staff, and other partners to develop a plan for sampling, maintenance, and construction of dedicated wells nests.	2a	4	7	1	2	4		>1-5

R#	Category	Issue	Recommendation	Priority Matrix Quadrant	Impact (Program Benefit)	Sum of Difficulty Ratings	Difficulty (Cost)	Difficulty (Staff FTE)	Difficulty (Technical)	Difficulty (Other)	Implement Timeline (Yrs.)
GW-6	Sampling Design	• Discontinuation of the Ambient Groundwater Monitoring Program from 2007 to 2011 makes trend analyses difficult. In addition, dependence on public water supplies means that communities that approach or exceed water quality standards may discontinue use of the wells, thereby biasing sampling efforts. • Furthermore, sufficient data is not available to characterize seasonal variability. Past monitoring efforts focused on summer sampling; therefore, comparison to historical records may include bias. • The data is also insufficient for answering questions about possible acute exposures related to fast transport of anthropogenic contaminants to groundwater. For natural contaminants like arsenic, sulfate, or radionuclides, variability from year-to-year is seen, which implies some effect of pumping, sampling, or analyses.	• Identify contaminants for which annual monitoring is a higher priority for accurate trend analyses. Consider more frequent sampling for contaminants that may be impacted by seasonal variations in precipitation or land-use practices as well as natural contaminants with significant variability. Identify contaminants for which acute exposures are a concern and develop a plan to assess these variations.	2a	4	7	1	2	4		<=1

R#	Category	Issue	Recommendation	Priority Matrix Quadrant	Impact (Program Benefit)	Sum of Difficulty Ratings	Difficulty (Cost)	Difficulty (Staff FTE)	Difficulty (Technical)	Difficulty (Other)	Implement Timeline (Yrs.)
GW-7	Sampling Design	• Only one round of sampling for viruses and bacterial pathogens has been conducted (2013). This study indicated that some transport of pathogens to the groundwater may occur and standard methods may not be sufficient for determining groundwater susceptibility to these contaminants. • Monitoring for radionuclides has followed a tiered approach to analyses as required by the Safe Drinking-Water Act; however, variations in holding times makes interpretation of gross alpha radioactivity distribution difficult. • Sampling for radionuclides has been very limited or non-existent. Only five samples have been analyzed for uranium. • Several contaminants on the CCL4 list have not been assessed including hormones. • No assessment of cyanotoxin occurrence in groundwater under the influence of surface-water has been conducted as part of the Ambient Groundwater Monitoring Program . Some cyanotoxin analysis work has been done by water utilities as part of the DNR drinking water program.	• As funds become available, consider conducting additional monitoring for pathogens during different hydrological conditions to allow for more confidence in characterization of the occurrence of these contaminants. Before collecting any additional radionuclide data, develop a sampling plan, refine standard laboratory procedures, and determine which contaminants on the CCL4 would be appropriate for monitoring.	2b	4	11	5	2	4		>1-5
GW-8	Data Manage-ment	• The geodatabase does not contain complete metadata information; therefore, assessment of holding times and other factors cannot be completed. Some, but not all past data from the Ambient Groundwater Monitoring Program data are included in IASTORET. Efforts to upload 2014 data to the new water quality database, EQuIS, are ongoing; however, a significant effort and additional resources would be necessary in order to upload historical records to this system with sufficient quality control. Current plans do not include pushing groundwater data to EPA STORET via WQX.	• Continue sharing data via the Groundwater Quality geodatabase. Complete the upload of 2014/2015 data and future data sets into EQuIS. Assess the best methods for making historical records available both to internal DNR staff and the public.	3	3	5	1	1	3		<=1

R#	Category	Issue	Recommendation	Priority Matrix Quadrant	Impact (Program Benefit)	Sum of Difficulty Ratings	Difficulty (Cost)	Difficulty (Staff FTE)	Difficulty (Technical)	Difficulty (Other)	Implement Timeline (Yrs.)
GW-9	Data Manage-ment	see issue statement for R# 76	• Complete the upload of 2014/2015 data and future data sets into EQuIS. Assess the best methods for making historical records available both to internal DNR staff and the public.	1	5	5	1	1	3		<=1
GW-10	Data Manage-ment	see issue statement for R# 76	• Assess the best methods for making historical records available both to internal DNR staff and the public.	3	3	5	1	1	3		<=1
GW-11	Data Manage-ment	• Documentation of QA/QC from pre-2012 years has not been collated. Laboratory QA/QC documentation is not readily available for review. A wide variety of methodologies and focus on emerging contaminants makes evaluation of QA data complex.	• Review and update the QAPP as necessary to reflect any changes in the standard practices of the program. Consider developing a consistent format for reporting QA/QC results on a regular basis. Collate and summarize pre-2012 QA/QC data and make it available via the groundwater monitoring website for future reference.	3	3	5	1	1	3		<=1
GW-12	Data Manage-ment	see issue statement for R# 79	• Consider developing a consistent format for reporting QA/QC results on a regular basis.	3	3	5	1	1	3		<=1
GW-13	Data Manage-ment	see issue statement for R# 79	• Collate and summarize pre-2012 QA/QC data and make it available via the groundwater monitoring website for future reference.	3	2	5	1	1	3		>1-5
GW-14	Products & Services	• Analysis and presentation of historical results was done using a patchwork of software packages, some of which are no longer accessible to DNR staff. Trend analyses have not been summarized despite evaluation of trends being identified as a principle objective.	• Develop reports regarding groundwater trends and discussion of data gaps.	2a	4	8	1	3	4		>1-5
GW-15	Products & Services	• Most summaries of groundwater quality by aquifer and region are no longer current and do not represent baseline data for all contaminants that have been monitored.	• Summarize existing data for all contaminants, using basic statistics, by aquifer and region and make these reports available to the public via the DNR website.	2a	5	7	1	2	4		>1-5
GW-16	Products & Services	• Documentation of sampling efforts for past years is scarce. Trend analyses and other comparisons between years have been completed , but rarely published.	• Continue issuing regular reports.	1	5	5	1	1	3		<=1
GW-17	Products & Services	see issue statement for R# 108	• Develop a prioritization for additional analyses by contaminant group and aquifer.	3	3	6	1	1	4		<=1

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GW-18	Products & Services	see issue statement for R# 108	• Continue efforts to collaborate with the Iowa Geological Survey (IGS), USGS, and other groups to document changes to aquifer quality over time.	3	3	6	1	1	4		>1-5
GW-19	Products & Services	• The website may be difficult to find for users who are not familiar with DNR's organization, or are confused about DNR and IGS roles.	• Regularly review the DNR groundwater website to ensure that web links are functional and all other information is up-to-date. Work with partner organizations to direct the public to this resource by posting links on their websites.	1	4	4	1	1	2		<=1
GW-20	Products & Services	• No automated reports have been developed. The Hydrogeologic Atlas was meant to serve data products to users, however, it is no longer functional.	• Redesign the Hydrogeologic Atlas. Consider developing automated summary reports.	2a	5	7	1	2	4		>1-5
GW-21	Program Coordination & Evaluation	• Contact and goodwill with some partners was lost when annual monitoring ended in 2006.	• Coordinate with USGS and others to review historical data, fill data gaps, and ensure continued availability of high quality data to meet user's needs.	4	3	8	1	1	3	3	>1-5
GW-22	Program Coordination & Evaluation	• The program is not currently taking advantage of a vast amount of "non-ambient" monitoring data and experience residing with DNR regulatory programs.	• Develop a plan for integrating groundwater data from Contaminated Sites, Solid Waste, and others.	4	3	9	1	1	3	4	>1-5
GW-23	Program Coordination & Evaluation	• Stakeholder comments tend to be broad recommendations for contaminant groups of interest, or focused on issues related to fate and transport of contaminants that are beyond the scope and budget of the current Ambient Groundwater Monitoring Program.	• Conduct more detailed needs assessments by scheduling meetings with individual stakeholder groups.	3	3	5	1	1	3		<=1
GW-24	Program Coordination & Evaluation	see issue statement for R# 146	• Meet regularly with partner agencies to review monitoring plans and coordinate future plans to the extent that it meets the goals of this program.	3	3	5	1	1	3		<=1

