COMPREHENSIVE REPORT OF AMBIENT WATER QUALITY MONITORING PROGRAMS IN IOWA

INCLUDING

STRATEGIES TO ADDRESS THE GAPS AND WEAKNESS IN THE AMBIENT WATER MONITORING PROGRAM

PREPARED JOINTLY BY:

USEPA REGION 7 and IOWA DEPT. OF NATURAL RESOURCES

February, 2003
Update: August, 2006

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INTRODUCTION

This report was prepared based upon a series of monitoring planning meetings conducted between EPA Region 7 staff and IDNR staff beginning in 2002 and ending in 2005. The purpose of those meetings was to produce a long-term strategic plan to build a complete and adequate state monitoring program relative to the water monitoring and assessment requirements of the Clean Water Act. In addition to the overall programmatic review, under Consent Decree Mississippi River Revival, Sierra Club, and Sailors, Inc. vs. EPA (Consolidated Case Number 98-134-mjm) EPA committed to a review of Iowa's water monitoring program. The purposes of this report are therefore the following:

1) Provide a detailed description of the current ambient water-monitoring program in the state,
2) Identify the water monitoring program gaps and weaknesses as they relate to monitoring requirements and guidance of the Clean Water Act,
3) Identify strategies for overcoming the monitoring program gaps and weaknesses,
4) Provide EPA and IDNR managers and staff with the necessary monitoring program information from which to make decisions regarding ambient monitoring needs and priorities.
5) Meet the commitment under paragraph 10 of the TMDL settlement agreement with particular attention to identifying impaired water bodies for the 303d list.

EXECUTIVE SUMMARY

Since the year 2000, the Iowa legislature has provided approximately 14 million dollars to fund Iowa's ambient surface and ground water monitoring program. This represents a tremendous increase over past funding levels and has allowed the State of Iowa to make tremendous strides in improving its monitoring and assessment capabilities in a short amount of time, especially in regard to interior rivers, lakes and beaches. However, despite the rapid and significant improvements in the monitoring program, it is important to keep in mind that the status of the program must ultimately be evaluated based upon what is needed to achieve true measurement and protection of all the water resources. And, relative to this, significant gaps remain, such as lack of monitoring coverage for entire resource issues such as sampling of wetlands and large rivers. In addition, there are some serious program weaknesses, especially relative to tools and indicators needed to assess the lake systems and biological condition of most water resources and staff and time available to produce written assessments. In addition, EPA must find ways to ensure that adequate data collection is occurring to support TMDL development.

In regard to funding, 2.9 million dollars annually is certainly significant **especially relative to state funding in many other states**. However, it is far short of the estimated 6 to 8 million dollars that Iowa independently estimated (Iowa Monitoring Strategy, 2000) was needed annually to answer all the important questions for all of the monitoring programs (such as, TMDL, 303d, 305b, water quality standards, source water protection, etc.) at all the necessary spatial scales. Only the execution of a coordinated cross-program, cross-agency, long-term monitoring strategy (such as that contained in this document) with, a long-term commitment to funding the implementation of that strategy will ensure the possibility of successfully protecting all of Iowa's water resources.

Given the recent shortfalls in state budgets, gains made through the increase in infrastructure funds have been offset by decreases in the allocation of EPA 106 dollars through the PPG. Because it is unlikely there will be significant increases in funding in the near term, these decreases in the PPG funding will erode the gains made if not addressed in the near future. Building the program in the future will have to be done in cooperation with other monitoring partners and using additional funding sources such as state and federal grants.

Part A: Iowa Water Monitoring Program Description

A fairly comprehensive description of Iowa's current water monitoring program is contained in Attachments A and B, "Iowa Water Monitoring Plan 2000" and "Water Monitoring Program Highlights 2004." In the future, these two documents may be merged and expanded to provide a more tactical and comprehensive description of Iowa's overall water monitoring program. Equivalent documents describing the current TMDL and 303d programs do not exist but will added to this strategy document as they become available.

The goal of developing Iowa's monitoring program is to positively affect the quantity and quality of data and ultimately, the information available for the effective protection and management of all of Iowa's water resources by enabling the following activities:

1) *The development of appropriate monitoring and assessment methods for all Iowa's waters.*
2) *A periodic assessment (status and trends) of the condition and stressors of Iowa's waters.*
3) *The identification of all Iowa's impaired waters.*
4) *The development of appropriate TMDL's for Iowa's impaired waters.*
5) *An assessment of the effectiveness of management activities and programs toward meeting resource management goals.*
6) *The setting of appropriate water quality and biological standards for protection of all waters.*
7) *Reporting of water resource conditions to the citizens of Iowa.*

Part B: Iowa Water Monitoring Program Strengths

1) Advisory Committees and Public Support: The underlying strength of Iowa's current ambient monitoring program is that the program's mission, goals, principles and priorities were, in 1999 and 2000, formed through a broad public participation and consensus building process. This process featured two advisory committees, a Water Monitoring Advisory Task Force which was, and still is, a public stakeholders committee to provide IDNR with input on public needs and priorities for monitoring, and a Technical Advisory Committee which consists of monitoring professionals to guide implementation of the priorities. These two advisory committees continue to function and provide guidance as the current plan is implemented and evolves.

In addition, Iowa conducts annual public information meetings to convey monitoring results and to discuss the status and future directions of the monitoring program. This is a key component in EPA Region 7's strategy to improve water monitoring and Iowa should be recognized as a model for the rest of the Region.

2) Mission, Goals and Principles: The mission, goals and principles of the state's water monitoring program, as stated in the Iowa Water Monitoring Plan 2000, set an excellent foundation for defining and building a comprehensive state-wide monitoring program based upon good science. In addition, the Iowa Water Monitoring Plan 2000 states, "characterization of safe and healthy waters is equally as important as the characterization of contaminated waters." This equates to and also incorporates the goal of achieving a balanced program. With this, these mission, goals and principles are directly in line with EPA Region 7's guiding principles for state monitoring programs. This permits a close and more effective monitoring partnership between the state and EPA to be formed. Regarding the principle of good monitoring and assessment science, it was agreed that the issue of defining "good science" will be addressed at the individual program level.

3) Funding: Since the year 2000, the Iowa legislature has provided approximately 14 million dollars to fund Iowa's ambient surface and ground water monitoring program. This represents a tremendous increase over past funding levels and has allowed Iowa to make tremendous strides in improving their monitoring and assessment capabilities. ***However, this level of funding is far short of the estimated 6 to 8 million dollars that Iowa independently estimated was needed on an annual basis to answer all the important questions at all the necessary spatial scales to successfully protect all water resources.***

4) Surface Water & Ground Water Network: With the increase in funding for the monitoring program, the state has been able to greatly expand the surface water monitoring network to achieve reasonable progress toward comprehensive coverage of interior rivers using a variety of good monitoring designs and resources. This includes a volunteer monitoring program, "IOWATER" which utilizes trained citizen volunteers to gather stream data for public education, screening purposes, and collection of baseline data. In addition, the groundwater-monitoring network, which was strong even before the increase in funding, remains a strong, comprehensive aspect of the program.

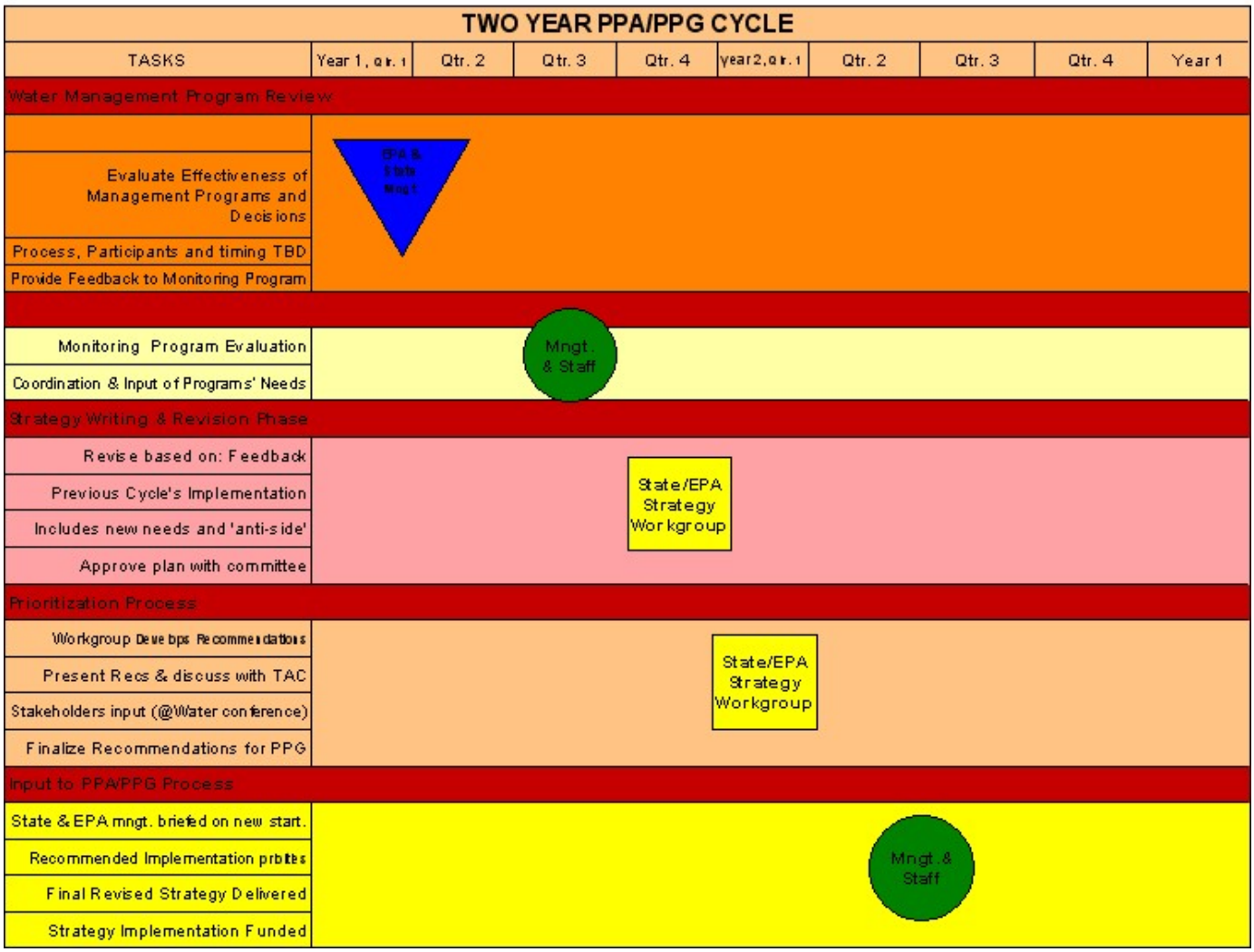
5) Staff: Staffing for the water monitoring program is achieved through the use of EPA 106 grants since the appropriated monitoring funds are discouraged from being used for department personnel. The Water Monitoring Section of the Iowa Geological Survey and Land Quality Bureau (IGSLQB) partnered with the existing IDNR water quality staff to form a more functional and effective water monitoring and assessment group. Although coordination between programs continues to be a challenge, the IDNR / IGSLQB staff with their collective knowledge and experience, especially the ability to manage and assess data, are a strength of the current program. In addition, over the course of the meetings and process to construct this report and strategy, the Iowa staff were generally cooperative and a constructive relationship was initiated and maintained. Moreover, Iowa and EPA agreed there is a need to conduct Regional discussions on monitoring issues and to keep conducting monitoring planning meetings at the state level.

6) Monitoring Program Coordination, Communication and Feedback Processes: Since water quality monitoring programs are effective only when they meet the information needs of water quality resource managers, the State, in consultation with EPA, should conduct periodic reviews of each aspect of its monitoring program to determine how well the program serves its water quality decision needs. This should be done for all State waters, including all water body types and, should include

identification of new gaps and program weaknesses as well as revisions of those already identified in the existing state strategy. Decision-makers at the national, regional, and State program levels should be considered in this process which should be implemented as part of a continuous improvement feedback loop. This programmatic evaluation process should include determining how needed changes and additions are incorporated into future monitoring cycles and, take into consideration the effects of funding shortfalls on a State's implementation of its monitoring program strategy.

The state (along with EPA) has worked hard to develop and implement detailed strategy implementation, communication and program coordination processes (See diagram 1 below). These processes (formerly a program weakness) are now strengths of the program and benefit it by increasing its efficiency and effectiveness. Noteworthy elements of these processes are the establishment of a cross-program strategy workgroup, linkage of the workgroup's strategy to both the state Technical Advisory Committee (TAC) and the state stakeholder's group and, linkage of the monitoring program to the function of evaluating the effectiveness of resource management programs and activities.

