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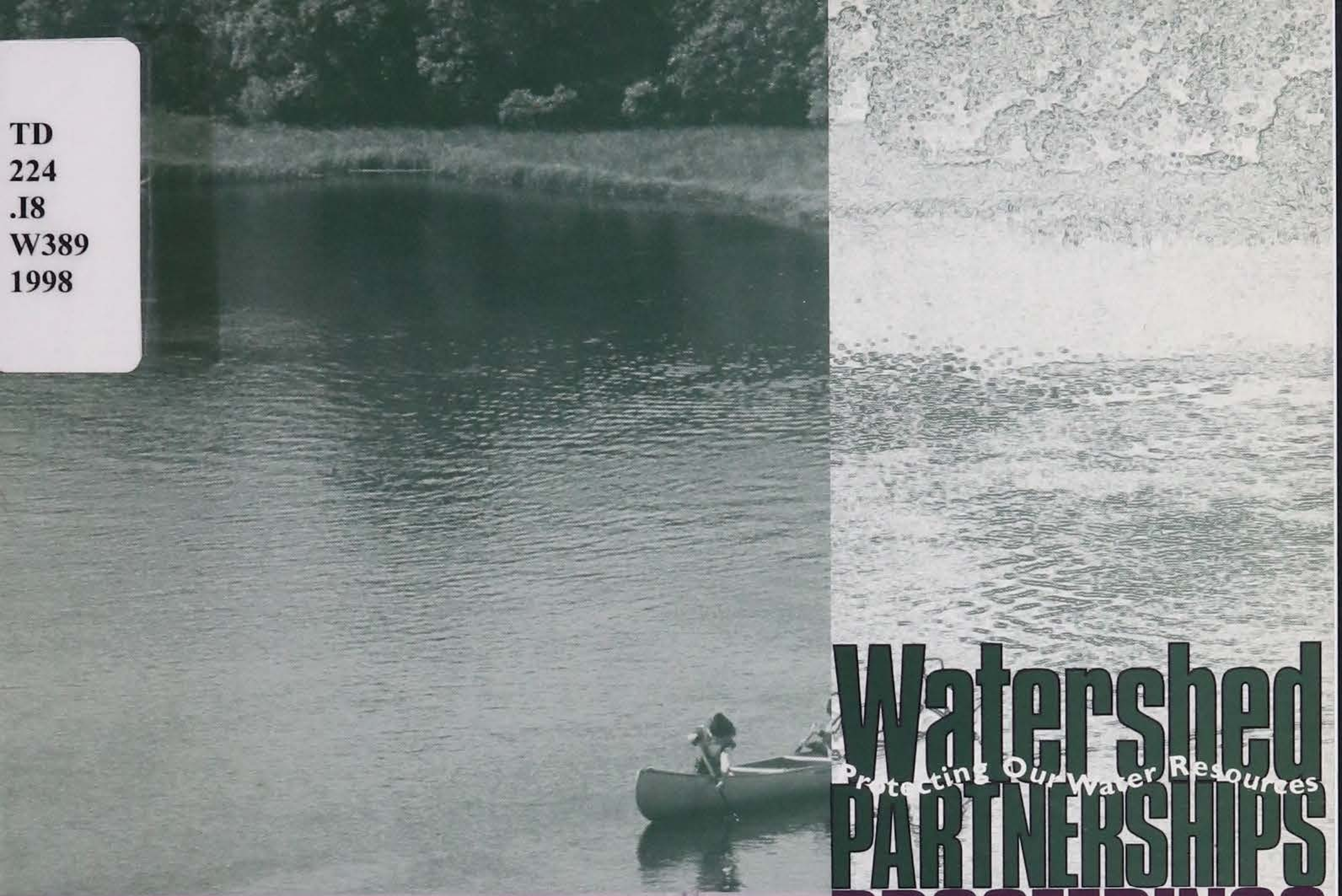
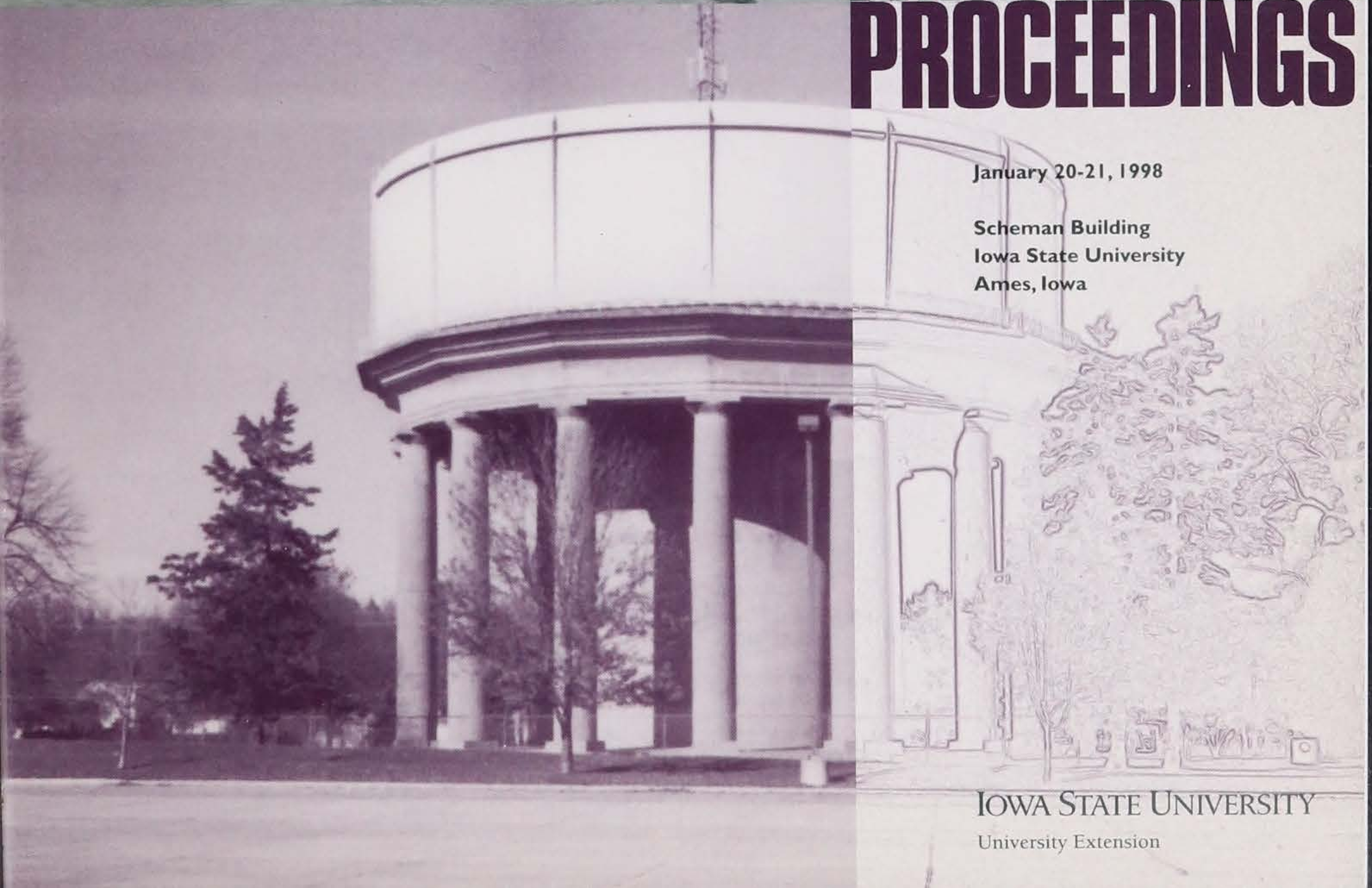