Lake and Reservoir Monitoring

R#	Category	Issue	Recommendation	Priority Matrix Quadrant	Impact (Program Benefit)	Sum of Difficulty Ratings	Difficulty (Cost)	Difficulty (Staff FTE)	Difficulty (Technical)	Difficulty (Other)	Implement Timeline (Yrs.)
LR-1	Monitoring Objectives	• The program is not providing the type of data and interpreted information needed to fully achieve the CWA Section 305(b) waterbody assessment objective. Specifically, the program does not provide biological data that can be used to directly evaluate aquatic life uses, nor is lake habitat quality monitored. Consequently, only indirect assessments of aquatic life uses are possible based upon physico-chemical water quality parameters (e.g., DO and pH).	• As additional resources are made available, develop a methodology and collect aquatic community data (e.g., invertebrates and fish) and habitat data that will allow for improved CWA Section 305(b) assessments of aquatic life use support status in monitored lakes.	2b	4	11	4	3	4		>1-5
LR-2	Monitoring Objectives	• The program is not providing adequate data needed to fully achieve trend monitoring objectives. The monitoring design is capable of providing good resolution of trends at the statewide scale; however, the limited number of samples collected at each lake and the number of lakes sampled only allows for poor trend resolution at finer spatial scales of interest (e.g., individual lake, county, river basin, ecoregion, and landform region).	• Bolster the monitoring design and sampling intensity to allow for more robust status and trend analyses and improved accuracy of lake-specific use support assessments for CWA reporting purposes. For example, consider implementing higher intensity monitoring at a subset of lakes on a rotating basis.	2b	4	9	5	1	3		>1-5
LR-3	Sampling Design	• Only a fixed number (138) of lakes are monitored, thus many (non-SPOL) lakes do not have any water quality monitoring data available for them. No alternative sampling network designs have been considered within the program. For example, a rotational basin approach could be used to increase monitoring coverage over the long term, thus providing data to complete additional lake water quality assessments and provide a more comprehensive assessment of lake conditions in the state.	• Consider implementing a rotational basin monitoring network design within the Ambient Lake Monitoring Program as a means to expand monitoring coverage of lakes, particularly those that are heavily used by the public. This would allow for assessment and data for the public/stakeholders for these locations. The expanded coverage would allow for more comprehensive reporting of designated use support status under CWA Section 305(b) and would support lake management objectives such as restoration prioritization.	2b	4	10	5	2	3		>1-5

R#	Category	Issue	Recommendation	Priority Matrix Quadrant	Impact (Program Benefit)	Sum of Difficulty Ratings	Difficulty (Cost)	Difficulty (Staff FTE)	Difficulty (Technical)	Difficulty (Other)	Implement Timeline (Yrs.)
LR-4	Sampling Design	• Several highly used urban lakes are not currently included in the network (e.g., Ada Hayden, DMACC pond, Gray's Lake, Blue Heron Lake, etc.). Therefore, some lakes that are heavily used by the public currently have little to no data.	• As additional resources are made available, add monitoring at heavily used urban lakes to the network of monitored lakes. This would allow for assessment and data for the public/stakeholders for these locations.	3	3	5	1	1	3		<=1
LR-5	Sampling Design	• The use of one sampling location at each lake is unlikely to represent conditions found in many of the arms of impoundment lakes, and thus provides an incomplete picture when trying to assess the whole lake, either for CWA Section 305(b) assessment or for status and trends analysis. Many of the lakes function differently in the arms than in the main basin of the lake. As a result, the lake may be inaccurately characterized or identified as impaired based on data from a single sampling location at the deepest spot in the lake.	• As additional resources are made available, extend monitoring to multiple locations within many lakes on a rotational basis. This will provide data needed to understand how the arms of impoundment lakes may function differently than in the main basin where monitoring usually occurs.	2b	4	9	3	2	4		>1-5
LR-6	Sampling Design	• No sampling locations or work within the program is dedicated to sampling and assessing habitat, vegetation, or other physical characteristics of the lake. The current approach only allows for the collection of chemical and limited biological data (i.e., phytoplankton and zooplankton). As a result, the program is not able to adequately assess the status of designated aquatic life uses for each lake.	• Develop and implement sampling protocols that specifically target biologically productive areas of the lake (e.g., littoral zone) for the purpose of developing biological indicators for incorporation into 305(b) aquatic life use assessments.	2b	4	16	5	4	4	3	>1-5

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LR-7	Sampling Design	• Three sampling events per lake is too infrequent to quantify water quality parameters with much statistical confidence; therefore, results from the analysis of short-term patterns in lake water quality for individual lakes carries little weight. Many years of data are needed before a statistically significant trend can be detected. • Long intervals between sampling events present the risk that relatively short-lived events of major significance (i.e. hazardous algae blooms) will be missed and can lead to an inaccurate portrayal of lake conditions. • The data generated from three sampling events annually does not fully meet the needs of the Lake Restoration program (for prioritization and pre/post restoration analysis) and other technical stakeholders (e.g., TMDL Modelers and Fisheries Biologists).	• As additional resources are made available, expand the sampling frequency (e.g., 5-7 samples each year instead of three) at a subset of lakes each year. The expanded monitoring could be implemented within a five-year basin rotation design such that once every assessment cycle each lake has more data available for preparing CWA Section 305(b) assessments. This recommendation can be combined with the recommendation for sampling more than one location per lake during the year in which the lake is sampled with greater frequency. This would help solve multiple "weaknesses" at once because more robust 305(b) assessments could be completed, and additional data would be available for other data users (e.g., Fisheries and TMDL) and for better trend analyses. Additionally, the Lake Restoration Program would have better data for making decisions and evaluating project success.	2b	4	9	4	2	3		>1-5
LR-8	Sampling Design	• Sampling for lake biological indicators is currently limited to phytoplankton and zooplankton taxa composition and biomass. The program does not sample other important components of lake aquatic communities (e.g., fish, macroinvertebrates, and vegetation). This limitation makes it difficult to accurately describe lake biological condition and assess support status of designated aquatic life uses for the CWA Integrated Report.	• Biological components – Form an interdepartmental technical advisory team to evaluate needs and identify existing sources of data (e.g., Fisheries Bureau monitoring) that could be used to address weaknesses. Develop sampling procedures and a methodology for assessing biological condition and habitat. Incorporate them in the Ambient Lake Monitoring Program over time.	1	5	5	1	1	3		<=1

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LR-9	Sampling Design	• The program does not include monitoring for algal toxins, which may become important in the near future as the USEPA works to develop water quality standards for algal toxins. The program also does not include any monitoring for emerging contaminants of concern, such as personal health care products and pesticides. The lack of monitoring for these types of parameters limits what can be said about the water quality of Iowa's lakes and the ability to evaluate for trends in emerging contaminant occurrence and magnitude.	• Algal toxins and emerging contaminants – Periodically sample for these parameters to allow for long-term trend analysis and to prepare for anticipated USEPA guidance and standards for algal toxins in Class A (recreational use) waters.	2a	4	8	4	1	3		>1-5
LR-10	Sampling Design	• The program experienced some data quality issues in the early years of the program and there have been some analytical method changes over the life of the program (e.g., total nitrogen was monitored through 2007 and then replaced with total Kjeldahl nitrogen). These issues have created some limitations as far as data continuity for trend analyses.	• Data quality/continuity issues – Continue to work with certified laboratories and rigorously implement QA/QC measures for all data received by the program. Ensure that an approved QAPP governs data collection.	3	3	5	1	1	3		<=1
LR-11	Sampling Design	• The program does not utilize in-situ sensors and continuous data loggers to monitor lake water quality parameters such as ammonia, chlorophyll-A, nitrate, dissolved oxygen, pH, specific conductance, temperature, and turbidity. This technology is an effective way to measure diel cycles and season-long fluctuations in water quality parameters. Continuous monitoring is becoming more common as in-situ technology improves and becomes more affordable. The program's lack of experience with deploying the technology and the lack of a framework for incorporating continuous monitoring data in lake condition assessments is preventing the program from moving forward.	• Continuous monitoring data – With the assistance of a technical advisory team, develop a framework for incorporating in-situ continuous monitoring data into lake water quality analyses and designated use assessments. The framework will help the program efficiently manage and utilize this type of data as its availability is expected to increase in the future.	1	4	6	1	2	3		>1-5

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LR-12	Data Manage-ment	• There is lag time between when data are collected and when they are available online to the public. While the DNR only has to wait about a month from when samples are collected and analyzed until the results are submitted by the contractor, the data are not uploaded to EQuIS until the end of the monitoring season after all the data has been submitted. Consequently, data from the current year are not available to the public and stakeholders in a timely manner to make decisions about lake recreational use or for other time-sensitive purposes. • Not all information collected as a part of the program is stored in a state database, including: phytoplankton and zooplankton composition data, lake water quality depth profile data, and photos of Secchi disk submergence (water transparency) or other field conditions. As a result, there is a greater risk that this information could be lost over time. • There is no direct connection between water quality data stored in EQuIS and the DNR's water quality assessment database (ADBnet); therefore, additional data manipulation steps and a significant amount of staff time are required to complete lake designated use status assessments.	• Find a mechanism for storing all monitoring data and related monitoring information in a database maintained by the DNR to minimize chance for data loss over time.	4	3	7	1	2	4		<=1
LR-13	Data Manage-ment	• The database only provides access to raw monitoring data for any given lake monitoring site. Stakeholders and the public are not able to view statistically or graphically summarized monitoring information. The database's limited query capabilities make pulling data cumbersome for stakeholders and the public.	• Using the data from the Ambient Lake Monitoring Program, develop products for stakeholders and the public allowing them easy access to both raw data for individual lakes of interest and data for the entire state. Ideally, this functionality would be accomplished as part of the development of a new and improved Iowa Lake Information System.	2b	5	11	3	4	4		>1-5