IOWA MONITORING STRATEGY REVISION PROCESS



Part C: Threats to the Monitoring Program:

While the Iowa Legislature has significantly increased funding for its ambient surface and groundwater monitoring program, some of those increases have been offset by recent state budget difficulties and cuts made by other agencies. Prior to 1999, the only state General Funds available for water monitoring in Iowa were used to support a cooperative program between the Iowa DNR and the U.S. Geological Survey. This program supported gaging stations (both discharge and sediment) and Iowa's groundwater level and water quality network. However there have been major decreases in funding of groundwater monitoring.

The General Fund support of this program slowly eroded from $250,000 in Fiscal Year 2000 to $154,000 in Fiscal Year 2001 to $106,000 in Fiscal Year 2002 to $0.00 in Fiscal Year 2003. The U.S. Geological Survey Cooperative Program is a significant component of the Ambient Water Monitoring Program, providing the backbone of the ambient groundwater network and invaluable flow data for the ambient surface water network. Because of its importance, these losses in funds were replaced with funds from the Ambient Water Monitoring Program. Additionally, beginning in 2004, the U.S.G.S. cooperative program in Iowa now requires a 55-45 match rather than the traditional 50-50 match. This change in match structure effectively reduces the amount of monitoring that can be accomplished with the same dollars.

The Ambient Monitoring Program also picked up the cost of 5 sediment stations ($50,000) starting in Fiscal Year 2002 due to decreased funding from other agencies and programs (most notably the U.S. Army Corps of Engineers). From Fiscal Year 2000 through 2005, the Ambient Water Monitoring Program also covered the cost of 7 additional U.S. Geological Survey gages, at a cost of more than $45,000 annually.

Most recently, State funding shortfalls and more specifically budget cuts within IDNR have resulted in decreases of the amount of EPA 106 funding received for staffing of the water monitoring, water assessment, and TMDL programs. These shortfalls have necessarily been offset by funding from the water monitoring infrastructure dollars, but are not sustainable for the long term especially if the infrastructure fund does not increase.

Part D: Program Gaps and Strategies

IDNR and EPA constructed a matrix table of Iowa's water resources and ambient monitoring program elements (see Matrix Table 1, Summary of Iowa Water Resources and Annual Ambient Monitoring Program). The matrix table was used to both quantify all Iowa's water resources (columns 1 and 2, respectively) and then, for each water resource category, the matrix table was populated in order to identify the monitoring gaps and the monitoring program weaknesses. Monitoring gaps are defined as resource categories either not receiving comprehensive coverage (see columns 3 and 4), or not achieving good monitoring science with regard to appropriate monitoring design and/or type of monitoring conducted (see columns 4 and 5). The gaps are summarized in this section.

Monitoring program weaknesses, which are considered less serious than gaps, were also identified

using the matrix table and these are summarized in Part E. Weaknesses are inadequate monitoring program elements such as incomplete biological monitoring tools or indices (column 7) or inadequate or incomplete reference conditions or reference site sampling regime (column 8). Gaps and weaknesses in Iowa's program appear in bold on Table 1, are discussed in detail below but are not discussed in order of importance.

In addition to gaps and weaknesses, opportunities to improve the monitoring program were also identified and these are summarized in Part F.

Gap 1) Comprehensive coverage of wetlands:
No monitoring or assessment is currently performed on Iowa wetlands, which fall into several categories such as, permanent, semi-permanent, temporary and seasonal. In addition, no definitive inventory of all Iowa's wetland resources currently exists since the development of the National Wetland Inventory in 1985. The net effect of this gap is to create significant potential for undetected impairment of wetlands and, to perpetuate the state's current inability to answer the 305b question, "what percent of all waters meet their designated use for protection of aquatic life?"

Strategy to address gap in wetlands monitoring and assessment:
The State will work with EPA Region 7, ORD, the EPA National Wetlands Monitoring Work Group, and other Region 7 states via the Regional wetlands monitoring workgroup [Heart of America Assessment of Wetlands Work Group (HAWWG)] to develop a statewide wetland protection plan and execute a series of coordinated strategic steps (or pilot projects) which, when taken in their entirety, will be designed to provide a scalable (to the ecoregion and state levels), holistic (integrated biological and chemical) and effective monitoring and assessment program for all of Iowa's wetlands.

These strategic steps and projects will be coordinated, documented and linked through this Strategic Monitoring Plan and will include, but not be limited to, the following 1) a "Color Infrared Digital Orthography Project" to identify and inventory all of Iowa's wetlands (permanent, semi-permanent and temporary), 2) establishment of a wetlands technical advisory committee, to help define appropriate monitoring protocol and assessment methodologies, 3) a R-EMAP pilot project for probability-based wetlands monitoring to assess baseline biological and chemical conditions, 4) a wetlands biological indicator development project (similar to Iowa's existing stream biocriteria development program), 5) a reference site development and testing program, and 6) public information and education on the socio-economic values of wetlands. Funding for the linked projects will be sought through appropriate channels and sources such as Clean Water Act Section 104 or 106 appropriations.

The ultimate goal of developing this wetland monitoring program is to positively affect the quantity and quality of data and information available for the effective protection and management of all of Iowa's wetland resources by enabling at least the following activities:

1) *The development of a wetland monitoring and assessment methodology to be used by the Iowa Department of Natural Resources to conduct wetland monitoring as part of the state's ambient water quality monitoring program.*
2) *A periodic assessment (status and trends) of the condition and stressors of Iowa's wetlands.*
3) *An assessment of the effectiveness of wetlands toward meeting nutrient management goals.*

4) *The setting of appropriate water quality and biological standards for wetlands protection.*
5) *Reporting of wetland conditions to the citizens of Iowa.*
6) *Make more informed decision regarding the following: areas to prioritize wetland protection, restoration efforts, preservation of bio-diversity.*
7) *Development of methods to track state-wide and watershed net loss and/or net gain of wetlands*

TASKS FOR WETLANDS STRATEGY

1) The first task of this project will be to update and supplement the National Wetlands Inventory (NWI) database that identifies and classifies existing wetlands in the state. This project will build upon an existing initiative in the state to re-inventory existing wetlands and geographically locate and define these wetlands using remote sensing techniques. The Iowa Color Infrared Digital Orthophotography Project (ICIDOP, attachment 2) will provide the needed digital ortho-rectified aerial photography to serve as the base map for more detailed wetlands mapping efforts. Color Infrared (CIR) photography will then be compared against state records of restored or constructed wetlands (permanent and semi-permanent) to determine their existence (present, absent, indeterminate), location, geographical extent of open water, and, if possible, NWI classification (forested, emergent, shrub). The revised database from this task will provide the sampling frame from which to select candidate wetlands for a R-EMAP probability based pilot monitoring project. Revision of the NWI with respect to temporary and seasonal wetlands will require a much more intensive effort with a substantial ground-truthing component. Because most of these wetlands are farmed, they will be significantly more difficult to develop monitoring protocols and benchmarks for their quality. The Iowa Technical Committee for Wetland Monitoring will address the inclusion of temporary and seasonal wetlands for monitoring and the potential for the development of monitoring tools for these wetlands.

2) The second step in this process will be to conduct a R-EMAP pilot project for probability based monitoring to assess baseline biological, chemical and habitat conditions for Iowa's permanent and semi-permanent wetlands. The project would use volunteer monitoring and would begin in 2003 or 2004. Quality assurance for the volunteer monitors would be provided through a tiered training program similar to that used for the Missouri Stream Teams program. The wetlands monitoring and assessment project would be subsequent to completion of an Iowa wetlands inventory project, which would provide the base wetlands inventory data from which to draw the probability-based samples. Details of both the inventory project and R-EMAP Wetlands sampling project can be obtained in the individual project plans.

Although the long-range goal is to build a monitoring and assessment program for all Iowa wetlands, this R-EMAP project will initially focus on and define the population of interest as all permanent and semi-permanent wetlands of Iowa. By doing so we address the portion of wetlands presently recognized within the Iowa water quality standards. In addition, we believe this population is less logistically and technically challenging to sample and will therefore have a greater chance of success upon which to build the remainder of the program, which could be directed at temporary and seasonal wetlands.

3) The third step in this process will be to establish a Wetland Monitoring Technical Advisory Committee. Participants of this committee will come from a number of university, state, and federal

entities including EPA Region 7 Wetlands and Environmental Services Division program staff, IDNR program staff, Iowa State University, University of Iowa, Iowa Department of Agriculture and Land Stewardship, Natural Resource Conservation Service, U. S. Army Corps of Engineers, U. S. Fish and Wildlife Service, and EPA ORD.

The committee will be charged with the following tasks: a) developing plans to update the NWI for temporary and seasonal wetlands, b) developing a wetlands biological indicator development project (similar to Iowa's existing stream biocriteria development program), c) a reference site development and testing program, d) provide recommendations to the IDNR and EPA Region 7 Project Coordinators (as well as to the EPA ORD Project Officer) regarding most appropriate sampling methods and parameters, any necessary adaptations to those methods and, the most appropriate biological indicators. This will be done by collecting and reviewing all appropriate guidance manuals or SOPs from sources such as Jackson et.al, the BAWGG web site and by contacting knowledgeable program individuals in surrounding states such as Ohio, Minnesota and Illinois. Sampling methods and indicator appropriateness will be evaluated based on relativity to the stated monitoring and assessment objectives, the resource management objectives of this project, and their potential use by citizen volunteers.

Outlook to address wetlands gap: Although the wetlands strategy laid out above is somewhat sketchy for work identified under task #3, tasks 1 and 2 are a good starting point for a previously undefined and unassessed resource. If executed correctly, the linked tasks have excellent potential to fill the wetlands monitoring gap by providing comprehensive monitoring and assessment coverage of this resource using trained citizen volunteers and, with sufficient quality of science to be comfortable with the assessment results. However, it must be recognized that significant resources and expertise will be needed to produce meaningful biological assessment indices and results.

Gap 2) Comprehensive coverage of Large "border" Rivers:
Virtually no monitoring is currently performed by Iowa on the state's large border rivers, which consists of 660 miles on the Mississippi (14 segments) and Missouri Rivers (5 segments). In addition, the Long-term Resource Monitoring Program administered by the USGS and contracted through the Department of Natural Resources sustained a significant decrease in funding starting with FFY03. This project has provided long-term monitoring on the backwater ecosystems of the Mississippi River in the area of Bellevue, Iowa (pool 13). This cut in funding undermines the ability of the state to assess the condition of the Mississippi River above pool 13 and the associated fish nurseries in the slackwater areas.

Strategy to address gap for large river monitoring and assessment:
The State will actively participate in the State/Regional GRE-RFA steering committees convened for various Big River monitoring and assessment issues. The State will work with EPA Region 7 and ORD to evaluate the applicability and transferability of the monitoring tools, methods and design developed for the EMAP Great Rivers Ecosystem project (EMAP - GRE). The State will work with EPA Region 7 and ORD to develop a proposal (using the EMAP-GRE research funding proposal) to build a partnerships to conduct a probability based monitoring project aimed at assessing baseline biological, chemical and habitat conditions for the Missouri and Mississippi Rivers.

Outlook to address gap:
Cooperative regional monitoring agreements between the Upper Mississippi River states and the federal agencies such as the United States Geological Survey may be employed to address this gap. However success of this strategy will depend upon the availability of matching funds in other states and within the USGS as well as staff time to construct proposals and evaluate methods.

Gap 3) Non-significant public and private lakes*:*
Iowa has four general categories for lakes it considers within the purview of its monitoring program: A) significant public lakes including flood control reservoirs, B) non-significant public and private lakes with public access and C) private lakes without public access regardless of size. The fourth category, R, is monitored for the purposes of meeting research needs of the state. Significant public lakes are defined as: 1) principally maintained for public use, 2) have a minimum surface area of 10 acres, and 3) are capable of supporting fish stocks of at least 200 lbs/acre. Non-significant public lakes carry essentially the same definition except they are smaller than 10 acres. The definition of private lakes with public access is self-explanatory. All of the lakes in these categories have water quality standards defined within the Iowa Administrative Code; however many of the lakes in the nonsignificant public lake category may be more appropriately listed as wetlands.

Although Iowa does a good job monitoring (both spatially and temporally) all significant public lakes, reservoirs and state-owned beaches through a census design, only 17 of the 530 non-significant public lakes and none of the 12 or so private lakes with public access are sampled. In addition, sampling of the non-significant public lakes is achieved using a targeted design which does not represent the entire population.

Strategy to address gap:
IDNR staff (Mary Skopec, Adam Schneiders, Jeff Kopaska, and John Olson) will work across the necessary programs to categorize each of the lakes currently listed in Iowa's Water Quality Standards into one of the four "bins" – A, B, C, R plus a "W" wetland bin for those lakes that can be determined to be more appropriate for the wetland classification. A protocol for determination of a "W" classification needs to be developed with input from the IDNR standards and fisheries staff as well as EPA representatives.