# Watershed PARTNERSHIPS PROCEEDINGS

Protecting Our Water Resources



January 20-21, 1998

Scheman Building
Iowa State University
Ames, Iowa

IOWA STATE UNIVERSITY
University Extension

# Proceedings

of the

# WATERSHED PARTNERSHIPS:
## PROTECTING OUR WATER RESOURCES
CONFERENCE

January 20-21, 1998
Scheman Building
Iowa State Center
Ames, Iowa

IOWA STATE UNIVERSITY
University Extension

# WATERSHED PARTNERSHIPS: PROTECTING OUR WATER RESOURCES

## January 20 - 21, 1998

## Iowa State University
## Ames, Iowa

## Proceedings

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# WATERSHED PARTNERSHIPS: PROTECTING OUR WATER RESOURCES

Gerald A. Miller
Professor/Extension Agronomist
Department of Agronomy
Iowa State University

Welcome to the third annual watershed partnership conference. This year's conference is a continuation of a statewide cooperative effort of citizens, nonprofit organizations, agribusiness firms, educational institutions, and government representatives to recognize and celebrate the successes of Iowa's watershed and water protection programs. A feature of this year's conference is the involvement of representatives of Iowa's water utilities and a focus on source water protection.

An initial conference was held over the course of three days during January 1996. The 1996 conference was designed to facilitate an exchange of information about a wide range of nonpoint source pollution prevention efforts both locally and nationally. Most specifically, the 1996 conference provided an in-depth discussion of many of Iowa's local watershed and water quality projects. This discussion featured problem identification, development of a plan of action, implementation of the plan, and evaluation and transfer of project results. A total of 108 concurrent sessions were scheduled.

The second annual conference was a two day event held during January 1997. The conference was a forum for continuing the exchange of information on the status and future of nonpoint source pollution prevention efforts both in Iowa and at the national level. It was designed to serve as a building block for future forums having parallel as well as expanded objectives. The conference consisted of both plenary and concurrent sessions as well as a resource fair.

Copies of the proceedings of the 1996 and 1997 conferences are available from Agribusiness Programs, 2104 Agronomy Hall, Iowa State University, Ames, Iowa 50011.

Dozens of watershed and agricultural nonpoint source pollution prevention projects have been sponsored in the state. These projects began with the establishment of the Agricultural Energy Management Advisory Council in 1986 by the Iowa Legislature and the Council's subsequent funding of the Integrated Farm Management Demonstration Project. Subsequently, the creation of the Water Protection Fund Account under Iowa's Resource Enhancement and Protection (REAP) Program and the completion of the state's Nonpoint Source Management Plan have provided for sponsorship of additional projects. Also, investments have been made by non-government organizations in the development and funding of watershed efforts. Through these collective efforts, some of the projects have already been completed; others are still ongoing; and new projects are being planned. Projects have been located in all regions of Iowa and have been implemented by many different organizations, ranging from branches of federal and state government and local soil and water conservation districts to nonprofit organizations. While many of these programs included an outreach of public information component, there is still a great need among program managers, project staff, community leaders and individual citizens for an exchange of in-depth, detailed information on the designs, findings, successes, failures, and future direction of these programs. Therefore, given this situation, the need, scope, and objectives of this year's conference are timely.

## Objectives

This conference has five objectives. These objectives are:

- Develop an appreciation for how activities in a watershed impact water sources, including quality and quantity.
- Learn what the Safe Drinking Water Act requirements mean for the municipal water suppliers, farmers, natural resource managers, and the public.
- Develop an understanding of how the Safe Drinking Water Act will impact watershed management.
- Learn how to develop and implement successful watershed partnerships through enhancing problem solving, fund raising, and presentation of results.
- Learn techniques to fund watershed projects by developing grant writing skills.

## Organization

The conference is organized with a plenary speaker and five panelists, three other plenary speakers, 19 concurrent and/or roundtable sessions with one to three presentations in each session and two luncheon presentations. Many of the concurrent sessions are conducted twice. Plenary sessions have a broad focus compared to the concurrent presentations and roundtable discussions, which have a specific topic or project emphasis. Presentations range from a plenary panel discussion that addresses "Why Source Water Protection," to a concurrent session titled "Creating Consumer Confidence: Reporting What's in the Water." An added feature of this conference is an afternoon grant writing workshop.


## Acknowledgement

This year's conference is being conducted as a result of the generous contributions by the following 19 organizations and businesses. Financial contributions ranged from $100 to $3,000. Each contribution was critical to funding this conference. These funds allowed the conference to be conducted for a minimal registration fee. The registration fees charged cover participants' meals and refreshments, while all other conference expenses are supported by the financial contributions previously described. The 19 contributors are:

Agribusiness Association of Iowa
American Cyanamid Company
Center for Health Effects from Environmental Contamination
Dow Elanco
DuPont Company
Iowa Chapter, Soil and Water Conservation Society
Iowa Department of Agriculture and Land Stewardship
Iowa Environmental Council
Iowa Farm Bureau Federation
Iowa Natural Heritage Foundation
Iowa Pork Producers Association
Iowa Soybean Association
Iowa State University Extension
Iowa State Water Resource Research Institute
Iowa Water Pollution Control Association
Iowa Watersheds
The Leopold Center for Sustainable Agriculture
Minnesota Valley Testing Laboratories, Inc.
Natural Resources Conservation Service, USDA
Novartis Crop Protection, Inc.