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LR-14	Data Manage-ment	• The lack of connectivity or linkages between lake monitoring information and GIS data and spatial analysis tools makes it difficult for program personnel to build more comprehensive reports.	• Connect GIS data and tools with the EQuIS water quality database to help program personnel and other stakeholders better integrate information from both sources for multiple purposes, including: general lake condition reporting, lake status and trends analysis, lake problem diagnosis, TMDL development, and lake restoration prioritization and effectiveness evaluation.	2a	4	7	1	2	4		<=1
LR-15	Data Manage-ment	• The replicability of analysis results is poor (i.e., low precision) for phytoplankton biomass and composition samples according to the 2013 phytoplankton pigment pilot study. The results of the study call into question whether it is appropriate to use phytoplankton data from the Ambient Lake Monitoring Program for Section 305(b) assessments or lake status/trend analyses.	• Continue to collect information on the reliability and repeatability of particular parameters and methods currently included in the Ambient Lake Monitoring Program. The chlorophyll-A split sample study and phytoplankton methods comparison are recent examples of recent work in this area. Continuing this work will provide DNR with a better understanding of the methodological limitations and amount of sampling error associated with data used in lake status/trends analyses and for other purposes. A technical advisory team within the DNR could provide guidance in this area of the program.	3	2	5	1	1	3		<=1
LR-16	Data Manage-ment	• Occasionally, sample holding times are exceeded or equipment failures occur. Disruptions in sample collection and processing operations are discussed with and approved by the DNR prior to the contractor's deviation from the QAPP. Nevertheless, these situations can result in missing data which can negatively impact the program's ability to complete water quality analyses and CWA Section 305(b) assessments as planned.	• Continue to work with the monitoring contractor to improve QA/QC through the development and implementation of approved laboratory analysis methods, QAPPs, and SOPs for sampling and analysis.	3	2	5	1	1	3		<=1

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LR-17	Products & Services	• The data have been used minimally for academic research and publication. As a result, the Ambient Lake Monitoring Program has limited visibility in the scientific community and has missed opportunities to validate the program's approaches and methods through the peer-review process. • Overall, the level of data interpretation has been minimal in comparison to the potential to produce information that would be valuable to stakeholders and the general public.	• Develop reports for public distribution on a regular basis (e.g., biennially with the 305(b) cycle).	1	4	6	1	2	3		>1-5
LR-18	Products & Services	see issue statement for R# 113	• Form a technical advisory team within the DNR to work on data analysis, interpretation, and reporting on topics of interest to the scientific community , lake stakeholders, and the general public.	1	4	6	1	1	4		>1-5
LR-19	Products & Services	• Previous fact sheets have not provided detailed information about individual lakes, so they have not been as useful to some of the public and stakeholders who seek this type of information. • Previous reports have not provided a complete picture of lake condition because they have lacked information about lake ecosystem components other than water quality (e.g., fish, habitat, macroinvertebrates, and vegetation). • After 2016, the existing Iowa Lake Information System (ILIS) will not be supported by the monitoring contractor. The ILIS is one of the main ways that stakeholders and the public access monitoring results and other information about Iowa's lakes.	• Create a new on-line lake information system that has similar information reporting capabilities as BioNet, the stream biological monitoring and assessment information system. The new system should be capable of providing lake stakeholders and public with access to monitoring data and interpreted water quality information for individual lakes and the monitoring network as a whole. It should also have the ability to summarize and interpret other types of monitoring data besides water quality (e.g., aquatic community and habitat).	2b	5	15	3	4	4	4	>1-5

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LR-20	Products & Services	• The DNR does not currently offer any internet applications or automated reports showcasing information from the Ambient Lake Water Monitoring Program. Monitoring results for individual lakes are available as mini-reports through the ISIL. Interpreted monitoring results with respect to CWA Section 305(b) assessments, are available in the ADBnet internet application. Other than these services, the public and stakeholders have difficultly accessing summarized and interpreted information that provides a deeper understanding of the condition of Iowa's lakes. • It is possible to generate reports automatically by pulling data from the EQuIS water quality database; however, these capabilities have yet to be vetted by the DNR. • The DNR Ambient Lake Monitoring Program web page is outdated. • Internet map-based information services are non-existent.	• As part of the development of a the new on-line lake information system (see recommendation above) develop similar automated reporting capabilities as BioNet, the stream biological monitoring and assessment information system. The new system should be capable of providing summarized and interpreted lake monitoring results for individual lakes and the monitoring network as a whole. The system should have the ability to update reports automatically as new data are added to the system. • GIS data has recently been completed for the monitored lakes. As funding becomes available, the DNR should couple this data with the lake water quality data to generate reports that are more meaningful to lake stakeholders and the public. This would better strengthen the monitoring program by making results more accessible providing the public with a better understanding of what water quality is like at their lake.	2b	4	9	2	3	4		>1-5
LR-21	Program Coor-dination & Evaluation	• The program needs to do a better job of communicating and sharing information with monitoring partners and stakeholders. Better communication will contribute toward meeting the objective of providing monitoring support for federal and state water quality programs and initiatives. • More input from technical staff of the DNR is needed to guide the monitoring program and ensure that the data and information it produces will be accessible and useful to stakeholders and the public. • Additional input from internal and external stakeholders is needed to maximize program benefits.	• Meet regularly with partner agencies to review annual monitoring plans and develop future plans.	1	4	5	1	1	3		<=1

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LR-22	Program Coordination & Evaluation	see description above	• Develop a technical advisory team within the DNR to address department-wide goals, needs, and priorities for lake management, monitoring and assessment, and restoration. Better coordination at the technical level will help the monitoring program to better serve a variety of stakeholders and help guide the monitoring program to meet current and future objectives.	1	4	6	1	1	4		>1-5

Stream Biological Monitoring

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SB-1	Monitoring Objectives	• Ambient stream biological monitoring objectives do not address the data needs of the DNR Water Quality Standards (WQS) Program, particularly in support of Use Attainability Analysis (UAA) determinations of site-specific designated aquatic life uses. The lack of connection between the two programs is a hindrance to the collection of data that could be used to inform the UAA process. • Ambient stream biological monitoring objectives do not specifically address the development of a Tiered Aquatic Life Uses (TALU) framework within Iowa's Water Quality Standards (WQS). TALU is a data-driven approach recommended by the USEPA for the establishment and refinement of aquatic life use goals. Because monitoring program objectives do not currently include collecting and analyzing data to support TALU development, the DNR will continue to be limited to the current bioassessment approach which has an indirect relationship with designated aquatic life uses defined in Iowa's Water Quality Standards.	• Meet periodically with the DNR water quality standards program to identify monitoring objectives that better serve WQS program needs relating to UAA and TALU development. Increased communication and coordination will be beneficial to both programs.	1	4	5	1	1	3		<=1
SB-2	Sampling Design	• The biological reference site network is not comprehensive. Candidate reference sites representing coolwater streams and nonwadeable rivers have not been identified. The lack of a comprehensive reference site network limits the stream bioassessment program's ability to fully develop and implement bioassessment criteria.	• Develop a rationale and criteria for choosing candidate reference sites representing coolwater streams and nonwadeable rivers. Apply the criteria to identify the locations of 10-20 candidate reference sites for each stream subclassification. The selection of candidate reference sites for coolwater streams and nonwadeable rivers is an important step toward obtaining appropriate data for the development of bioassessment criteria that apply to all stream types in Iowa.	1	4	6	1	2	3		<=1

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SB-3	Sampling Design	• The program does not currently employ a probabilistic monitoring network in order to achieve comprehensive biological monitoring of Iowa's rivers and streams. The probabilistic design is ideally suited for obtaining statistically-defensible estimates of status and trends in stream biological condition and support status of designated aquatic life uses.	• Develop monitoring network design specifications for a statewide (probabilistic) statistical survey of stream condition status and trends. Establish a survey design that strikes a good balance between cost and statistical power. The design will support the program's objectives for comprehensive biological condition status and trends monitoring.	2a	5	7	1	2	4		<=1
SB-4	Sampling Design	• The program lacks a rotational basin monitoring design to support a watershed-based, data driven approach to CWA program implementation and to support the Nutrient Reduction Strategy.	• Develop design specifications for a rotating basin/watershed monitoring network. Determine the appropriate basin/watershed scale and rotation schedule. Determine the appropriate allocation of sites to achieve various monitoring objectives and data needs (e.g., basin/subwatershed outlets, random (probabilistic), targeted (for site-specific issues) long-term trend, etc.). The monitoring design can be designed to serve objectives and data needs beyond the ambient monitoring program, including the Nutrient Reduction Strategy, Section 319 NPS program, wasteload allocation and wastewater permitting, UAA water quality standards, etc.	3	3	6	1	2	3		>1-5
SB-5	Sampling Design	• The program is lacking a network of sites dedicated for monitoring long-term trends in stream biological condition and climate change indicators.	• As funding is available, establish a network of fixed monitoring sites for long-term trend monitoring of stream biological condition and climate change indicators. Insure that the network provides adequate representation of ecoregions and stream types. A fixed network of sites that is monitored annually will significantly add to the trend monitoring capabilities provided by the current reference site network that is sampled on a four-year rotation.	1	4	5	1	1	3		<=1