A strategy for each of the lake "bins" will be developed using the lake monitoring goals identified by IDNR and EPA during strategy meetings. Currently, agreement exists that "A" lakes (roughly 120 lakes) will continue to be monitored in a manner consistent with the existing lake monitoring program using a census approach. Monitoring of "B" lakes will most likely be accomplished using either a probability approach or a targeted monitoring of these lakes. Given the variety of uses in the "C" lakes, support was expressed for sub-dividing this class into subclasses such as private lakes with substantial public use or valuable aquatic resources versus small farm ponds. Details of this sub-classification need to be developed and monitoring tailored to these groupings. Lastly, IDNR staff will identify the research goals associated with lakes and tie the monitoring of some of the "A" and "B" lakes to these research goals as funding becomes available.

When this classification is final, IDNR will work with EPA to develop a proposal for a monitoring design and network for these lakes that first meets the strategy goals of comprehensive coverage and good monitoring and assessment science and secondly, some of the lakes research needs expressed within this strategy. In order to devise a monitoring system that meets these goals and needs, the proposal will take into consideration a number of factors including (but not limited to) the number and distribution of the lakes in each of these classes, what are the appropriate questions to answer for each class (relative to water quality standards) what is the quality of data needed, the lakes classification system (from John Downing) and, the existing lakes monitoring network. The proposal will be developed by the end of October 2005 and will be reviewed by the Iowa technical advisory committee.

Outlook to address gap:
Given the relatively small size of the population of non-significant public lakes and private lakes with public access, overlaying and implementing a probability based design would be a relatively routine operation considering the state's experience with the other current R-EMAP probability based projects (wetlands and wadeable streams). In addition, if biological end points are needed to make the assessment of these resources relevant to state water quality standards, then a biological indicator and reference site development process, similar to that described for wetlands and wadeable streams, will need to be established. If so, this will take considerably more investment of resources and expertise.

The interest in pond monitoring expressed by volunteers indicates that the outlook to address this gap is good. While volunteer data are not as rigorously developed as professional data, simple measures such as secchi depth and nutrient concentrations using field kits can provide basic measures of pond quality. Similarly, many of the measurements used for the calculation of Trophic State Index are relatively low cost and could conceivably be collected using volunteer or fisheries professionals co-located at the lakes.

Gap 4) Intermittent streams and 1st order perennial streams
Iowa does not do any monitoring of its estimated 43,000 miles of intermittent streams. And, although intermittent streams may technically not be covered by the Clean Water Act as "navigable waters of the U.S.," they are undoubtedly an important aquatic ecological resource and should be monitored for status and trends. In addition, although the state is using a probability-based design for most of its wadeable streams, this design omits the first order perennial streams.

Strategy to address gap:
IDNR will work to produce an inventory of the streams in both these classes. IDNR and EPA will then work together to develop a proposal for a monitoring design (or set of designs) and monitoring network(s) that first meets the strategy goals of comprehensive coverage and good monitoring and assessment science and secondly, meets most of the research needs for expressed within this strategy for these streams. In order to devise a monitoring system that meets these goals and needs, the proposal will take into consideration a number of factors including (but not limited to) the number and distribution of streams in each of these classes, what are the appropriate questions to answer for each class (relative to water quality standards and use

designations) what is the quality of data needed, etc. Possible solutions discussed for both the inventory and assessment work were, use of volunteers, models and aerial photography. The proposal will be developed by the end of FY 2005 and will be reviewed by the Iowa technical advisory committee.

The development of Iowa's volunteer monitoring program (IOWATER) may help to address some of the resource limitations. The focus of the IOWATER program is on small first and second order streams where volunteers can safely wade into the water in order to collect water samples, collect benthic macroinvertebrates and manually measure discharge. There are currently more than 2,000 volunteer monitoring sites across the state, but are distributed according to the volunteer's interest rather than a randomly selected network. In the future, volunteers could be called upon to do a screening level assessment based upon the department's preference of sites. In addition, the state does not currently have bioassessment tools available to determine the ecological health of intermittent streams. Given the large amount of data collected by volunteers, the development of assessment methods is critical to both the long-term success of the volunteer program as well as will provide progress on the assessment of small streams. The use of voluntary data in 303d and TMDL development will need to be weighed against the state's "credible data" law as well as appropriate QA/QC considerations.

Outlook to address gap:
The outlook for addressing the gap using volunteer methods for basic screening level parameters is fairly good. However, if the goal is to do a more thorough assessment with in-depth biological assessments and extensive water chemistry analyses, the outlook is less optimistic based on the lack of resources (both financial and staffing) and the higher prioritization of other water resources.

Gap 5) Precipitation / Air Deposition
There are serious concerns over the possible contribution of pollutants such as nutrients, pesticides, antibiotics to the waters of the state from air deposition and/or precipitation. Iowa currently has no program for monitoring precipitation.

Strategy to address gap:
The United States Geological Survey operates two wet/dry deposition monitoring stations within the state of Iowa. Iowa will work to ensure the continuity of these stations and in addition will cooperate with federal agencies (USGS, NOAA, EPA, and USDA) to build upon the existing network and add stations in critical airsheds. Partnerships with the Air Quality Bureau of DNR may also be pursued in order to build upon existing compliance monitoring of air by adding wet/dry deposition equipment.

EPA Region 7 has identified the need for an air deposition network for the Region and the states and will attempt to develop such a network through coordination with the states and the air monitoring program. As an initial step in the development of such a network, a pilot project has been envisioned and could be developed in partnership with the states and could be funded with R-EMAP or air program funds.

In FY04, IDNR in conjunction with EPA Region 7 utilized a cross-program (air and water) coordination approach to develop a draft list of the most important air deposition questions that need to be addressed through precipitation/air deposition monitoring. In FY05, IDNR and EPA will use this list and the cross-program coordination approach to develop a pilot monitoring project proposal that will begin to address some of these most important questions. The proposal will be developed (or at least peer reviewed) in conjunction with the Iowa Technical Advisory Committee. Implementation of the pilot project could begin as early as FY06.

Outlook to address gap:
There is limited potential for success in the near-term future depending upon the ability to influence continuity of USGS long-term wet/dry deposition stations. There may more success in working with the Air Quality Bureau of DNR depending on the ability to find funds to purchase wet/dry deposition equipment or modify existing equipment (see strategy above). Also, because UHL is contracted to collect both water quality and air quality samples, economies may be achieved through coordinating efforts between the two programs.

Gap 6) Stream and Lake Gaging Data & Stations:
Stream flow measurements are a necessary component for many of the Department's water quality activities including NPDES permits, development of water quality standards including nutrient criteria, TMDL's, floodplain permits, and water quality modeling. This program is primarily administered through cooperative agreements with the United States Geological Survey and has suffered decreases in funding both from the state and federal level over the past decade. Additionally, the development of TMDL's requires stream flow measurements at smaller stream sites that have never been gaged and at a level of activity that is beyond the current capacity of the system. In development of TMDL's for runoff-driven contaminants such as sediment, pathogens, and phosphorus, event sampling is important and logistically difficult. Refining flow monitoring methods and finding resources to implement this monitoring is crucial to the TMDL program and for other water quality modeling purposes. For example flow data and cross sectional information is needed for at least two different flow regimes and at three to four locations on an impaired stream depending on its length, for regression analysis/QUAL2E modeling.

Lake modeling and mass balance equations need to have inflow and outflow information. Flow devices on weirs at inflow and outflow sites are needed to provide this kind of information and to contribute to understanding of the hydrology of the waterbody. Residence time of water in the lake is needed for modeling, but requires both a sound understanding of the lake morphology and the volume of water flowing in and out of the lake from multiple locations.

Closely related gap:
Continuous stage monitoring and flow estimates for ungaged and impaired streams are needed for TMDL development. Field techniques and estimation methodology need to be refined. The use of volunteer monitoring data in 303d and TMDL development will not likely fill this need considering the state's "credible data" law as well as other QA/QC issues. The state will need to find ways to gather data necessary for TMDL completion on any of the ungaged and listed streams. Iowa could also benefit from GIS-based flow estimation techniques that utilize remotely sensed landscape data and climatological data to generate a predicted hydrograph and/or flow duration curve. The

constructed flow data can then be used to model nutrient and sediment loads at various spatial and temporal scales of interest to resource managers.

Strategy to address gap:
The Department has prioritized the existing gages with respect to their value for various water quality programs and potential for funding partnerships with other government agencies (municipalities, counties, DOT, USDA, etc.). Priorities for establishing new gages and potential sites will be drafted and proposed to the funding partners. The Department continues to work with the USGS to request new gages under the NSIP program (National Stream Information Program). The Department will also pursue new funding partnerships and attempt to restore the previous levels of State General Fund appropriations by highlighting this gap as a serious threat to many of the water quality programs. In order to address the lack of stream flow measurements for the TMDL program, the state will work to develop its own ability to gage small streams using new technologies such as Doppler Radar, which have been successfully implemented within other states (Minnesota). The event driven sampling may need to consider additional equipment but the main challenge will be maintenance and sample collection resources to meet holding times.

Other options could include renting a suite of portable flow monitoring equipment through an arrangement the currently exists between USGS and OTT Equipment Co. State and/or USGS personnel could then move the equipment to different locations as needed.

The Department will investigate GIS-based flow estimation models. Potentially useful models can be applied and calibrated in various ecoregions of the state, both in watersheds where active, long-term stream flow gages exist and in streams where flow data have been collected for TMDL development purposes.

Outlook to address gap:
Discussions with other funding partners are on-going and, to date, have been encouraging. A watershed partnership consisting of DNR, Iowa Association of Water Agencies, and USGS has begun to examine the amount of monitoring in and around metropolitan areas in an effort to maximize the amount of information generated by the various agencies. One potential result from this examination may include shifting funding from water chemistry analyses to stream gaging. The outlook for improving and/or maintaining the current level of USGS gaging is not so optimistic. The downturn in the State General Fund is not likely to reverse in the near-term future and thus restoring SGF appropriations for gaging is not likely. The development of alternative gaging techniques employed by the State is more likely given the potential for grant opportunities within the TMDL program. The expertise and data needed to evaluate GIS flow estimation methods exists within the Department's GIS Section. Funding to support a GIS technician to compile data and perform the flow modeling work is needed.

Gap 7) Biological Indicators and Reference Conditions for Assessing Lake Health
Development of appropriate lake criteria for N, P, and chlorophyll a for water quality standards development will depend on having a good monitoring basis. TMDL development also depends on adequate lake and tributary information. Despite census type sampling of Iowa's significant public lakes, the assessment of these lakes is limited by the following factors:

a) Lack of biological indicators calibrated for Iowa lakes

b) Lack of reference conditions developed for Iowa lakes
c) The current lake sampling methodology (one sample from the deepest part of the lake, taken three times during the swimming season) provides statistically defensible information about the population of lakes, but does not answer questions regarding specific lakes including the temporal and spatial variability of various parameters.
d) Lack of tributary flow information and lake hydrology, including lake bathymetry, residence times, groundwater/surface water contributions.
e) Fisheries and biological assessments are needed since these may be used to determine if management targets are being achieved. Monitoring and modeling need to provide the connection between the assessment and the WQ problem indicator (sediment, P, N, chlorophyll a, etc.).
f) Sediment coring is needed to provide deposition history and an understanding of how sediment nutrients are recycled in the water column.

Strategy to address gap:
Formalize the process to develop biological indicators using the Iowa technical committee similar to process described for wetlands including an analysis of what other states are currently doing. In addition, Mary Skopec will link the lakes classification study by John Downing at Iowa State to the lakes richness data developed by the DNR fisheries section. The state TMDL program currently contracts with USGS to collect bathymetry and sediment coring. As part of the ongoing TMDL sampling program, the UHL is collecting and analyzing phytoplankton and zooplankton samples from nutrient impaired lakes. From this data, UHL will calculate a number of biological data metrics and will evaluate their usefulness as lake biological indicators. The plankton assemblage metrics from TMDL lakes will also be compared with phytoplankton and zooplankton assemblage data collected from lakes sampled in the ambient lake monitoring program that are attaining lake uses. The comparison will help evaluate candidate metric responses across a broader gradient of lake quality.

Outlook to address gap:
The completed contract with John Downing to develop a lake classification system will advance DNR in its efforts to develop biological indicators, especially in regard to the use of non-traditional measures such as phytoplankton and zooplankton populations. However, it is unlikely this study by itself will result in a methodology for the state to assess biological use attainment in lakes. Other approaches, including identification and sampling of reference lakes are needed to fill this gap. Without dedication of technical staff for data analysis and interpretation of plankton sampling results biological indicator development is not likely to progress.