Many have contributed much time and effort in organizing and coordinating this conference. The conference planning committee members earned high marks for their willingness to allocate several days for in-depth discussion. The objectives, topics, and organization of the conference sessions are due to ideas developed during the several planning sessions. In addition, many of the planning committee members personally recruited and organized a concurrent or roundtable session. It was indeed my privilege to chair this effort. The planning committee included:

Ubbo Agena, Environmental Protection Division, Iowa Department of Natural Resources, Des Moines
Linda Appelgate, Iowa Environmental Council, Des Moines
Lyle Asell, Natural Resources Conservation Service, Des Moines
Susan Cosner, Des Moines Water Works
James Gulliford, Division of Soil Conservation, Iowa Department of Agriculture and Land Stewardship, Des Moines
George Hallberg, formerly of the University of Iowa Hygienic Laboratory, Iowa City
Lynn Hudachek, University of Iowa Hygienic Laboratory, Iowa City
Steve Jones, Department of Civil Engineering, Iowa State University, Ames
Jill Knapp, Conservation Districts of Iowa, Johnston
Gerald Miller, Department of Agronomy, Iowa State University, Ames
Rich Pirog, Leopold Center for Sustainable Agriculture, Iowa State University, Ames
Rick Robinson, Iowa Farm Bureau, Des Moines
Roger Schnoor, Iowa Watershed, Mt. Ayr
Peter Weyer, Center for Health Effects of Environmental Contamination, Iowa City

In addition, a thank you is extended to Roger Link, State Water Quality Specialist, Natural Resources Conservation Service; Tim Kautza, Natural Resource Planner, Natural Resources Conservation Service; and Tom Oswald, Natural Resources Conservation Service/IDNR liaison. Each was drafted by a planning committee member to assist with coordination of their agency's activities for the conference and to represent the primary planning committee member at various meetings.

Also, a thank you for a job well done was earned by several individuals who assisted in various phases of coordinating the conference and assembling the proceedings. Robin Pruisner, Extension Program Specialist for the Iowa State University Agribusiness Education Program unit, located within the Agronomy Department, agreed to coordinate the administrative and logistical aspects of the conference. Robin spent many long days and evenings coordinating the administrative and logistical issues. Robin's careful attention and timely actions allowed everything to come together and are the reason all of us are present today. Thanks, Robin, you did an outstanding job and set high standards. Jerolyne Packer, also a member of the Agribusiness Education Program unit, assisted in preparing manuscripts and Jerolyne was responsible for assembling this publication.

In addition, a special thanks is extended to all of the speakers and session moderators. Without your presentations and assistance, there would be no conference.

Finally, a special thanks to each author who prepared and submitted their manuscript. Without your manuscripts, these Proceedings would not be available to document the information shared at this conference.

# Concurrent Session Speakers

## PARTNERSHIPS TO IMPLEMENTATION: TAKING STEPS TO IMPROVE WATER QUALTIY

Amy Bouska
Environmental Specialist
Johnson County Soil and Water Conservation District
Iowa City

### History

From 1980-1990, Johnson County had the highest rate of population growth in the state of Iowa. Rapid urbanization was occurring in close proximity to major bodies in the county. The District Commissioners were concerned about the growing threat to water quality.

The District Commissioners responded to the significant population changes by submitting a water quality proposal in order to begin addressing water quality issues arising from urban development.

Once the proposal was approved, a project coordinator was hired to implement the project. Efforts on the project began about 1 1/2 years ago.

### The Johnson County Urban Water Quality Project

The objectives of the Water Quality Project include:
(1) To provide assistance on construction site erosion and sediment control and storm water management techniques to developers, engineering firms, contractors, government officials, realtors, and others on land slated for development.

To develop demonstration sites for erosion and sediment control and storm water management practices.