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SB-6	Sampling Design	• The number of warmwater reference sites is fewer than the recommended level (i.e., minimum of ten) in certain ecoregions. Two ecoregions (47c, 47f) in which coldwater streams occur in a limited extent are not represented by any CW reference sites. Inadequacies in the reference site network have a negative impact on the level of confidence placed on stream biological assessments prepared for the CWA Integrated Report.	• Choose candidate reference sites to address deficiencies in the distribution and number of CW and WW reference sites. As funding becomes available, sample the candidate reference sites and use the data to confirm or deny reference status. Repeat the first two steps until reference site representation targets have been met. This process will lead to a stronger network of reference sites and reference condition data that will provide greater confidence in biological assessments for the CWA Integrated Report.	1	4	6	2	1	3		>1-5
SB-7	Sampling Design	• The program lacks a sampling strategy for large rivers including design specifications for the number and type of monitoring sites needed (e.g., free flowing and impounded). Having a strategy and appropriate sampling design would help to ensure that adequate data will be collected to support the development of biological assessment criteria and fulfillment of status and trends monitoring objectives.	• Define large river bioassessment data collection needs and develop a sampling strategy to meet them. Incorporate the strategy in the bioassessment program's five-year master plan. The sampling strategy will ensure that appropriate data are collected for the development of bioassessment criteria and to fulfill status and trends monitoring objectives.	1	5	6	1	2	3		<=1
SB-8	Sampling Design	• Often, biological monitoring data from multiple sampling sites are not available to assess ALU support status of stream segments that are long or diverse. The current rule-of-thumb is one sample site for every three-to-five miles of stream. In some cases, the lack of data from multiple sites may result in lower confidence in bioassessment determinations of ALU support status.	• Establish guidelines for determining the appropriate number and location of bioassessment sites to represent a stream segment or a watershed. Consistent site selection guidelines will lead to greater confidence in biological assessments for the CWA Integrated Report and will better serve the needs of DNR's water quality programs (e.g., TMDL, 319, and NPDES).	1	4	5	1	1	3		<=1

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SB-9	Sampling Design	• The appropriate number and distribution of long-term biological and climate trend sites has not been determined yet. These determinations must be made before long-term trend monitoring can be initiated. A sound rationale for site selection will help to ensure the monitoring data are useful for answering trend-related questions.	• Establish a clear rationale for selecting biological and climate trend monitoring sites. The rationale needs to address considerations such as number of sites and representativeness as well logistical considerations for successful long-term data collection. For example, a minimum of approximately seven climate change monitoring sites is needed to participate in the USEPA's Regional Monitoring Network (RMN) initiative for the Region VII states of Iowa, Kansas, Missouri, and Nebraska. Determining the appropriate number and locations of sites will insure the validity and relevance of the trend monitoring data.	1	4	6	1	1	4		<=1
SB-10	Sampling Design	• The last probabilistic survey (REMAP) was completed in 2006; therefore, there are no recent statistical estimates of stream biological, chemical, and physical characteristics and ALU support status. This limits the program's ability to comprehensively report on status and trends in Iowa's rivers and streams.	• Develop a plan for repeating probabilistic surveys every five-to-ten years to generate statistical estimates for stream condition indicators with known statistical confidence. Implementing this plan is the only realistic way for the ambient monitoring program to report comprehensively on status and trends of Iowa's rivers and streams.	1	5	6	1	1	4		<=1
SB-11	Sampling Design	• Temporal variability sampling has not been done systematically to support the development of a large river benthic macroinvertebrate IBI and biological assessment criteria.	• Establish temporal monitoring sites in larger rivers. Doing so will benefit bioassessment criteria development by providing data to document seasonal variability in biological metrics and for determining the appropriate bioindex sampling period for obtaining consistent bioassessment data.	1	4	5	1	1	3		>1-5

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SB-12	Sampling Design	• The frequency of monitoring at reference sites (i.e., 2X in five years) is not optimal for evaluating long-term trends among Iowa's least disturbed streams. Sampling frequency of streams needing follow-up monitoring is not always sufficient to keep CWA Section 305(b) assessments up-to-date. A minimum of two IBI samples within five years is required to be considered a monitored assessment.	• As funding becomes available, add annual or bi-annual sampling at a proposed network of fixed trend monitoring sites. Conducting annual trend monitoring at least disturbed reference sites would complement efforts to examine trends using data obtained from randomly selected sites in probabilistic surveys completed on a 5-10 year schedule.	1	4	6	2	1	3		<=1
SB-13	Sampling Design	• The reference site network lacks continuous monitoring for temperature and stream stage to support the analysis of long-term trends in stream condition related to variation in climate indicators.	• Develop a climate trend monitoring plan that meets the sampling frequency requirements for participation in a (USEPA) Regional Monitoring Network. Conduct biological and climate trend monitoring at the same sites for cost savings and to enhance data analysis opportunities.	1	4	6	2	1	3		>1-5
SB-14	Sampling Design	• The typical collection of a single grab sample for physico-chemical water quality parameters is inadequate for diagnosing causes and sources of ALU biological impairment in the CWA Integrated Report. The lack of water quality data typically results in listing the cause of biological impairments as unknown which is not helpful to water quality management programs.	• Develop sampling frequency and duration guidelines for the assessment of biological impairment causes and sources based on the knowledge and experience gained from Stressor Identification studies. Incorporate the guidelines in the biennial 305b/303d assessment methodology and apply them to determine causes and sources of biological impairment. The guidelines will also be useful for designing future monitoring projects to provide sufficient data for these determinations.	3	3	5	1	1	3		<=1

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SB-15	Sampling Design	• Nonwadeable rivers and streams are only sampled for one biological assemblage (i.e., benthic macroinvertebrates). Sampling of two or more biological assemblages is recommended to provide for a robust assessment of stream biological condition and ALU support status. The fish assemblage is a logical choice for large river bioassessment given the diversity of native species, including many that have been identified as Species of Greatest Conservation Need (SGCN). The lack of fish assemblage monitoring data limits the program's ability to develop bioassessment criteria and contribute data for biological conservation purposes.	• Research and determine which biological assemblages are the most useful bioindicators for each stream category (e.g., headwater, wadeable, and nonwadeable). In addition to the traditional choices of benthic macroinvertebrates and fish, additional biological assemblages such as algae, freshwater mussels, and Chironomidae (midge flies) should also be considered.	2a	4	7	1	2	4		<=1
SB-16	Sampling Design	• Watershed condition indicator data (e.g., basin morphometry, land use, AFOs, and WWTPs) are not routinely obtained for biological monitoring sites. The lack of readily-available, summarized data makes it difficult for the program to quantify linkages between stream biological indicators and watershed characteristics. This limitation also makes it difficult to identify stressor-response thresholds that could potentially be used to assign causes and sources of biological impairment for the CWA Integrated Report.	• Research and determine which watershed condition indicators are the most useful for bioassessment purposes. Define the data sources and procedures for quantifying each indicator. Develop a plan to systematically gather and analyze watershed data including an estimate of GIS technical assistance needs for updating the data in a timely manner. These steps should help to clarify watershed indicator data needs and organize the process for acquiring these data in the future.	1	4	6	1	1	4		<=1
SB-17	Sampling Design	• The program lacks a systematic process for planning and implementing supplemental indicator monitoring. Supplemental indicators are occasionally added to the annual monitoring work plan in response to short-term funding, rather than as part of a long-term plan. The current approach makes it difficult to set priorities and follow a logical path to address supplemental monitoring needs.	• Identify and prioritize supplemental indicator monitoring needs. Establish a mechanism or placeholder (e.g., work plan task) for including supplemental indicator monitoring in the annual budget and work plan. These steps will elevate awareness and consideration of supplemental monitoring priorities and help the program to be more proactive and responsive to emerging issues and data needs.	3	3	5	1	1	3		<=1

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SB-18	Data Manage-ment	• Contact information for private landowners and operators who have provided access to biological sampling sites has been challenging to manage and keep current. Consequently, reports and communications with landowners have not always been timely or adequate to maintain good working relationships, which can result in denied access to previously monitored sites. The ability to repeat sampling at the same site over time is critical to program objectives such as long-term trend monitoring of biological reference sites.	• Work with SHL to update all of the site landowner/manager information stored in BioNet. Produce and distribute a new set of letters to landowners/managers thanking them for their support and detailing where and how they can access sampling data collected on their land.	3	3	4	1	1	2		<=1
SB-19	Data Manage-ment	• Data entry, storage and retrieval capabilities are lacking for the following: ○ Continuous (logger) monitoring data (e.g., DO, temperature, pH, nitrate, etc.); ○ GIS data summarized for watersheds of biological sampling sites; ○ Field data sheets and digital photographs; and ○ Water quality and flow data for all years dating back to 1994 (work in progress). The data are stored in various electronic files and folders located on the DNR computer network. For most efficient access and use, the data ideally should be stored in a central location and accessible from the BioNet application. The lack of easy access to all of the data collected by the program has caused many inefficiencies and delays impacting the program's ability to achieve its objectives, not the least of which is providing data to stakeholders and the public.	• Acquire additional staff with appropriate skills to assist with all data management needs of the stream bioassessment program. The current level of staffing does not allow for some of the routine and less time-sensitive tasks to be completed in a timely fashion or at all. When additional staffing is obtained, the bioassessment program staff will determine where and how the data (detailed above) can be made available inside and outside of the DNR. Gains in data management efficiency will translate into time savings for existing staff members and will allow them to focus more time on data analysis, interpretation, and reporting.	2a	4	7	2	2	3		>1-5
SB-20	Data Manage-ment	• The lack of a Quality Management Plan (QMP) and/or a Quality Assurance Project Plan (QAPP) for the Ambient Biological Monitoring Program prevents the program from efficiently documenting and communicating all elements of QA/QC that are currently implemented. The document is also needed to guide QA/QC planning and development.	• Determine if the recently updated bioassessment SOP can serve as a QAPP; if not, develop a QAPP for the program.	1	4	5	1	1	3		<=1