Gap 8) Lack of sediment data for stream bed, bank erosion, lake deposition of sediments, and suspended sediment concentrations in Iowa's waterbodies.
Estimates on the contribution of sediment in streams from the literature indicate that roughly 50% of sediment is derived from stream bank and stream-bed erosion. For several Iowa sediment and siltation TMDL's, bed and bank erosion appear to be the main problem and methods for evaluating these are crucial to targeting appropriate water quality goals. Monitoring of suspended sediment loads in various water body types is virtually nonexistent in Iowa at this time. Additionally, monitoring of suspended sediment loads or bed sediment loads do not provide complete information about the source of sediment and therefore the management

strategies for addressing the sediment loads. RUSLE tends to underestimate the amount of erosion attributed to sheet and rill, and to accredit gully, bed and bank as contributing more than is considered realistic. Local knowledge, watershed surveys, or investigation by Department or other agency representatives provide more accurate estimates of the status of gullies and bank erosion. The quantity of sediment deposited in Iowa lakes during the past century is also not well understood, but could provide a reference point to understanding the effectiveness of management activities aimed at reducing sediment loss from the landscape.

Strategy to address gap: For the near term, more evaluation of bank and gully erosion is needed through visual investigation and estimating various parameters, such as: amount of bare bank vs. vegetation, type of vegetation, bank stability, degree of slope, depth/height of bank, for sediment impaired TMDL streams. Implementation of USDA's Stream Visual Assessment Protocol would provide an accepted protocol for acquiring this information. In the long term, installing monitoring pins in banks of major impaired streams and rivers would assist in getting a better understanding of such erosion on TMDL streams and for comparison among the state's ecoregions. A proactive effort by local District Conservationists, Soil and Water Conservation technicians, and Iowa Extension in investigating degree of gully and bank erosion would be of valuable assistance to the IDNR TMDL program. An alternate new technology, PEEPs, measures the amount of exposure to light the pin receives and this information is recorded on a datalogger. This new method holds promise in better characterization of stream and gully bank erosion

The Agricultural Research Service (in particular Andrew Simon) has been assessing the regional waters to further develop a stream channel evolution model. Recent work by Rosgen may shed light on appropriate strategies to monitor these channel issues. A random subset of R-EMAP sites could be assessed using a geomorphic approach (Simon or Rosgen) to determine benchmarks for various stream orders across the state. Additionally, the TMDL program may be able to utilize research work by Isenhart, Schultz and Schilling which is looking at relationships between riparian vegetation and land use, water movement through the riparian zone to the stream banks, and bank erosion and slumping. Project title: Quantifying the role of riparian land use on stream bank erosion and nutrient pollution (2004-2007).

The TMDL/WQA Section received an EPA 104(b) grant in 2004 to develop a sediment-biological translator protocol. The project will establish procedures to collect and analyze data needed to identify, describe, and manage sediment impacts to stream biological communities. Stream bank and bed sediment characterization will be a key element that will be addressed by the protocol.

Bathymetry and sediment volume analysis on TMDL lakes has been conducted by USGS for the TMDL program since 2002 and continues to be a valuable tool for development of TMDLs for sediment impaired lakes. The bathymetry mapping defines the original lakebed and the accumulated layers of sediment. By comparing this data with the original baseline values, the extent of deposition is determined, the volume of sediment calculated, and a rate of sediment delivered estimated over the life of the lake. This is needed to establish targets in the TMDL for sediment delivery reduction. These data have been helpful in the development of lake TMDLs

and the continued collection on public lakes would be beneficial to many areas of IDNR including TMDL, Fisheries, Nonpoint 319, and Water Quality Standards.

Increased suspended sediment monitoring will be pursued through cooperative partnerships with the USGS and Corps of Engineers as funding allows and through the use of potential surrogates for suspended sediment concentrations such as in-situ turbidity levels.

Outlook to address gap: Further discussion with the Iowa water quality programs will need to occur in the future on appropriate approaches. A satisfactory approach should be possible, although training and resources will be of concern. Research results from Iowa researchers (Isenhart and Schultz; Schilling and Wolter) that quantify relationships between land cover/use and amount of stream bank erosion could be extrapolated to characterize bank erosion rates at the watershed and regional scales.

Additional potential research opportunities involving the USDA-ARS (Andrew Simon) and Conservation Environmental Assessment Protocol (CEAP) watersheds in Iowa would help the Department characterize and monitor channel morphological evolution and sediment conditions at a broader scale.

The TMDL & WQ Assessment Section received an EPA 104(b)(3) grant for 2005 to develop a sediment-biological translator protocol. This study will determine the procedures needed to collect data in determining sediment impacts to the aquatic/ biological communities in the stream. Iowa State University will be conducting this work. Bank and bed sedimentation will be considered.

Funding for lake bathymetry mapping has been available through EPA grants during the past few years and is likely to continue depending on the EPA budget and the ability of the staff to write successful grant applications.

Gap 9) Targeted TMDL Monitoring

Targeted TMDL Monitoring: TMDL development requires intensive data collection on streams, rivers, and lakes over a short period of time, during different flow conditions, and in multiple locations within the affected watershed, stream, or lake. Data are needed to provide adequate input for both lake and stream modeling with an emphasis on event monitoring. To fit the modeling needs, automated samplers (or event sampling) need to be strategically placed, specifically, at the start of the impaired reach, at the end of the reach, and at least midway – or more – depending upon the length of the impaired reach. The use of automated samplers has the added benefit of providing stage information which is especially helpful when other flow data are unavailable. Precipitation quantity data, specific for the impaired reach(s)' watershed, is also needed. Local rainfall amounts contribute to a more accurate output from SWAT and other models. Thus, there is a need for more weather stations or official precipitation recording efforts in impaired watersheds.

Attention must be given to the requirements of TMDL models to ensure that the right parameters

are collected at the right times in the best locations. For example, the Stressor Identification process, developed by the TMDL & WQ Assessment Section staff in 2004, is a valuable tool in identifying the biological impairment of a stream and the causative pollutant(s) contributing to the impairment of the aquatic community. It requires various categories of data and watershed analyses, and often the data requirements are more than what is available. Unknowns have to be entered in those categories and that diminishes the defensibility of the tool's results. Chlorophyll and diurnal DO data are two needs that are specifically needed.

Agricultural stakeholder groups have increasingly emphasized the deficiency of the IDNR and TMDL monitoring programs to adequately assess the relative contribution of various tributaries to the impairment within a particular watershed. They would like to see which sub-watersheds are contributing the most towards nutrient or sediment impairments. Once identified, the NRCS and the Nonpoint Source 319 programs can work with producers in those areas for cost-share conservation or tillage practices that will assist in reducing the causes of the impairments.

Bioassessments for determination of health of the aquatic life community provide valuable data for 303(d) listing, TMDLs, and Stressor Identification. Iowa could benefit significantly with more than one bioassessment conducted on an impaired stream within a 3-4 year time span. A greater number of streams receiving bioassessments conducted each year would also allow for seasonality and weather variances from year to year. Additionally, the lack of reference conditions for urban, general use, intermittent or 1st order streams, is also a significant major weakness. The Water Quality Standards program is currently reviewing use designations and will be re-designating general use streams. To support this effort and to better understand water quality in small and ephemeral streams for TMDLs, increasing Iowa's ambient monitoring of these types of streams would be of significant use.

Watershed surveys: These are surveys conducted in an impaired watershed to assess ground cover, amount of residue, tillage practices, conservation practices in place, grazing impacts, livestock confinements and open feedlots, etc. This information allows for insight in erosion susceptibility and causes of impairment for the TMDL. These surveys are accomplished currently either by trained staff in the TMDL program or by contract-hire through the nonpoint source 319 program. The TMDL program needs this capability over the long term and throughout the state.

<u>Waters in need of further investigation</u>

As provided for in Iowa's credible data law, the department develops and maintains three separate listings including a Section 303(d) list, a Section 305(b) report, and a listing for which further investigative monitoring is necessary. This list, also know as the list of waters in need of further investigation or "follow-up list", is technically not part of the Section 303(d) process in Iowa and includes waterbodies where limited information suggests, but does not conclusively (credibly) demonstrate, a water quality impairment. If the results of further investigative monitoring demonstrate, with credible data, that a water quality impairment exists, the affected waterbody can be added to Iowa's Section 303(d) list (i.e., Category 5 of the Integrated Report).

The state list of waters in need of further investigation is comprised of those waterbodies assessed (evaluated) as "impaired" in subcategories 2b and 3b of the Integrated (305(b)/303(d)) Report. The determining factor for placing an impaired waterbody on the state's Section 303(d) list versus on the WINOFI is the type of assessment developed: "evaluated" versus "monitored":

> **Category 2b: At least one use assessed as supported with at least one other use "evaluated" as "impaired."** An "evaluated" assessment of impairment lacks sufficient confidence to take forward to either Category 5 (Section 303(d) list) or Category 4 (impaired but TMDL not required). This subcategory allows tracking of the "impaired / evaluated" waterbodies (e.g., a biological assessment of impairment based on either (but not both) fish and macroinvertebrate IBI values).

> **Category 3b: Insufficient data exist to determine whether any designated uses are met, but at least one use is potentially impaired based on an "evaluated" assessment.** This category is similar to IDNR's Category 2b, but no other uses are assessed as "fully supported" or "fully supported / threatened" (i.e., the only use assessed is the one assessed as "impaired/evaluated." Similar to IDNR subcategory 2b, this subcategory allows tracking of the "impaired / evaluated" waterbodies.

According to U.S. EPA's 1997 guidelines for Section 305(b) reporting, **evaluated assessments** are those for which the use support decision is based on water quality information other than current site-specific data such as data on land use, location of sources, predictive modeling using estimated input values, and some questionnaire surveys of fish and game biologists. As a general rule, if an assessment is based on older ambient data (e.g., older than five years), the State should also consider it "evaluated." For example, water quality assessments based on results from only a few grab samples, otherwise incomplete data, or on best professional judgment of local biologists would be considered "evaluated" assessments. In contrast, **monitored assessments** are those waterbodies for which the use support decision is principally based on current, [five years old or less] site-specific ambient monitoring data believed to accurately portray water quality conditions. Waters with data from biosurveys are included in this category along with waters monitored by fixed-station chemical/physical monitoring or toxicity testing. To be considered "monitored" based on fixed station chemical/physical monitoring, waters generally should be sampled quarterly or more frequently.

In terms of the ability of Section 305(b) assessments to characterize current water quality conditions, IDNR considers "evaluated" assessments as having relatively lower confidence while "monitored" assessments are of relatively higher confidence. IDNR considers "monitored" assessments as sufficiently accurate to be appropriate for both Section 305(b) assessments and Section 303(d) listing (i.e., for placing waters into Category 5 of the integrated report). The lower confidence "evaluated" assessments, however, are viewed as appropriate only for Section 305(b) reporting. Thus, any waters assessed (evaluated) as "impaired" are identified as having "insufficient data" to determine whether beneficial uses are met and will be placed in

Subcategories 2b or 3b (i.e., categories for waterbodies with insufficient information) of the integrated report/list.

Strategy to address gap: The primary reason that waters are placed on the list of waters in need of further investigation is not a lack of monitoring but a lack of assessment protocols, including a lack of water quality criteria in the *Iowa Water Quality Standards*. IDNR currently lacks assessment protocols for the following waterbody types and potential impairments that appear on Iowa's list of waters in need of further investigation:

- **impairments of general use-only streams based either on results of biological or chemical monitoring:** The majority of waterbodies potentially impaired by "unknown causes" on Iowa's follow-up list are general use-only waters where results of either biological or chemical monitoring are inconclusive.

- **impairments of aquatic life uses in Iowa's lakes, rivers, and streams due to nutrients:** Considerable data exist on nutrient levels in these waterbody types; however, protocols for using these data to conclusively demonstrate impairment of aquatic life uses do not yet exist.

- **impairments of aquatic life uses in Iowa's lakes, rivers, and streams due to siltation:** Siltation remains one of the most difficult parameters to quantify, especially in ways that are relevant to developing assessments of support of aquatic life uses. Although identifying impairments at Iowa's impoundments due to lake volume lost to accumulated sediment would appear to be straightforward—and is a major concern of the IDNR Fisheries Bureau—no protocol yet exists for systematically identifying such impairments. This type impairment remains based on "best professional judgment" of IDNR field staff. Siltation impacts to aquatic life uses in wadeable streams have been identified based on results of detailed habitat assessments conducted as part of IDNR/UHL biological monitoring projects (e.g., biocriteria development and REMAP projects). Despite this attempt at quantification, the decision to identify "siltation" as a stressor remains largely a "best professional judgement of IDNR staff. Siltation impacts in non-wadeable streams and rivers—although generally perceived to occur—are difficult to quantify. Thus, any identification of "siltation" as a cause of impairment in non-wadeable streams is based strictly on "best professional judgment."