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SB-21	Data Manage-ment	• Several SOPs are needing to be prepared or updated: o Rapid Bioassessment Protocol (RBP); o Continuous Water Quality Sensor and Data Logger Deployment; o Nutrient Impact Assessment; o Watershed Condition Indicators; and o Sediment Impact Assessment. These SOP documents are needed to insure that appropriate methods and procedures are followed, thus enabling consistent and high quality data to be obtained.	• When annually updating the bioassessment task list, prioritize SOP development needs and develop plans and timelines to complete the highest priority SOPs. These actions will help to move the program in the direction of having a comprehensive QA/QC system that will ensure that consistent, high quality data are available to serve all program objectives.	3	3	6	1	2	3		<=1
SB-22	Products & Services	• • Several additional indicators need to be developed in order to convert raw sampling data into useful information. These include: o Coldwater stream fish IBI (Index of Biotic Integrity); o Headwater creek benthic macroinvertebrate and fish IBIs; o Large river benthic macroinvertebrate and fish IBIs; and o Wadeable warmwater stream benthic macroinvertebrate habitat index. These indicators will allow the program to expand and strengthen its bioassessment capabilities. Their lack of availability currently limits the program's ability to report on the biological and habitat condition of Iowa's rivers and streams and ALU support status.	• As part of the annual bioassessment task priority update (see below), continue to review and adjust the timelines for development of biological and habitat indicators and keep these projects moving forward. This work will support the program's biocriteria development and CWA-related monitoring objectives.	2a	5	8	1	3	4		>1-5
SB-23	Products & Services	• The lack of regular (e.g., annual) trend analyses for biological and habitat indicators prevents the bioassessment program from achieving the trend monitoring objective.	• Analyze the IBI and habitat data annually for reports or fact sheets to be published on our web page. This work will benefit the trend monitoring objective.	1	4	5	1	1	3		<=1

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SB-24	Products & Services	• Stressor-biological response relationships have not been fully analyzed for the development of IBIs and bioassessment criteria: ○ Stressor diagnosis from biological sampling data is somewhat limited by imprecise taxonomic resolution in the Chironomidae (midge) family of Aquatic Dipterans and the lack of detailed studies quantifying stressor-biological response relationships (see Midwest Biodiversity Institute (MBI) Technical Memorandum, November 22, 2010); and ○ Quantitative gradients in individual and/or composite stressor indicators are needed for IBI development for headwater and nonwadeable streams. The lack of these analysis products negatively impacts the program's ability to report on the status of designated aquatic life uses and the causes and sources of biological impairment for the CWA Integrated Report.	• Plan and conduct a stressor-biological response analysis project for the specific purpose of developing and calibrating benthic macroinvertebrate and fish multimetric indices for headwater streams. Do the same for development of a benthic macroinvertebrate index and reference biological condition criteria for large rivers. Continue the ongoing nutrient stressor-biological response analysis to support the development of nutrient assessment criteria for all stream habitat and ALU classifications. This work will benefit the biocriteria development objective and the impairment causes and sources status reporting objective.	2a	4	7	1	2	4		>1-5
SB-25	Products & Services	• Currently, the program lacks a mechanism for reporting on status and trends other than the DNR's Water Quality Assessment Database (ADBnet), for example: o Annual trend report of IBI scores and stream habitat indicators.	• Annually develop an IBI and habitat trend report and publish it on the stream biological monitoring website, either as a stand-alone web page or as a link to a fact sheet (pdf document).	1	4	6	1	1	4		<=1
SB-26	Products & Services	• Currently, the program lacks a mechanism for reporting on status and trends other than the DNR's Water Quality Assessment Database (ADBnet), for example: ○ Probabilistic (REMAP) monitoring project summary reports.	• Develop a plan to complete the REMAP sampling reports and add them to the stream biological monitoring web page.	3	3	5	1	1	3		<=1

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SB-27	Products & Services	• While BioNet serves many of the program's needs, the DNR has not sought feedback from its customers and constituents to insure that the online database is meeting their needs.	• The next round of letters sent to landowners should include a brief questionnaire asking the following: (1) Did you look at the sampling results? (2) In which results were you most interested? (3) Is there anything else that you would like to see? and (4) Do you have any questions about the information or suggestions for improving it? A similar questionnaire could be provided to DNR staff. The responses to the questionnaires would be used to determine whether the information is useful and whether modifications in content or format are needed.	3	2	4	1	1	2		<=1
SB-28	Products & Services	• Automated data summarization and reporting are difficult to achieve for some types of data (e.g., in-situ continuous dissolved oxygen and temperature data logger).	• Determine a way to summarize and distribute some of our harder to automate data we collect such as continuous DO and temperature data (data loggers), etc. This work will benefit the program objectives of providing data to the public and to support DNR programs.	4	3	7	1	2	4		>1-5
SB-29	Products & Services	• The biological monitoring web page is not updated regularly.	• The biological monitoring web page should be updated annually after staff meet to update the bioassessment task priority document, and perhaps after forming and meeting with technical advisor and stakeholder groups (see recommendations in next section). This work will benefit the program objectives of providing data to the public and to support DNR programs.	3	3	5	1	1	3		<=1

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SB-30	Program Coor-dination & Evaluation	• The program is not actively investigating or seeking potential internal or external partnerships that might help to expand stream biological monitoring in Iowa (e.g., Internal: DNR Fisheries, Water Quality Standards, Watershed Improvement; External: SWCD water quality projects, Water Management Authorities, USGS, Colleges and Universities, Municipalities, NGOs, private industry, and professional associations). As a result, the program might be limiting its ability to expand biological monitoring to include more streams, to potentially realize cost-efficiencies, and to connect with other groups for the purpose of achieving mutually compatible goals.	• Explore monitoring partnerships through the formation of stakeholder and technical advisory committees (see recommendations below). Expand efforts toward collaboration and sharing of resources and data.	3	3	5	1	1	3		>1-5
SB-31	Program Coor-dination & Evaluation	• The program lacks a formal process for receiving technical and non-technical input. Not having this feedback process or mechanism is a threat to maintaining technical proficiency and program relevance from the standpoint of serving the needs of stakeholders and the public. Receiving technical advice and stakeholder input on a regular basis would help insure the program continues to grow in the right direction.	• Assemble a bioassessment technical advisory committee comprised of individuals inside and outside of the DNR who have expertise relating to stream ecosystems and biological monitoring. Use the TAC to review and provide input on technical components and functions of the program such as development of IBIs, reference condition development, data management, analysis, and reporting, etc.	3	3	6	1	1	4		<=1
SB-32	Program Coor-dination & Evaluation	see issue statement for R# 154	• Assemble a stakeholder committee consisting of internal and external customers and users of biological monitoring data and information. Use the stakeholder group to receive input on non-technical issues relating to improving relevance and usefulness of stream biological monitoring products and services.	3	2	5	1	1	3		<=1

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SB-33	Program Coordination & Evaluation	• The bioassessment task priority document which covers the performance review, needs assessment and strategy updates is not updated regularly. Not having this document represent the most recent knowledge of program direction and needs can negatively impact the ability of staff to set short- and long-term priorities and efficiently develop appropriate annual work plans.	• During the initial development of the annual stream biomonitoring work plan, normally from December to February of each year, update the bioassessment task priority document so that the work plan will reflect the current vision of bioassessment strategy, goals, and direction.	1	4	5	1	1	3		<=1

Stream Water Quality Monitoring

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SWQ-1	Monitoring Objectives	• Over time, monitoring objectives have become less clearly defined. Cost inflation and static funding from the State has eroded the program's ability to achieve multiple goals over the past fifteen years. For example: ○ The ambient trend monitoring objective has been weakened by occasional termination or movement of long-term monitoring stations; ○ Available data are not completely sufficient for the development of water quality standards, wasteload allocations, and CWA Section 305(b) assessments. The locations of fixed ambient monitoring sites are strongly biased toward large interior rivers. Relatively little data are available to characterize water quality in small streams or coldwater streams, thus hindering the ability of DNR staff to develop wasteload allocations and wastewater permit limits for small streams. The program also does not conduct monitoring on the large border rivers (i.e., Big Sioux, Missouri, and Mississippi rivers). Consequently, the DNR lacks sufficient data to describe water quality of the border rivers or to assess the support status of designated uses for the CWA Integrated Report; ○ The program's monitoring design limits the usefulness of the data for calculating stream nutrient loads and evaluating the effectiveness of Best Management Practices (BMPs) in support of the State Nutrient Reduction Strategy. Greater accuracy in nutrient load calculations might be achieved if the ambient program could implement additional continuous monitoring sensors for nutrient parameters or	• Enumerate and prioritize the monitoring objectives, other than assessment and trends and questions for the ambient streams program, and then align the monitoring design pieces to fit the objectives as additional funding is available. Work with internal and external stakeholders to prioritize the list of additional monitoring needs, questions, and objectives. Develop a strategy document that helps to define when multiple goals can be met simultaneously. Include in the strategy document a matrix of how design elements are meeting goals (e.g., which sampling sites are critical to one or more program).	1	4	6	1	2	3		>1-5

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		adjust sampling frequency and timing in order to capture peak flow events. The program's ability to provide useful data for evaluation of BMP effectiveness and potential water quality improvements is very limited because of the ambient monitoring network bias toward large rivers and streams. Monitoring conducted in small watersheds would better serve the BMP effectiveness monitoring objective.									
SWQ-2	Sampling Design	• The existing fixed-station monitoring network is strongly biased toward the representation of medium-to-large interior rivers and streams. Small headwater streams, coldwater streams and large border rivers, especially the Missouri and Mississippi Rivers, are not represented. These deficiencies limit the program's ability to support multiple program needs and objectives, including: public information, nutrient reduction strategy support, water quality standards development, wastewater (NPDES) permitting, and CWA Integrated Reporting.	• As funding becomes available, additional fixed monitoring stations should be added in coldwater streams and small warmwater streams representing all of Iowa's designated use classifications and ecological regions. This monitoring data would allow DNR to better understand, assess, and protect water quality conditions in largely un-monitored stream types. It would also provide a better understanding of regional differences in stream water quality. Monitoring of small streams designated as Outstanding Iowa Waters (OIW) would allow the DNR to determine whether these streams actually have outstanding water quality and what aspects of water quality contribute to exceptional biological integrity. Adding monitoring in these stream classes would help address the issue of comprehensive monitoring and better serve DNR water quality program objectives.	2b	5	10	5	2	3		>1-5

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SWQ-3	Sampling Design	see issue statement for R# 58	• The DNR should add monitoring sites on the Missouri River and work with the Upper Mississippi River Basin Association (UMRBA) to place monitoring stations on the Mississippi River that are consistent with the planned water quality monitoring network. This monitoring would greatly increase the data available (from virtually none) to describe water quality in Iowa's portions of the Mississippi and Missouri rivers and assess these waterbodies for the CWA Integrated Report.	2b	4	9	4	2	3		>1-5
SWQ-4	Sampling Design	• The fixed station network design combined with the lack of additional monitoring resources has meant that streams representing several regions and stream classes have remained un-monitored and are not included in the CWA Section 305(b) assessment of Iowa's water quality.	• As funding becomes available, layer a probabilistic monitoring design on-top of the existing fixed site network while maintaining the ability to detect long-term water quality trends. Probabilistic monitoring is the only defensible and realistic approach to achieving the USEPA requirement that States comprehensively monitor "all waters" within their jurisdiction. Some states utilize a rotating basin design to increase stream monitoring coverage, thus providing more support for water quality programs and better alignment with wastewater permitting issues on a large watershed scale.	2b	4	9	4	2	3		>1-5
SWQ-5	Sampling Design	• The current fixed station network has experienced occasional termination or movement of long-term stations which negatively impacts the trend monitoring objective.	• Consider establishing dedicated trend monitoring stations that are not subject to termination or movement and possibly increase the monitoring frequency at these stations. Stability in trend monitoring sites and reducing or eliminating non-detect values will positively impact the status and trends monitoring objectives.	1	5	6	2	1	3		<=1

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SWQ-6	Sampling Design	see issue statement for R# 52	• Develop a strategy that identifies sentinel sites that would be monitored for a more extensive list of organic chemical contaminants such as pesticides and pharmaceuticals. The purpose of sentinel sites would be to provide consistent long-term data to evaluate changes through time.	1	4	5	1	1	3		<=1
SWQ-7	Sampling Design	• The fixed monitoring network's ability to provide useful data for evaluation of BMP effectiveness and potential water quality improvements is very limited because of bias toward monitoring in medium- and large-size watersheds. Monitoring conducted in small watersheds would better serve the BMP effectiveness monitoring objective.	• Given the many potential alternatives for improving the ambient stream water quality network, it is not recommended that the network be altered to accommodate monitoring in small streams and watersheds for specific purposes such as evaluating the effectiveness of BMPs or progress in achieving goals for NPS pollution reduction. These purposes are not consistent with the ambient monitoring program's primary objective, status and trend monitoring, and would be better suited for targeted monitoring and research studies.	4	2	11	5	2	4		>1-5
SWQ-8	Sampling Design	• The number of locations doesn't provide coverage of all HUC8 basin outlets and some areas of the state are under-represented.	• As funding becomes available, add sites at un-monitored HUC8 basin outlets to allow for better spatial coverage of river miles in Iowa.	2b	4	10	5	2	3		>1-5
SWQ-9	Sampling Design	• The ambient site network does not provide data from effluent-dominated or headwater streams needed for development of water quality standards, wasteload allocations, and wastewater permits.	• Add monitoring stations in effluent dominated B(WW-2) and headwater streams to support water quality standards development (e.g., Copper Biotic Ligand Model); include monitoring for parameters such as CBOD5, ammonia and dissolved oxygen to support the development of wasteload allocations and wastewater discharge permits.	2a	4	8	4	1	3		>1-5

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SWQ-10	Sampling Design	• Monthly sampling may not be frequent enough for parameters that exhibit extreme fluctuations, which is especially true of sites located on smaller, more "flashy" streams. A one-size fits all sampling frequency model doesn't consider site variability and ignores the reality that some sites will need more frequent sampling to detect change and calculate loads.	• Work with monitoring partners (e.g., DNR field offices) and utilize in-situ sensor technology, as additional funding becomes available, to collect higher frequency data for priority parameters with high variability. Having field office staff/partner staff collect one additional sample for phosphorus, TSS, and other parameters greatly enhances our ability to track changes in these parameters and estimate loads. Investigate the use of other sensors for deployment to improve the sample frequency (OP, TSS, Ammonia, etc.).	2a	4	8	3	2	3		>1-5
SWQ-11	Sampling Design	see issue statement for R# 65	• Investigate the use of other sensors for deployment to improve the sample frequency (OP, TSS, Ammonia, etc.).	2a	4	7	2	2	3		>1-5
SWQ-12	Sampling Design	• The monthly sampling regimen does not provide the DNR Wasteload Allocation Program with an optimal amount of water quality data representing low flow conditions.	• Increase monitoring frequency during low flow conditions to provide better data for the development of wasteload allocations and wastewater permit limits.	3	3	6	2	2	2		>1-5
SWQ-13	Sampling Design	• While monthly monitoring is sufficient for 305(b) assessments, it is not sufficient for other purposes such as nutrient load calculations for the Nutrient Reduction Strategy (NRS).	• At sites used to calculate nutrient loads for the NRS, as additional funding becomes available, increase the sampling frequency to every two weeks or another suitable interval as determined by nutrient load models. If, however, the desired frequency is weekly or more frequent, it is unlikely the ambient monitoring program could sustain this level of sampling without utilizing in-situ sensor technology.	4	3	8	3	2	3		<=1

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SWQ-14	Sampling Design	• The parameter list lacks a strategy to evaluate what should be included, what should be rotated on and off the list and at what frequency to answer particular questions. The parameter list tends to be driven mainly by budget and needs to be realigned to ensure that it matches the program's monitoring objectives.	• Develop a short-term strategy to address inadequacies in the list of monitoring parameters. The strategy should evaluate the parameter list against the list of parameters for which Iowa has water quality standards then determine coverage gaps with respect to current standards and emerging parameters of concern (e.g., algal toxins and pesticides). For emerging concerns, the strategy should consider using surrogate parameters or analytical methods to contain costs. For example, the ELISA atrazine analysis method could be used rather than the more expensive methods for all pesticides.	1	5	5	1	1	3		<=1
SWQ-15	Sampling Design	• Available data are not adequate data to support certain elements of the WQS triennial review and the Wasteload Allocation Program. The list of toxic parameters monitored is short and monitoring is only conducted intermittently. Toxics monitoring data available from other monitoring programs in Iowa is too limited to fill the data gap.	• Add continuous temperature monitoring in coldwater streams to provide data for refinement of the coldwater designated aquatic life uses (Implementation of this recommendation will likely require more targeted site-specific UAA monitoring). The data are also needed for biological and climate trend monitoring purposes.	3	3	5	1	1	3		>1-5
SWQ-16	Sampling Design	see issue statement for R# 6	• As funding becomes available, enhance data collection to provide better support for Section 305(b) assessments and the Water Quality Standards Program, including metal monitoring on surface waters for both dissolved and total recoverable levels.	2a	4	6	3	1	2		<=1