- **impairments of aquatic life uses in Iowa's rivers and streams due to habitat alterations:** Waters on Iowa's follow-up list with potential impairments due to "habitat alterations" are primarily general use-only waters where biological data suggest a potential impairment.

- **impairments related to presence of bluegreen algae (cyanobacteria) in lakes, streams, and rivers, including aesthetic impacts and potential impacts from cyanotoxins:** Although a relatively large amount of data exist on biovolumes of bluegreen algae at Iowa lakes, no protocol exists for using this information to conclusively demonstrate impairment of designated uses. The emerging issue of cyanotoxins may provide a means of more conclusively demonstrating impairments due to bluegreen algae. Currently, the only cyanobacteria-related impairment that is appropriate for Section 303(d) listing, is the closing

of lakes or their beach areas due to high levels of cyanotoxins measured in lake water. Monitoring of cyanobacteria and cyanotoxins may need to be expanded to other waterbody types (e.g., streams and rivers).

- **impairments to the variety of Iowa wetland types from siltation, nutrients, and exotic species (plants and animals) or other stressors:** Assessment protocols do not exist for identifying impairments of aquatic life uses at Iowa wetlands; thus no wetlands appear on Iowa's 2004 Section 303(d) list. All current assessments of Iowa wetlands are based on "best professional judgment" of IDNR field staff. Ideally, an assessment protocol for wetlands should be developed prior to the implementation of a routine ambient monitoring network for this waterbody type.

Although not a part of the state list of waters in need of further investigation, a number of stream and river segments were placed in Category 5b of Iowa's Section 303(d) list without a complete understanding of the nature of the impairment. These waterbodies fall into three general groups:

1. Stream/river waterbodies assessed as impaired due to declines in species richness of the freshwater mussel community. Based on the available published information, declines in species richness at all sites were attributed to three stressors: siltation, nutrients, and habitat alterations; the site-specific stressors remain unknown. Until a more detailed understanding of the cause of declines in Iowa's freshwater mussel community exists, additional monitoring will likely be of little use in terms of addressing this impairment.

2. Stream/river waterbodies assessed as impaired and added to Iowa's Section 303(d) list due to pollutant-caused fish kills where no source of the pollutant (e.g., responsible party) was identified. Identifying a pollutant source in such waters depends on the occurrence of an additional kill or kills and a potentially intensive follow-up investigation (e.g., Elk Run Creek in Carroll County).

3. Stream/river waterbodies assessed as impaired on the basis of biological monitoring for fish and aquatic macroinvertebrates where no cause of the impairment was identified.

<u>Follow-up Monitoring for Completed TMDLs:</u>
The IDNR began developing TMDLs in 2000. Monitoring on completed TMDLs is necessary to document changes in water quality where TMDLs have been completed and implemented. By following adaptive management techniques, the TMDL targets and/or implementation plan can be modified to better achieve water quality improvements based on monitoring results following the completion and implementation of the TMDL. Documenting improvements in water quality validates the TMDL program and can result in water bodies being removed from the 303(d) list.

Strategy to address:
The follow-up monitoring phase should represent a decrease in monitoring effort following the intensive work to identify the impairment, determine potential sources and contributing areas, and get flow data. Therefore the overall monitoring plan for a waterbody TMDL should consist

of a scaled down follow-up monitoring plan. Funding for this effort may be available through the traditional sources of TMDL monitoring including EPA grants or through innovative partnerships with local stakeholders.

Outlook to address:
To partially fund follow-up monitoring and make it a priority monitoring, the TMDL & WQ Assessment Section applied for and received 104(b)(3) grant funding for 2005. The monitoring will include: lake monitoring, stream biological assessments, and bathymetric mapping. Continuation of this follow-up assessment of TMDL waterbodies must be included in each year's monitoring plan. Follow-up monitoring at a few other TMDL sites have also been incorporated into the routine monitoring program.

Gap 10) Special Studies or Research Needs

Sediment Oxygen Demand (SOD)
Low dissolved oxygen affects the aquatic life uses of some Iowa streams, as determined through water quality monitoring, diurnal datalogger monitoring, and the Stressor Identification process. One of the variables often missing in the evaluation of water column oxygen dynamics is sediment oxygen demand. SOD is the rate of oxygen consumption exerted by the bottom sediment on the overlying water of the stream. Substantial oxygen demand from the sediment can result in detrimental effects for aquatic biological communities, including fish kills and elevated stress to benthic macroinvertebrates. The TMDL & WQ Assessment Section has a 2005 104(b)(3) grant to continue its investigation of SOD, an ongoing project from the previous year contracted by the UHL. Measurement of SOD is achieved via a closed chamber system mounted in the streambed in which a multi-parameter probe with DO, temperature, etc. sensors are installed. Three TMDL/impaired streams are involved in the study in 2005 and with successful completion of the study, the method and equipment will be utilized for SOD monitoring on similar streams in following years.

Nutrients and Tile Flow
Nitrate values from tile outflows and modifications to the hydrology of the watershed by tile are additional areas needing further study. Nitrate values in water from tile outlets varies considerably from field to field and sub-basin to sub-basin, and while ISU has continuing research studies on this, general knowledge and understanding is still lacking. Modified hydrology, whereby surface water moves quicker and with greater velocity, is one of the most consequential causes for lack of biological integrity of Iowa streams. The loss of slow infiltration of precipitation into the ground water, the subsequent rapid movement off the field, and the straightening of creeks or construction of ditches, contributes to greater sediment and nutrients in the water and loss of habitat for the biological communities. Also, groundwater contribution to stream/rivers needs to be more clearly defined.

Cycling of Nutrients/Sediment
Internal recyling of sediment and nutrients is a major contributor of nutrient loading and impairment in lakes. Many of Iowa lakes collect sediment with attached phosphorus. Wave and wind action, plus internal movement re-suspends phosphorus and sediment. This internal recyling is a major cause of impairment and yet definitive data are lacking. Recycling of

phosphorous from bottom sediments is often significant and of unknown quantity. Development of TMDLs on these lakes is difficult without more information. The TMDL & WQ Assessment Section received a 104(b)(3) grant for 2005 to collect data, develop a hydrological history of the lake system, and develop a protocol to estimate phosphorous flux to the water column in shallow lakes. This assistance in developing specific procedures for estimating phosphorous flux loads from lake bottoms will be of long-term benefit to understanding the nutrient problems in Iowa's waterbodies and in the development of TMDLs in Iowa. Iowa State University is contracted to do this work.

Bacterial Source Tracking:

A significant number of impaired waters and TMDLs in Iowa are for pathogens. Microbial/Bacterial Source Tracking is a method used to identify sources of fecal pollution impacting a waterbody. Identification of the bacteria source – at least whether human or non-human – would be of significant assistance in the development of a TMDL and determining load allocations. The development of a state DNA library is expensive and difficult for state agencies to have funding to conduct bacterial source tracking in impaired waterbodies. New technology for fluorescence *in situ* holds promise as a suitable alternative to the more expensive DNA-based methods. Greater priority for addressing this is needed by both Iowa and EPA.

Strategy to Address:

The IDNR staff will develop a list of research or special study project needs (perhaps beyond what is listed here) and prioritize those projects based on the benefit to programs, how achievable the projects based on current funding and staff resources, and develop potential sources of funding to meet the needs. Special studies and research priorities are unlikely to be met with dedicated state funding, however it may be possible to leverage funding from several different sources within state, federal, or NGO organizations.

Outlook to address:

Good. Bacteria Source Tracking has already been implemented for several watersheds using grants and by partnering with other states and universities.

Sediment Source Tracking:

Tracking of sediment sources from the landscape and stream corridor is needed in order to better determine sediment's impact as a stressor for biological communities. In addition, EPA is likely to require clean sediment standards in the future and Iowa lacks the necessary data to determine healthy levels of suspended and bed-load sediments. Studies to characterize the sources of sediment and potential impacts on biotic communities are therefore critical.

Strategy to Address:

Pursue funding sources through 319, 104b, or other federal funding partners to support this work. Work collaboratively with the USGS, Corps of Engineers, and universities to develop analyses of sediment impacts on biological communities.

Outlook to Address:

Fair. Funding is limited, although some funding does exist through the TMDL program for stressor id work.

Part E: Program Weaknesses and Strategies

Weakness 1: Program Infrastructure for Program Evaluation, Reporting and Coordination

The current monitoring program has good leadership as well as a qualified, hard working and dedicated staff. In addition, that staff has done an admirable job organizing and managing a monitoring program that has experienced enormous growth over the past five years. However, because of its increased size as well as the changing / maturing nature of the program and strategy, the program requires significantly more time (especially from the managers) to fully organize, direct, evaluate and plan than it did in the past. This includes the time required to critically evaluate, revise, prioritize, implement and communicate the strategy to all necessary programs, management, the Iowa TAC and Iowa stakeholders groups. Without the necessary time to complete these program management and evaluation functions, the goal of developing a comprehensive, scientifically defensible monitoring program for the state is jeopardized. Other areas where this program infrastructure weakness is apparent include (but is not limited to) the following:

a) Evaluation of Water Management Programs
As part of the "Cycle of Resource Management Activities" (see Attachment 1, Diagram 1), the states, in conjunction with EPA, should periodically review its management programs and activities to determine if they are working to protect and restore water quality. This activity has been identified to be included as part of the 'Iowa Monitoring Strategy Revision Process (refer to the Iowa Monitoring Strategy Revision Process diagram within the current strategy, Section B, Program Strengths). However, the process to accomplish this evaluation as not been determined at this time and, no active dialogue on this issue has occurred between the state and EPA since Sept. of 2004.

b) Reporting
Even though Iowa plans to produce an Integrated (305b/303d) Report (IR) in 2006, this report would essentially be no more than an electronic data dump into the IR format (based on personal communication with John Olson) and thus, would be just an accounting of water bodies' attainment status. Although this is acceptable for the IR, the 'report' falls short of several state requirements (including the charge from the legislature) to produce information appropriate to the public, stakeholders, governor on the condition of the waters of the state. In addition, in light of the need to evaluate the effectiveness of management programs and the possible data analysis work that might be required to do that, it appears the state needs to significantly increase its capability and capacity to assess its data and produce informative reports in a variety of formats. In particular, the current 305b/303d report does not contain much information on volunteer based water quality monitoring efforts or groundwater monitoring and assessment. Without significant emphasis on reporting during the next PPA/PPG cycle, the water monitoring program runs the risk of facing the same criticisms that were voiced during the development of the new monitoring program – namely that the data already being collected were not being fully utilized

by the Department or the State Additionally, the data analysis and reporting element of the strategy should not merely limit itself to data collected by the Department, but should also attempt to incorporate compatible datasets.

c) Program Coordination

Despite significant recent improvements in coordinating the routine ambient monitoring program (especially with the TMDL and 303(d) programs), cross program coordination needs to be improved especially, relative to the water quality standards program. In particular, the water quality standards and monitoring programs must be more interactive and better utilize a feedback loop system which would ensure that monitoring the chemical, physical and biological components of aquatic systems results in more scientifically-based water quality standards and defensible determinations of use impairment. Specifically, the monitoring program should support the expansion and refinement of the state's designated aquatic life uses and the adoption of water quality criteria for parameters or conditions which are causing water quality impairments (e.g., biological criteria, nutrient criteria, suspended solids/siltation criteria). This is especially true for the list of approximately 400 lakes that have recently been added to Iowa's water quality standards. The standards program should assist the monitoring program to evaluate this list for both inappropriate water bodies (i.e., wetlands) and/or, to develop any additional monitoring data needs for this evaluation.

Strategy to Address the Weakness:

Delegate more operational details to staff in order to free up section and branch chief time for the higher level activities specified above. Hire staff to focus on reporting (and data crunching if needed). These staff could either be hired through traditional means (State FTE route) or could be contracted through appropriate vendors to address specific scientific questions. It is important that staff hired to do the data analysis and reporting be familiar enough with Iowa's water quality issues and data analysis techniques in order to minimize the amount of time needed to bring them up to speed on reporting. The recent combination of water monitoring and water assessment section staff into one section may also help to provide additional staff and or resources to accomplish some of the reporting goals.

By the end of October 2005, the water monitoring and assessment section staff will define the report products needed and develop an action plan consisting of the following elements:

- Number of staff or person-hours needed to complete the reports listed
- Identification of skill sets needed for each type of report defined
- Timelines for increasing reporting capability and capacity
- Identification of potential contractors, internal staff, or outside staff with required skill sets
- Plans for dissemination of the report information (hard copy, web, etc.)

2) *Validation and Refinement of Wadeable Stream Biological Indices and Reference Conditions*:

Iowa has developed a framework for evaluating the biological condition of Iowa's wadeable streams and rivers. The framework utilizes ecoregions, reference sites, and multi-metric biotic indexes (benthic macroinvertebrate and fish) to objectively measure stream biocondition and determine the

support status of aquatic life uses. However, the linkages between biological indices, physical habitat, and water chemistry need to be further investigated and quantified in order that bioassessment information can be more effectively utilized in water quality programs. The existing reference condition framework for wadeable streams should be refined by incorporating additional classification techniques that would ultimately lead to greater bioassessment sensitivity and reliability.

Strategy to address:
The Department will address the identified program weakness through additional data collection and advanced data analysis. Iowa will continue to collect biological, chemical and physical data through their enhanced monitoring network and continue the process of refining biological indices and quantifying relationships between chemical/ physical parameters and biological indicators. IDNR will continue using multi-variate data analysis approaches to strengthen their bioassessments including correlating nutrient levels and habitat measures such as sediment and channel morphology to these indices. Additional classification of reference conditions at the sub-regional scale (e.g., valley segment, reach) will be explored through multi-variate statistical analysis. The analysis will attempt to identify stream classes that could be incorporated along with ecoregions for an improved reference condition framework.

Outlook to address:
Good. The probabilistic (REMAP) stream survey initiated in 2002 will provide an unbiased, geographically comprehensive data set for application and refinement of biological indices. Stream physical habitat and water quality data combined with GIS watershed analysis tools can be used to further examine both local- and regional-scale relationships to biological indices.

The ambient monitoring program is supporting research by a M.S. student in the Natural Resource Ecology and Management Department at ISU. The focus of the research is relationships between watershed and riparian characteristics, stream physical habitat and biological assemblages (benthic macroinvertebrates and fish). Among the useful applications for these data, the project will help define which physical habitat variables are the most important to incorporate in long-term trend monitoring of Iowa's river and stream conditions. A Ph.D. research project that will utilize REMAP and other data sets to examine stream classification, reference conditions, and other bioassessment issues is being developed.

3) *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.*
Because Iowa is a highly modified landscape, there is generally a lack of undisturbed reference sites for almost all of the resource classes. This is especially true for the large non-wadeable streams, most of which flow across ecoregion boundaries and embody the cumulative impacts of a wide variety of human activities and pollution sources. The difficulty in defining reference sites and measuring reference biological conditions for the larger rivers are a major concern as they directly affect the state's ability to properly assess the condition of these resources.

Small, (headwater) perennial streams are another resource class needing reference condition development work. By some estimates, more than 50% of Iowa's perennial streams are not

currently designated for aquatic life uses. IDNR has proposed revisions in their water quality standards that would result in many new designated stream segments. The task of characterizing reference conditions is even more challenging in headwater streams because the systems are highly dynamic and variable in space and time. Data collection and analysis strategies need to be carefully designed to deal with this issue.

Cold water streams are a highly valued resource that currently lack biological indicators tailored for the unique biological assemblages they support. Many biological metrics developed for warm water streams do not respond the same way in cold water streams. Application of Iowa's warm water IBI's, particularly the fish IBI, can result in erroneous assessment conclusions. Additional data collection and analysis work is needed to complete the reference condition framework for cold water stream assessment.

Strategy to address:
The R-EMAP streams project may help refine reference conditions for wadeable streams by obtaining data from at wadeable streams at new sites and in new areas. And, the R-EMAP wetlands project will assist with the process of defining reference wetlands. However, the strategy is much less developed for larger non-wadeable streams and headwater streams but may include; the use of GIS tools to identify and locate point source and non-point sources, identify appropriate land use land cover types and, to identify stream segment types (such as MoRAP's valley segment work); take observations and recommendations from field agents regarding new sites and watersheds to sample for possible reference conditions. Because the REMAP probabilistic survey is a comprehensive sample of all interior perennial streams, it is likely that some potential reference sites and reference condition data can be gleaned from this large data set.

In regard to chemical criteria, Iowa is working with the RTAG work group facilitated by Region 7 and the Central Plains Center for Bioassessment (CPCB) at Kansas University to develop draft nutrient criteria for lakes and streams.

In regard to non-wadeable stream methods, possible strategies that were discussed were; adaptation and application of Iowa's wadeable stream methods or other agency methods (e.g., EMAP, ORSANCO); tasking CPCB to synthesize information about tools and indices being used by other states in the Midwest on non-wadeable streams. In 2005, bioassessment work planned by the Department includes refining sampling procedures and data analysis methods (i.e., biological indicators) for headwater streams and non-wadeable rivers. Guidelines for identifying and screening reference sites will also be done in 2005. Once sampling and data analysis procedures have been established, future work will concentrate on the identification and sampling of candidate reference sites for headwater streams and non-wadeable rivers.

Outlook to address:
The outlook is good with respect to streams and rivers. A solid foundation is in place for wadeable streams and these concepts and techniques are being transferred to other stream resource types in need of reference condition work. Ongoing data analysis, including advances in stream classification and GIS analysis will improve the definition and verification of reference conditions.

The outlook for lakes, non-wadeable rivers, and wetlands is fairly good from the standpoint there are

projects underway that can contribute toward the goal of characterizing reference conditions. However, with each of these aquatic resource categories, a considerable amount of time and expertise must be devoted to developing the basic reference condition framework (e.g., regions, reference sites, resource classes/strata and indices) for establishing reference conditions.

4) *Data Management:*
The water-monitoring program has implemented a wide variety of monitoring activities on a short timescale. Much attention has been given to the monitoring design, collection of good data, and successful data management. Iowa has been very successful at migrating collected data into STORET, however retrieving data from the system is more difficult. Retrieval of large volumes of data, complex queries, or repeated retrievals can be cumbersome, especially to novice users.

Production of information on water quality for the public is one of the strengths of the program. However, the synthesis and analysis of data for more technical reports has not been a top priority given the need to get the water monitoring program operating. This need to produce more in-depth analysis of the data are becoming critical as the state attempts to deal with issues such as nutrient criteria, TMDL development, and the emphasis on numeric water quality standards. As the volume of volunteer monitoring data continues to increase, the pressure to incorporate this data into statewide assessments of water quality also increases.

Data base tools for organizing, plotting, querying, etc. are needed by the TMDL and other programs. These tools should feed smoothly into statistical analysis packages, GIS layers, and models and be able to acquire data directly from STORET, which is used by Iowa. Various scales of land use and land cover data in GIS coverages will be needed for watershed level and statewide analyses for a variety of issues. NRCS development of Iowa SSURGO soils information is needed for dependable watershed modeling and as an aid to the TMDL program. Valuable DNR resources are and will be used to convert existing county soil maps into SSURGO-like information for modeling. Completion of NRCS SSURGO for Iowa would help the TMDL program. It would also help develop land use and cropping practice information if FSA data was digitized and available in a GIS format. Joint development of shuttle imaging radar elevation data would be useful for watershed analyses.

Strategy to address:
Data management: Utilize current DNR staff to continue development of data retrieval applications and web-based data management tools. Develop a data warehousing structure to facilitate faster data retrieval and the ability to save queries. Follow EPA's lead by contracting with third-party vendors (such as Gold Systems, Inc.) to improve the data management of STORET. Continue to work with EPA to fix bugs within STORET and advocate for the development of additional capabilities within the database.

Data analysis and reporting: The water monitoring section will continue to produce fact sheets to provide information on the program and water quality issues in the state. However, resources will be shifted to place a stronger emphasis on the writing of technical reports, which will require more time to be spent on the development of assessment methodologies and analysis tools. If FTEs are not available within DNR, reliance upon contracted labor from the USGS, UHL, university researchers, and temporary staffing agencies will be investigated. The water monitoring section is

also working to develop short-term scientific task force or workgroups to analyze specific issues. These task forces draw upon existing knowledge and expertise in a flexible system that minimizes the amount of work for any one individual while increasing the defensibility of the analysis in the end. EPA will continue to explore opportunities to help with this issue, but state resources will still be a concern.

Outlook to address:
Data management:
Moderate to good chance of success in improving the data analysis and interpretation depending upon the ability to find and hire qualified scientists or to develop functional workgroups.

Part F: Opportunities to Improve the Monitoring Program

1) *Parameter Coverage*:
In general, Iowa's chemical, physical and biological parameter coverage for the resources being monitored is fairly good. However, the following parameters were identified as desirable additions to the program should the resources become available:

a) Fish tissue at the current urban stream locations, plus some additional urban locations.
b) Persistent Bioaccumulative Toxics (PBTs) in water, sediment and fish tissue at, a minimum of a sub-set of all the ambient sites. This list includes but is not limited to; mercury and other metals, pesticides and their degradates, arsenic, antibiotics, PAHs (at coal tar sites).
c) Periphyton at the stream reference sites.
d) cyanobacteria, viruses and parasites at public beaches (limited progress on this in FY04 and FY05)
e) Replacing measurements of some pesticides and metals that were dropped due to funding cuts in FY05 and FY06

Strategy to address:
The Iowa technical committee includes USGS and could work to establish a state-wide network of sites to look for these parameters. The state-wide network could also include an air deposition component to address gap #6. Work with research scientists within the state's universities and colleges to build the capability to analyze these parameters on a limited basis. Additionally, municipal water utilities are interested in developing techniques to analyze for some of these parameters in order to better predict future issues regarding water safety and potential regulations. The state can also examine both the states pesticide application records to make a parameter list of pesticides commonly used in bulk and, the 94/95 Region 7 R-EMAP data to eliminate pesticides with only a few detections. Targeting of parameters is also feasible based on the historical frequency of detection or other models to focus monitoring when contamination is likely to occur.

In addition, the EPA Region 7 Fish tissue monitoring workgroup is currently working on expanding both the number of fish tissue samples being collected as part of the RAFTM program and, on adapting and expanding the parameters of interest (including dioxins-furans and PBDE).

Outlook to address:
The outlook for this weakness is very optimistic given the current level of cooperation between the state and various researchers. Municipal utilities are moving forward to develop techniques on a

very limited basis for cyanobacteria and viruses within the drinking water source water areas.

***2) City and County Owned Beaches*:**
The state has an unknown quantity of city- and county-owned beaches for which, the quality and quantity of monitoring is also largely unknown. Although the state has an interest in these types of beaches there are questions to be resolved about who has responsibility for monitoring them. Despite these questions the state will attempt to develop an inventory of these beaches.

Strategy:
In 2004, Janice Boekhoff, the former Iowa Beach coordinator, contacted county conservation boards for records on county and city beaches. A comprehensive list of county beaches was developed based on her inquiries. During 2004, county officials collected samples and sent samples to UHL for analysis. DNR covered the costs of shipping and analysis. Negative publicity caused a few of these counties to drop out of the program in 2005, but several counties and cities joined also joined the program in 2005. DNR will continue to help offset the costs of analysis in counties that wish to participate, but will also investigate the use of IDEXX Colisure test kits by individual counties to reduce the overall cost of the program.

Outlook for success:
Guardedly optimistic

3) *Adding Historical Biological Record to Assessments:*
Over the course of its historical settlement, the state has lost a significant quantity and quality of its aquatic biological resources. IDNR and EPA staff agreed there would be value in adding a historical biological component to the state's aquatic assessments as a means to gain a long-term perspective on the current status of these resources.

Strategy:
Use grant money to fund a graduate student to pull together and produce a report on historical aquatic biological resources of Iowa.

Outlook for success:
It is difficult to predict the possible success of this effort as it may be based on numerous unpredictable factors such as existence of and access to relevant data, researcher thoroughness, etc.

Part G: Root Causes of Program Gaps and Weaknesses

The primary root cause of most of Iowa's monitoring program gaps and weaknesses is a lack of sufficient budget and staff to cover all the demands made of monitoring at all the spatial scales of interest. These demands include but are not limited to: point source monitoring, non-point source monitoring, 305(b) monitoring of all resources for status and trends, TMDL's, 303(d) impaired waters, standards development, biocriteria development, reference conditions, etc. Despite a much-improved annual budget and an improved overall program, the level of resources currently provided to the program will in all probability, not be sufficient to fill all the gaps and weaknesses identified

in this report.

Another important root cause of some of Iowa's monitoring program gaps and weaknesses is a lack of adequate reference conditions for some of the resource classes.

A secondary but important root cause is the lack of sampling and assessment guidance (including lack of biological indicators) and staff expertise; no inventory of the resource; no existing characterization of reference conditions.

Root causes of gap big rivers:
Resource limitations (staff time and funding); lack of sampling and assessment guidance (including lack of biological indicators); staff expertise and lack of proper large river equipment; technical challenges sampling large rivers; difficult to characterize appropriate reference conditions.