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SWQ-17	Sampling Design	• A primary weakness relating to monitoring parameters is the large number of non-detects that have been reported for toxic parameters. This condition makes the data much less useful to the Water Quality Standards Program, which has sought data from other agencies and adjacent states to fill the gap. Additionally, the DNR is not able to use the metals data to assess the support status of designated aquatic life or drinking water uses. The existing data are also not suitable as a historical baseline for long-term trend analyses. Existing data for metals are reported at detection levels that are, in general, too high (i.e., resulting in a high percentage of non-detect results) to be used for either water quality standards review and revision, or for Section 305(b) assessments.	• Work with the monitoring contractor to implement sample collection and analysis methods that provide lower detection limits for toxic parameters and useful data for (1) water quality standards development/revision, (2) CWA Integrated Report preparation, and (3) long-term trend analysis.	2a	4	7	3	1	3		>1-5
SWQ-18	Sampling Design	• Monitoring for emerging contaminants has been sporadic in recent years.	• Maintain the ability to monitor emerging contaminants. Such monitoring supports the goal of having a "comprehensive" monitoring program. The data are of use to the DNR Water Quality Standards Program and for informing decision makers and the public about the status of water quality.	4	3	10	5	2	3		<=1
SWQ-19	Sampling Design	see issue statement for R# 53	• After identifying sentinel monitoring stations (see recommendation #), use them as locations to implement monitoring enhancements, such as expanding the list of analytes to include pesticides and pharmaceuticals or increasing monitoring frequency to improve pollutant load estimation.	2b	4	9	4	2	3		>1-5
SWQ-20	Data Manage-ment	• Accessibility is difficult for monitoring data not stored in EQuIS.	• Make monitoring data stored in databases other than EQuIS/IASTORET accessible to all DNR staff. Continue to consolidate bioassessment data in BioNet, similar to how the stream habitat data have been matched with stream flow measurements.	2b	5	10	2	4	4		>1-5

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SWQ-21	Data Manage-ment	• In the past, the lag time between data receipt from SHL and entry into EQuIS has been an issue for timely preparation of the biennial CWA Integrated Report.	• Establish a QA/QC required timeline for data entry (e.g., six months from the time of receipt of the data from SHL). Continuing without a formal requirement can result in much extra work for staff who are trying to use the data and (2) probably will result in some water quality data being missed and not included in the 305(b)assessment/303(d) listing process.	1	4	5	1	1	3		<=1
SWQ-22	Data Manage-ment	• Another potential "weakness" is that the 305(b)/303(d)-related data analysis is essentially a staff-limited process. One person has written the auto-calculator program to take the data, identify water quality standards violations, and summarize these violations for 305(b) assessment and 303(d) listings. To ensure this capability will be available into the future, some provision should be made to replicate the knowledge and skills needed to maintain and run the auto-calculator among other staff of the Ambient Water Monitoring Program.	• Provide training to ensure that at least two staff of the Ambient Water Monitoring Program are able to modify and run the water quality standards violation auto-calculator.	3	3	6	1	2	3		<=1
SWQ-23	Data Manage-ment	• Data retrieval through IASTORET is not easy for those who are not familiar with the data they are seeking or the database structure. Success at downloading data requires some awareness of things like monitoring projects, organizations, and technical nomenclature (e.g., phosphate-phosphorus equivalence with Total P)	• Continue to build data reporting capabilities within EQuIS. For example, graphs of data can be updated automatically as new data are added. This particular feature would assist staff with quality assurance work and generating monitoring reports.	2a	4	7	2	2	3		<=1

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SWQ-24	Data Manage-ment	see issue statement for R# 94	• Develop a "How-to" guide that walks new and inexperienced users through the web retrieval of data including, but not limited to, information on how to find and use project codes, links to the map interface to find sites, and a cross reference guide for parameters (e.g., "Phosphate-phosphorus" = "Total Phosphorus"). Create a user group to provide feedback on the usability of the data retrieval functions and provide suggestions on how to make retrieval more understandable to users outside of the DNR.	1	4	4	1	1	2		<=1
SWQ-25	Data Manage-ment	see issue statement for R# 94	• Create a user group to provide feedback on the usability of the data retrieval functions and provide suggestions on how to make retrieval more understandable to users outside of the DNR.	1	4	5	1	1	3		<=1
SWQ-26	Data Manage-ment	• QA procedures have not been reviewed by DNR staff and updated in many years. Decisions made by field staff may not be consistent with the DNR's preferences for QA/QC procedures.	• Work with SHL to review QA/QC procedures and update them as necessary.	3	3	5	1	1	3		<=1
SWQ-27	Data Manage-ment	see issue statement for R# 97	• Use EQuIS functions more fully to enhance QA such as graphing the data as it comes into the system to show outliers and other suspect data points.	1	4	6	1	2	3		<=1

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SWQ-28	Products & Services	• The data are not analyzed as often or in-depth as needed. More frequent data analysis serves many purposes including identifying questionable data points, informing management or legislative actions, justifying funding needs, and highlighting situations that require follow-up actions (e.g., investigating high nitrate following the drought). Previous data analyses have often involved a cursory examination of basic statistics, but have lacked the depth needed to explain the reasons for observed patterns in the data and answering key monitoring questions related to, for example, water quality trends. The data reduction and QA requirements take a significant amount of time. The lack of staff time available to complete these tasks is a key limitation.	• Build tools to help with data reduction, QA and formatting to streamline the analysis process. Invest time in developing R scripts that can automate and expedite this process. For example, South Carolina's Section 303(d) listing methodology is accomplished using R scripts. Continue to use GIS data visualization tools and refer to the USEPA nutrient visualization challenge for ideas.	2a	4	7	1	2	4		>1-5
SWQ-29	Products & Services	see issue statement for R# 128	• Complete annual assessments of water quality trends in concentrations and loads to align with the Nutrient Reduction Strategy. Examine other water quality influences such as stream flow, seasonality, land use, management actions, policies, and regulations on a less frequent basis (e.g., approximately five years) as these things tend to change more slowly.	2a	4	8	1	3	4		<=1
SWQ-30	Products & Services	see issue statement for R# 128	• Increase staff training in the use of R statistical language and GIS tools. This is likely to require a combination of training opportunities such as classes, seminars, and webinars, as well as ongoing mentoring by experienced individuals within and outside the Department. For example, the National Water Quality Monitoring Council is developing an R user group to help support and build skills of state monitoring program staff.	1	5	6	2	1	3		>1-5

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SWQ-31	Products & Services	• Other than the biennial CWA Integrated Report, there has not been enough interpretation and reporting of bacterial, chemical, and physical ambient monitoring data. Such reports could be useful for responding to inquiries about the status of water quality in Iowa (e.g., Is water quality getting better or worse?) DNR staff often rely upon subjective observations and "best professional judgement" when responding these inquiries. Information prepared for the Integrated Report has not been useful for this purpose largely because of the CWA-specific reporting requirements.	• Require periodic (e.g., biennial) analysis and interpretation of the ambient stream water quality monitoring data. This requirement should also apply to the other ambient monitoring programs.	2a	4	7	1	3	3		>1-5

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SWQ-32	Products & Services	see issue statement for R# 126	• Work with DNR communications staff to produce a new publication that presents DNR's perspective on water quality in a manner that is interesting, informative, and eye-appealing. The publication would present a different perspective than the popular "open sewer" view of Iowa's water quality. It should communicate the problem aspects of Iowa's water quality as well as highlight the good aspects. The publication could include high quality photos of interesting subjects such as Iowa's native fishes and mussels. It would summarize and interpret physical/chemical/bacterial data, biological data, fish & turtle tissue monitoring data, and should cover all the designated uses. The report could also include a water quality retrospective that contrasts the worst of the worst conditions from the past compared to the worst today. The piece might be publishable in the Iowa Outdoors magazine. The Integrated Report is another option; however, the reporting format would need to be changed from previous reports to make it more relatable to the general public.	1	4	6	1	2	3		>1-5

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SWQ-33	Products & Services	• The general lack of fact sheets on the ambient monitoring network has meant there has been less summarized information on Iowa water quality conditions available to CWA programs such as water quality standards and wasteload allocation. For example, DNR staff used the monitoring data summary statistics for the development of chloride and sulfate water quality standards criteria. • Achievement of the objective to inform the public about water quality in Iowa is hindered by the limited amount and effectiveness of communication tools. Beyond the Water Quality Index (WQI) and other information available from the monitoring web site, the program does not have many other means of communicating with the public. Concerns have been raised about the usefulness of the Water Quality Index (WQI) that is calculated using the ambient monthly stream monitoring data. Among the concerns is the view that the WQI has relatively little relationship with the degree to which Iowa's surface waters meet water quality standards or whether biological (aquatic life use) goals are met. Some DNR staff believe that the current version of the WQI unfairly misrepresents Iowa's water quality conditions and its use as a tool for communicating with the public and tracking conditions over time should be reconsidered.	• Data interpretation in general, and preparation of fact sheets in particular is difficult and time consuming. However, without them, the DNR will have little or no input on the perception of Iowans regarding the status of water quality in Iowa. Modifying the CWA Integrated Report to serve as a public education tool is a bad idea. The 305(b) and 303(d) reporting processes are far too standards-driven to be useful for communicating Iowa's water quality conditions to the public. For example, nonpoint source pollution issues such as nutrients and sediment would almost disappear, especially for streams and rivers because standards do not currently exist in Iowa for these parameters. Instead, summaries of ambient monitoring data could be prepared for the entire state, individual monitoring sites, river basins (e.g., HUC8 basins), or ecoregions. These would include summary statistics for key parameters regardless of whether they have a water quality standards criterion. Such summaries would be useful for CWA program functions including the development of wasteload allocations and water quality criteria, and most likely other purposes.	1	4	6	1	2	3		>1-5
SWQ-34	Products & Services	• Relatively few fact sheets have been produced in recent years (i.e., one data summary per year). Lack of providing consistent information from the program risks the loss of interest and enthusiasm for the program from decision-makers.	• Annually develop a list of fact sheets to produce by the end of the year covering topics of interest. Create five fact sheets each year to achieve the goal of public information dissemination. The fact sheets should be linked to hot topics updated by DNR communications specialists.	1	4	6	1	2	3		<=1