Root Causes of gap public lakes:
Resource limitations (staff time and funding); competing priorities; lack of sampling and assessment guidance; staff expertise; difficult to characterize appropriate reference conditions; lack of biological indicators.

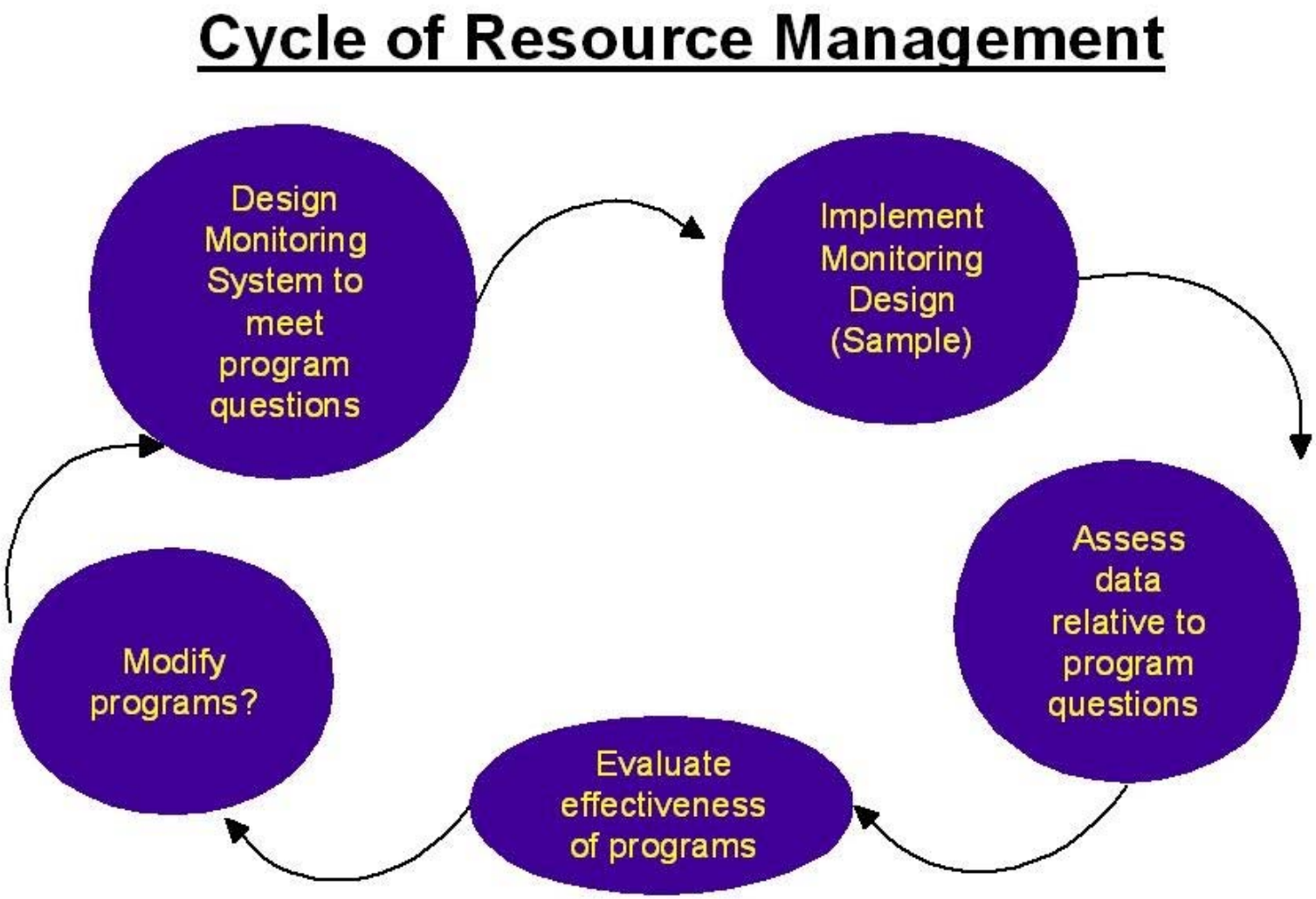
Root Causes of gap intermittent streams:
Resource limitations (staff time and funding); competing higher priorities; difficult to characterize appropriate reference conditions; lack of biological indicators.

Part H: Accomplishments

1) **Successful Development of a Volunteer Monitoring Program**
2) **Beach Monitoring**
3) **Successful Implementation of STORET and ArcIMS data retrieval**
4) **Annual Conference and Fact Sheets**
5) **Comprehensive Monitoring of Iowa's Significant Publicly Owned Lakes**

6) Expanded Monitoring of Iowa's Streams

Attachment 1, Diagram 1



Matrix Table 1: Summary of Iowa Water Resources and Annual Ambient Monitoring Program

Resource Category	# of waterbodies segments or HUCs	# of sites sampled/ frequency	Monitoring Design(s) Used	Types of Monitoring Conducted	Adequate Parameter Coverage	Adequate Bio. Monitoring Tools & Indices	Adequate Reference Conditions/ #of sites /sampled
Rivers/ Streams (total)	1519	141/ yr.	combination	(see below)	Y	(see below)	(see below)
Perennial interior(total) at large cities HUC 8s	1500 10 56	225 (60/yr) 23/ yr 58/ yr	P T T fixed station	B(2), WC, SC, FT, H, G, M B(2), WC, SC,? FT, H, G, M B(2), WC, SC?, FT, H, G, M	Y Y Y	Y Y Y	Y / 109/ 20 per year
Border (big) Rivers	19	**0**	NA	FT	NA	**N**	**N** / 0 / 0
Intermittent Streams	unknown	**0**	NA	NA	NA	N	unknown/ 0 / 0
Lakes	660	**132**/ yr	combination	(see below)	(see below)	(see below)	(see below)
significant public lakes	115	**115**/yr	C	B(1), WC, SC, FT	Y	**N**	**N**
nonsignif.public lakes pvt. lakes w/pub access	533 12	**17** **0**	T NA	B(1), WC, SC NA	Y NA	**N** NA	**N** NA
Farm Ponds	9,000	0	NA	NA	N	**N**	**N**
State owned beaches	37	35/ weekly	C	WC, M	Y	NA	NA
County/City Owned	50/?	28&1/wkly	T	WC, M	Y	NA	NA
Flood Control Reservoirs	4	4/ monthly	C	B(1), WC, SC, FT			
Wetlands	unknown	60	P	B(3), WC, SC, H	NA	**N**	**N**
permanent/semi-perm.	Unknown (new NWI 2007?)	60	P	B(3), WC, SC, H	NA	**N**	**N**
temporary	unknown	**0**	NA	NA	NA	**N**	**N**
Ground water	NA	150/ yr.	T, C	WC, G	Y	NA	NA
Runoff	7	12+event	T by ecoregion	WC, G	Y	NA	NA
Precipitation	NA	**0**	NA	NA	NA	NA	NA

Monitoring Design
P = probability;
C = census
T = targeted
O = other

Type of Monitoring
B() = biological (# of indicators used)
WC = water chemistry
SC = sediment chemistry
FT = fish tissue

Adequate
Y = yes
N = no

NA = not applicable

CR = census (rotating sites)

H = habitat
G = gaging (quantity or water level)
M = microbiological

Attachment 2
Iowa Color Infrared Digital Orthophotography Project
Planned Wetland Applications

The National Wetlands Inventory (NWI) for Iowa was based on 1:58000 color infrared photography acquired circa 1985. The majority of wetland restoration and construction work in Iowa did not begin until the early 1990s. The DOQQs produced by USGS as part of the National Digital Orthophotography Program (NDOP) were based on several NAPP flights ranging in time from 1990 to 1997, with the majority of coverage coming from flights prior to 1995. As such, we have not had access to a source of digital ortho-rectified photography to serve as the base map for mapping restored and constructed wetlands.

Wetland restoration projects have been conducted through a variety of private lands programs, water quality improvement projects (EPA 319 funding), conservation easements (most notably the wetland reserve program), mitigation projects, and via land acquisition programs targeted at purchasing lands for wetland restoration. On-site investigations using GPS technology would provide the needed information, but we have been unable to garner resources for monitoring of wetlands. The monitoring activities that do take place (such as are required for mitigation projects) have been difficult to coordinate.

Several wetlands tracking projects have been underway for a number of years now. We rely primarily on initial planning documents to estimate wetland location and size. We frequently find that the wetland that is constructed varies considerably in size, depth, and water regime from the initial plans, but scant information is available regarding specifications for what was actually constructed or restored.

The Iowa Color Infrared Digital Orthophotography Project (ICIDOP) will provide the needed digital ortho-rectified aerial photography to serve as the base map for more detailed wetlands mapping efforts. Color Infrared (CIR) photography will be acquired between March 10, 2002 and May 10, 2002. The photography will be 1:40,000 scale and will meet all standards and specifications of the National Aerial Photography Program (NAPP). Through a work-share agreement with the U.S. Geological Survey (USGS), the USGS NAPP laboratory in Reston, Virginia will inspect the film to ensure that it meets NAPP standards, and direct re-flights as necessary. USGS will also archive the original film.

The Digital Orthophoto Quarter Quadrangles (DOQQs) produced from the photography will be 1-meter resolution and will meet all standards set by the NDOP program. The USGS Mid-Continent Mapping Center located in Rolla, Missouri will inspect the DOQQ products. All DOQQs are scheduled to be delivered no later than April 1, 2003. (This schedule allows for delays in acquiring the photography. As of July 1, 2002, 100% of the state has been photographed and delivery of the images is months ahead of schedule). Further technical details related to the photography and resulting digital products are available upon request.

The U.S. Fish & Wildlife Service (USFWS) Private Lands Program established a highly effective wetland restoration program in the early 1990s. Wetlands were restored largely on conservation reserve program (CRP) lands under a 10-year agreement. We have mapped more than 90% of the wetlands restored through this program. Wetlands were mapped based on planned restorations identified in the agreements signed by the land-owners. Many of the contracts have expired over the last several years, but biologists estimate that as few as 10%-20% of those wetlands have been reverted to agricultural land uses. The CIR DOQQs will be used to assess status of all of these wetlands at a single point in time. We will be able to document how many have remained on the landscape after expiration of the agreement. We will also be able to accurately map the remainder of them before the agreements expire. Through similar efforts in the future we expect to demonstrate that this program has had a much longer impact on the Iowa landscape than the 10 years covered by the signed agreements.

The USDA Wetland Reserve Program (WRP) has been extremely effective in Iowa. More than 900 conservation easements have been recorded through the combined WRP and Emergency Wetland Reserve (EWRP) Programs. The majority of the easements include wetland restoration and construction projects. We have digitized more than 95% of the easement boundaries. The CIR DOQQs will facilitate the first statewide effort to assess the status of wetlands constructed on those easements. Wetland construction records are kept in the local field offices and have not yet been compiled. This mapping effort will be very useful in demonstrating the results of the program and the cumulative impact it is having in terms of adding wetland acres to many areas across Iowa.

The greatest amount of wetland restoration work has been done on public lands acquired since 1990. Purchasing lands for wetland restoration and waterfowl production has been a priority for the Iowa Department of Natural Resources and the USFWS. We have been mapping parcel boundaries as lands have been acquired, but we have not mapped wetlands restored on those areas. Wetland restoration records are kept at the local management units and have not been centrally compiled aside from summary statistics such as numbers of basins and total acres. The DNR's wildlife bureau has dedicated a technician position to the task of working with individual management units to reconcile their records with the restored wetlands mapped on the 2002 CIR DOQQs.

The Iowa Department of Transportation (DOT) identifies wetlands that are altered during road construction projects and also identifies associated mitigation efforts. The DNR has an ongoing project with DOT to create a GIS data set showing all of the wetlands restored through DOT mitigation projects. Additional mitigation efforts associated with the 401 permit program are also being mapped. While the DOT acquires high-resolution aerial photography for the areas along the construction projects, the mitigation projects are generally outside the area covered by the project photography. The CIR DOQQs will allow us to better map the wetlands and to better assess the overall success of the mitigation program. We would like to perform a similar project related to wetland mitigation projects associated with the 404 permit program administered by the U.S. Army Corps of Engineers, but we have not been successful to date in gaining access to the necessary paper records.
In 1991, an inventory was conducted to identify the remaining significant wetlands located on private lands. The effort was stimulated by draft legislation that would afford these remaining privately owned wetlands some protection under Iowa law. Protection of these wetlands via legislation never really materialized, but the DNR has a continued interest in protecting these wetlands through other programs such as land acquisition and conservation easements. These wetlands have been digitized from the existing black & white DOQQs from the early 1990s. The 2002 CIR DOQQs will allow us to assess the status of these wetlands 10 years following the inventory.

Impounded acres in the southern half of Iowa continue to increase. Farm pond construction has continued at a similar rate over the past 10 years. Dams constructed to create sediment retention basins are a primary practice within watershed projects funded through the EPA's 319 program. Larger dams require a permit and legal descriptions are maintained in a database for these impoundments. The DNR recently completed a project to locate all of these impoundments and augment the legal description with a more accurate geographic coordinate. Since many of these dams were constructed after the date of the currently available DOQQs, we have not yet mapped the area impounded by the dam. We will map these areas once the CIR DOQQs are available. We are currently investigating how we might map all of the impoundments constructed since the date of the photography used to produce the national wetlands inventory.

The cumulative impact of all of these programs is difficult to entirely understand without mapping them explicitly. Updated photography combined with past inventory allows us to assess wetland loss as well. The impacts will vary based on the spatial scale of the analysis. Iowa DNR has recently completed the 10-digit hydrologic units (HUCs) for the state and have a working version for the 12-digit HUCs. These watershed boundaries provide us a new, and likely more meaningful, set of geographic units for analysis of impacts of these programs on sediment reaching Iowa's lakes and streams, on lessening the duration and extent of flooding, and on regional wildlife populations. As we continue to define new boundaries and spatial scales of analysis, whether they are based on political or ecological criteria, we realize that we need explicit maps of wetlands and all surface waters to allow scientists and land managers to make the best use of the information. The Iowa Color Infrared Digital Orthophotography project represents a significant step toward that goal.

Attachment 3
PROJECT PLAN FOR ESTIMATING THE CONDITION OF
IOWA'S PERMANENT AND SEMI-PERMANENT WETLANDS

Resource Management Objectives

The ultimate goal of this wetland monitoring system is to positively affect the quantity and quality of data and information available for the effective protection and management of all of Iowa's wetland resources by enabling the following activities:
1) a periodic assessment (status and trends) of the condition and stressors of Iowa's wetlands,
2) an assessment of the effectiveness of wetlands toward meeting nutrient management goals,
3) the setting of appropriate water quality and biological standards for wetlands protection.

However, this project will only focus on the accomplishing the tasks necessary to complete resource management objective 1 and, only for the stated population of interest. Other tasks to accomplish resource management objectives 2 and 3 and to address temporary wetlands will be linked to and addressed in Iowa's Water Monitoring Strategy, which will be attached to the QAPP.

Technical Tasks and Methods

Task 1) Develop an inventory of all Iowa's wetlands

Method: The first task of this project will be to update and supplement the National Wetlands Inventory (NWI) database that identifies and classifies existing wetlands in the state. This project will build upon an existing initiative in the state to re-inventory existing wetlands and geographically locate and define these wetlands using remote sensing techniques. The Iowa Color Infrared Digital Orthophotography Project (ICIDOP, attachment 1) will provide the needed digital ortho-rectified aerial photography to serve as the base map for more detailed wetlands mapping efforts. Color Infrared (CIR) photography will be acquired between March 10, 2002 and May 10, 2002. The photography will be 1:40,000 in scale with 1 meter resolution scale and will meet all standards and specifications of the National Aerial Photography Program (NAPP). The current National Wetlands Inventory (NWI) was completed in 1984, prior to the implementation of many wetland restoration activities in the state. IDNR's remote sensing staff will visually examine the CIR photography to determine the status of wetlands catalogued in the 1984 NWI (present, absent, indeterminate). This effort will only focus on the wetland population of interest (permanent and semi-permanent) and does not attempt to revise the temporary or seasonal wetlands database. The CIR photography will then be compared against state records of restored or constructed wetlands (permanent and semi-permanent) to determine their existence (present, absent, indeterminate), location, geographical extent of open water, and, if possible, NWI classification (forested, emergent, shrub). The CIR project also includes an extensive ground-truthing component, which will assist with the identification of wetlands using remotely sensed techniques. The methodology used to update the NWI for permanent and semi-permanent wetlands, including the ground-truth data acquisition, will be explained in greater detail within the QAPP. Plans to update the NWI for temporary and seasonal wetlands will be identified in Iowa's Water Monitoring Strategy.

The revised database from this task will provide the sampling frame from which to select candidate wetlands for R-EMAP probability-based monitoring. The candidate wetlands will be selected from the permanent and semi-permanent wetlands categories.

Task 2) Develop a set of wetland sampling methods

The second task of this project is to develop a set of wetland sampling methods for Iowa. This project will develop these methods, while providing baseline data regarding the basic chemical, physical, and biological status of Iowa's permanent and semi-permanent wetland resources. The baseline data would then be used to track changes in Iowa's wetlands as the sampling regime and an assessment methodology are repeated over time. The wetland data could also be used to supplement the existing probability-based stream-monitoring program to assess the watershed health within and across eco-regions.

There are five proposed sampling components: 1) Water Chemistry, 2) Water Contaminants, 3) Sediment Quality, 4) Biological Community Composition, and 5) Physical Setting/Habitat. Water quality samples from wetlands will be tested for nutrients, metals, and pesticides along with standard water chemistry parameters (pH, dissolved oxygen, conductivity, etc.). Shallow sediment cores from the wetlands will be tested for sediment composition and quality (nutrients, pesticides, and metals). Physical habitat including surrounding land use and disturbance factors will be observed and recorded. The hydrogeology of the wetland will also be investigated to determine the geological setting, general groundwater flow path, and the stratigraphic framework. Biological monitoring will be conducted and could include potential indicators such as, types and abundance of emergent vegetation, macro invertebrate diversity, amphibian population, fish population, diversity and malformations of fish or amphibians. Chemical contaminants such as metals and pesticides/herbicides will be selected by the Project Coordinators reviewing relevant Regional data for prevalence of contaminants and in consultation with a Technical Committee. The final list of these chemical constituents will be provided within the QAPP. Final selection of biological parameters to sample will be based upon technical committee recommendations as described below.

Method:

This project will develop chemical, biological and habitat sampling methodologies by assembling a Wetland Monitoring Technical Advisory Committee (see "Project Participants and Partners") to collect and review appropriate guidance manuals or SOPs from sources such as Jackson et.al, the BAWGG web site and by contacting knowledgeable program individuals in surrounding states such as Ohio, Minnesota and Illinois. The technical committee will provide recommendations to the IDNR and EPA Region 7 Project Coordinators (as well as to the EPA ORD Project Officer) regarding most appropriate sampling methods, any necessary adaptations to those methods and, the most appropriate biological indicators. Sampling methods and indicator appropriateness will be evaluated based on relativity to both the stated monitoring and assessment objectives, the resource management objectives of this project and, their use by citizen volunteers. These recommendations will be provided within six months of the approval of this proposal. Final selection of chemical, physical and biological parameters as well as monitoring methods will be detailed in the QAPP and may be influenced by limitations of the project budget.

Professional biologists and water quality specialists will train volunteers to do all the sampling for this project, to perform standard water testing procedures and make field observations on wetland conditions and surrounding landscape factors. A professional crew leader will supervise all volunteer teams. A 10% subset of wetlands will be re-sampled by professionals to determine the quality of volunteer's measurements.

Task 3) Assess Water and Sediment Chemistry

Method:

The first assessment task for this project will be to establish an estimate of wetland health relative to the chemical condition of the water and sediment. This will be accomplished by plotting the cumulative distribution function (CDF) of the concentration of each of the contaminants from all the sites. The CDFs will be compared to applicable state water quality standards and or scientific literature values for threshold and probable effects levels to aquatic life. This comparison will permit assessment estimates (with known confidence boundaries) to be made such as, "25% of the wetlands of Iowa did not meet the minimum dissolved oxygen concentration value of 3.0 mg/l." Region 7 has much experience performing this type of analysis such as in the 94/95 Region 7 R-EMAP study and the subsequent Region 7 R-EMAP projects in Kansas and Nebraska. For this analysis we will use the Horvitz-Thompson ratio estimator software developed and provided to Region 7 by EPA ORD. The analyses and reporting for this project will be performed jointly between EPA Region 7 and IDNR. General questions the chemical assessment will focus on are posed below. The technical committee will determine specific assessment questions and chemical indicators.

What proportion of wetlands has impaired water quality conditions?
What proportion of wetlands is impaired by sediment contamination?

Task 4) Begin development of wetland biological assessment methodologies

Sub-task a) development and validation of biological health indices
Sub-task b) development and validation of eco-regional reference conditions

Method:

The second assessment task for this project will be of the biological data (including habitat data) collected as part of the sampling effort. A healthy wetland is defined for this project as one that has high biological integrity for both physical habitat and for the selected biological indicator taxa. However, measuring biological integrity requires careful construction of meaningful biological and habitat health indices as well as defining appropriate eco-regional reference conditions for wetlands. ***Given the budget limitations of this project as well as the data requirements and technical tasks needed to construct meaningful biological health indices and, to develop reference conditions for wetlands, this proposal only seeks to identify and begin the process to accomplish these things.*** Indices developed by other states for wetland assessment will be used as logical beginning point and modified to best suit Iowa's biological composition. Completion of the tasks required for biological assessment will be accomplished by the Iowa Wetland Monitoring Technical Advisory Committee with linkage to and consistency with this project provided through the State's Water Monitoring Strategy. The committee will identify all the work needed to accomplish the sub-tasks including identify candidate reference sites, soliciting participation of researchers, providing access to the data, etc.

By constructing and validating the indices and defining reference conditions, we will be able to estimate wetland biological health. This will be accomplished by plotting the cumulative distribution function (CDF) of the index scores from all the sites, relative to biological expectations of appropriate reference sites. Wetlands will then be categorized into distinct disturbance classes. These results could be used to assess the adequacy of wetland remediation and reconstruction projects as well as determine the baseline condition and measure the long-term health of Iowa's wetland systems by answering such questions as:

What proportion of wetlands has impaired biological communities?
What proportion of wetlands is biologically impaired by habitat alterations?

In addition, wetlands within the random population which are categorized as “pristine” could be added to the list of reference sites.

Consistency with Regional Strategy

This proposal is consistent with EPA Region 7's Regional water monitoring strategy and State/Regional Assessment Framework, which is, and has been for the past several years, the basis for selecting Regional R-EMAP projects. This strategy seeks to build each state’s monitoring capabilities by partnering with EPA and each state to provide the necessary monitoring tools, design and resources to enable comprehensive monitoring and assessment of all water resources with a high degree of scientific certainty. Wetlands are an important ecological water resource class that to date, have not been systematically sampled and assessed. This proposal will help provide a critical piece of the water resource assessment framework for Iowa. By piloting this project in Iowa, Region 7 and Iowa hope to develop a model wetlands monitoring system that will be of interest to other Region 7 states and EPA Regions. In addition, the use of volunteer monitors helps build another critical piece of the Region 7 State/Regional Assessment Framework.

Sampling Design

Scalable: Iowa’s strategic water monitoring strategy emphasizes an ecoregion approach, which will also be the spatial basis for drawing probability-based wetlands sites for this project. However, given the need to make statewide estimates of wetland health for CWA section 305(b) purposes, we will consult with the EMAP sampling design team to make the project sampling design scalable to the statewide assessment level as well. This will be similar to the process and design used for the on-going R-EMAP Iowa Wadeable Streams project.

Stratified: A stratified, probabilistic sampling design will be employed to select permanent and semi-permanent wetlands from the new inventory completed as part of Iowa’s Color Infrared Orthophotography project. This project will focus on the Level III Ecoregion classification and be limited to Ecoregion VI Corn Belt and Northern Great Plains Wetlands. The Technical Advisory Team will address the issue of whether this large ecoregion should be further stratified by wetland hydrogeomorphic classes (i.e. depressional, slope, riverine, lacustrine fringe wetlands). A minimum of 30 wetlands from this ecoregion is desired.

Reference wetlands: 30 reference wetlands from Ecoregion VI will be selected (initially) using best professional judgment as to the least disturbed wetlands, which is a method consistent with Iowa's stream reference sites.

Project Participants and Partners

Wetland Sampling Methodology and Establishment of Reference Wetlands will be developed with the assistance of a Wetland Monitoring Technical Advisory Committee. Participants of this committee will come from a number of university, state, and federal entities including EPA Region 7 wetlands and Environmental Services Division program staff, IDNR program staff, the Iowa State University, University of Iowa, Iowa Department of Agriculture and Land Stewardship, Natural Resource Conservation Service, U. S. Army Corps of Engineers, U. S. Fish and Wildlife Service, and EPA Region 7. The project will be coordinated by the Iowa Department of Natural Resources – Water Monitoring Section with significant assistance by DNR wildlife biologists, wetland scientists, and geographic information system specialists. Coordination of volunteer efforts will be organized using the existing IOWATER volunteer monitoring program.