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SWQ-35	Products & Services	• Automated reports and data applications such as IASTORET are weak on data summarization and interpretation (e.g., seasonal patterns and trends), thus leaving this up to the person viewing the data.	• Continue to expand and improve monitoring-related internet applications. For example, a re-designed version of ADBNet (in-progress) will be more user-friendly, especially regarding interactive mapping features. The development of ambient stream water quality data summarization capabilities like those offered by the BioNet (stream bioassessment) application would be a step in the right direction.	2a	4	8	1	3	4		>1-5
SWQ-36	Products & Services	• The HUC8 mini-report function is currently broken and staff are no longer available to fix and maintain it.	• Work with DNR IT and GIS staff to restore the mini-report application for HUC8 watersheds. Finish developing template reports for priority parameters and water quality issues.	3	3	5	1	1	3		<=1
SWQ-37	Products & Services	see issue statement for R# 134	• Finish developing template reports for priority parameters and water quality issues.	3	3	5	1	1	3		<=1
SWQ-38	Products & Services	• Some of the parameters included in the WQI are no longer monitored, and the lack of data for these parameters reduces its overall usefulness.	• Consider using affordable surrogate analysis methods such as the ELISA atrazine test to allow pesticide data to be collected and used again in the calculation of the WQI.	3	3	6	2	1	3		<=1
SWQ-39	Program Coor-dination & Evaluation	• Not all monitoring organizations in Iowa are willing to share their results with the DNR for purposes of the CWA Integrated Report. • Among monitoring programs operating in Iowa there are inconsistencies regarding monitoring parameters, sampling frequency, etc., which impact the ability of each program to utilize shared data. • Available data are not adequate to support the needs of the Water Quality Standards and Wasteload Allocation programs. More collaboration with federal water quality and land management agencies, academic institutions, and other monitoring entities is needed to maximize the use of data collected outside of the DNR.	• Consider establishing a state monitoring council that would meet periodically (e.g., once per year) for the purpose of building relationships and understanding the priorities and data needs of monitoring programs in Iowa. These efforts could lead to greater monitoring collaboration and resolution of data sharing/utilization issues.	3	3	5	1	1	3		<=1

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SWQ-40	Program Coordination & Evaluation	• Coordination is often done ad-hoc without an overall structure or goal. It has relied more on the individual efforts of staff rather than a strategic program coordination effort.	• Develop a working group to discuss and plan coordination efforts for stream monitoring both within and outside the DNR. The working group could serve as a formalized mechanism to share information from the participating entities and may allow for collaboration and shared funding for monitoring priorities. The group could also serve to transfer knowledge on monitoring tools/techniques/ methods and identify duplication or repetitive monitoring efforts, thus allowing partners to maximize efficient use of resources.	3	3	5	1	1	3		<=1
SWQ-41	Program Coordination & Evaluation	• The lack of a TAC or stakeholder group reduces the input of partners on monitoring goals, objectives, etc. and doesn't allow for partners to come to the table with resources they might be willing to share for common goals.	• Create a standing workgroup of technical advisors to evaluate program objectives, monitoring design and reporting issues on a yearly basis (see recommendations above relating to establishment of a monitoring coordination workgroup or council). It is unlikely that one over-arching group will achieve all of the goals (especially as it relates to sharing technical information); however, it could be used to form short-term discussion groups as necessary.	3	3	5	1	1	3		<=1
SWQ-42	Program Coordination & Evaluation	• Regular and systematic reviews of the program are no longer completed. Consequently, the program is more likely to become disconnected from stakeholder needs. The lack of review can also make it harder to adjust the program to address issues that periodically arise.	• Re-establish a TAC or other advisory groups to provide for continuing assessment of monitoring needs. A TAC would help to ensure that the monitoring program remains aligned with its core functions and monitoring objectives while also ensuring that new topics, priorities, and issues are addressed in a timely manner and before they become a critical gap in need of urgent attention.	3	3	5	1	1	3		<=1
SWQ-43	Program Coordination & Evaluation	• The program lacks a mechanism to receive feedback for continuous improvement.	• Periodically review the ambient monitoring strategy and receive continual feedback from internal (DNR) and external stakeholders.	1	4	5	1	1	3		<=1

Wetland Monitoring

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WE-1	Monitoring Objectives	• Monitoring activities are aligned with the following objectives: ○ Collecting statewide baseline data for future establishment of water quality standards; and ○ Determining water quality status and trends with a statewide reference network for fen, pothole, and riverine wetlands.	• Continue to track activities in other states (e.g., Missouri) to determine the protocol and parameters used in developing standards and the processes used to implement wetland standards.	1	4	4	1	1	2		<=1
WE-2	Sampling Design	• The monitoring network lacks sites in Southcentral, Southwest, and Western Iowa. Consequently, it does not provide true regional or statewide representation of wetland condition.	• Alleviate site distribution issues by hand-selecting sites in regions of the state where the GIS random selection process typically doesn't find any sites.	1	4	6	1	1	4		<=1
WE-3	Sampling Design	• Due to budget constraints, the program is unable to obtain data for emerging contaminants at all wetland monitoring sites. The data is not likely to be used to develop water quality standards; however, it would be useful to have for each monitoring site in order to effectively gage wetland condition/health.	• As additional funding becomes available, choose parameters and sample emerging contaminants at each wetland monitoring site and not just a small subset of sites.	4	3	14	5	2	3	4	<=1
WE-4	Data Manage-ment	• Not all of the wetland data from previous monitoring years has been entered into EQuIS database, which means the data is not accessible to everyone. • Currently, the task of entering the data into EQuIS must be shared with DNR staff outside of the wetland monitoring program. The data must also be aligned to fit a particular format for entry into EQuIS, which can place an additional burden on staffing resources.	• Continue uploading wetland data sets to EQuIS. Additional seasonal staff assistance may be needed to convert the original data format to an EQuIS-compatible format.	1	4	5	1	1	3		<=1
WE-5	Data Manage-ment	• Field data sheets can sometimes be very hard to read due to challenging sampling conditions, inclement weather, or poor handwriting. When field sheets are difficult to read there is a greater potential to make mistakes when transferring the data to an electronic storage format.	• Only water-resistant or waterproof paper should be used for field data sheets and training provided to seasonal staff should reinforce the importance of legibility when recording field data.	1	4	3	1	1	1		<=1

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WE-6	Products & Services	• The monitoring data are not currently used for determining impairments of wetland designated uses because of the lack of completed use attainability assessments (UAA) and water quality standards criteria for many wetland monitoring parameters.	• Develop and implement wetland water quality standards.	2b	4	13	1	3	4	5	>5
WE-7	Products & Services	• Wetland monitoring reports have limited visibility and dissemination to the general public because of staffing limitations. The DNR wetlands monitoring website is the only place where the public can access the reports.	• Continue to post reports on the DNR wetland monitoring website, but also utilize current and past project partners to disseminate reports for greater visibility and public awareness of wetland health.	1	4	6	1	2	3		<=1
WE-8	Products & Services	• The wetlands monitoring website is not updated regularly with data and reports and lacks information to inform the general public of wetland health.	• Provide wetlands monitoring staff with better access to the wetland website for timely updates of data and reports. Staff need to supply more products to update the wetland website annually.	1	4	5	1	1	3		<=1
WE-9	Program Coor-dination & Evaluation	• Access to wetland sites located on private land is becoming more challenging to obtain with changing landownership over time. Privately owned wetlands make up a very large percentage of wetlands statewide and without being able to include them in current and future monitoring activities the program will not be able to accurately represent the overall health of Iowa's wetlands.	• Seek new private landowners who are willing to work with the monitoring program to evaluate wetland health. Wetland monitoring staff should also work to build upon current relationships with private landowners who allow monitoring to occur on their land and should continue to respect the land they have been given permission to access.	1	5	4	1	1	2		>1-5
WE-10	Program Coor-dination & Evaluation	• More cohesiveness with data collection and data sharing, monitoring plans/strategies need to be shared amongst the wetland monitoring community. By doing so we will have a more comprehensive impact statement of wetland health statewide and will eliminate/reduce redundancy in sampling/data collection.	• Implement the new Iowa Wetland Program Plan statewide in cooperation with wetland monitoring partners and resource managers. Doing so will greatly improve collaboration for wetland monitoring and data sharing.	1	4	5	1	1	3		>1-5

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WE-11	Program Coordination & Evaluation	• Iowa State University has completed at least one project and is continuing work in a second project for the development of a wetland Index of Biotic Integrity (IBI) protocol. The monitoring program has yet to implement any of their work and recommendations to date because the protocol is still being refined. Implementation of IBI methods will likely impact monitoring protocols in the future.	• Once the IBI protocol is completed, DNR staff should evaluate the potential benefits to the wetland monitoring program and decide whether the protocol should be implemented.	4	3	8	1	3	4		>1-5

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