To create a series of educational programs for developers, engineering firms, contractors, government officials, realtors, homeowners, and others on erosion and sediment control and water quality issues.

To partner with local agencies, organizations, and individuals to promote the adoption and installation of erosion and sediment control and storm water management practices.

Developing and Maintaining Partnerships to Accomplish the Objectives of the Project:
One of the main focuses of the project early on was to meet with many of the key individuals in the construction industry to discuss the goals and objectives of the project, identify customer needs, find out how our project could benefit them, and most importantly, build trust and understanding about the project.

These meetings were conducted with the belief that the most effective way to achieve a long-term commitment towards erosion and sediment control and water quality was for the construction industry to understand and believe in the economic and environmental benefits provided by best management practices.

This philosophy has also provided numerous benefits. The majority of the people we initially me with are helping to promote the objectives of the project through referrals, establishment of conservation practices, enforcement of erosion and sediment control measures, establishments of demonstration sties, educational programs, publicity, allowing us to get involved in the planning and reviewing stages of proposed developments, etc.

These initial meetings have served to provide the basis of a strong partnership in helping the District accomplish the objectives of the project.

## STORMWATER RUNOFF STUDY AT DAVENPORT, IOWA, 1991-95

Keith J. Lucey
Supervisory Hydrologist
U.S. Geological Survey
Iowa City

Urban areas with populations greater than 100,000 have investigated stormwater runoff as a nonpoint source of pollution to meet U.S. Environmental Protection Agency guidelines for National Pollutant Discharge Elimination System permits for stormwater discharges. The City of Davenport, Iowa, and the U.S. Geological Survey cooperatively conducted a study from 1991 through 1995 to determine concentrations and loads of various constituents from several urban land-use types. The results of the study can be used to meet the technical conditions of the permit application.

Six open-channel sampling sites were selected to characterize water quality of stormwater runoff from five predominant land-use types: agricultural and vacant, residential, commercial, parks and wooded areas, and industrial. At each of the sampling sites, data loggers recorded rainfall and water levels every 5 minutes. Rainfall was recorded in 0.01-inch increments by a tipping-bucket rain gage, and water levels were measured in a stilling well connected to the open channel. Instantaneous discharges were measured periodically to develop a stage-discharge relation at each site for computation of flow. Although most stormwater-runoff samples were collected manually, automatic samplers collected samples at 15-minute intervals if personnel could not be at the site when runoff began.

Stormwater-runoff samples were collected during 1992 and 1994 and analyzed for many inorganic and organic constituents. Grab samples were analyzed for pH, temperature, total cyanide, oil and grease, total phenols, volatile organic compounds, and bacteria. Composite samples were analyzed for chemical oxygen demand, biochemical oxygen demand, suspended and dissolved solids, major ions, nutrients, metals, semi-volatile organics, organochlorine pesticides, and polyaromatic hydrocarbons.

Land use appears to influence stormwater-runoff quality. Largest nitrate as nitrogen concentrations were associated with agricultural land, largest total phosphorus concentrations with residential land, and largest ammonia plus organic nitrogen, lead, and copper concentrations with industrial land. A few organic compounds were detected at low concentrations in at least one sample associated with each land-use type.

# NEW ISU PHOSPHORUS FERTILIZER RECOMMENDATIONS: IMPACTS ON PROFITABILITY AND WATER QUALITY

Antonio P. Mallarino
Department of Agronomy
Iowa State University

Research results from long-term and short-term field experiments collected during recent years showed the need for updating phosphorus (P) fertilizer recommendations for several crops. The overall goal of the new recommendations is to increase the profitability of crop production while reducing the potential for P contamination of water supplies. It is known that P losses from agricultural areas contribute to eutrophication of surface water. Details of the new recommendations are available in the publication Pm-1688, "General Guide for Crop Nutrient Recommendations in Iowa." This publication can be requested from Publications Distribution, Printing and Publications Building, Iowa State University, Ames, IA 50011. Briefly, the major changes were (1) new soil-test interpretation classes were developed based on crop demand, subsoil P content, and soil-test values for the Bray-1 and Olsen extractants; (2) adjustments of fertilization rates based on geographic location of the field and soil type were updated and simplified; (3) recommended fertilization rates are sightly lower for the low-testing classes; and (4) the old "medium" class was renamed "optimum" to reflect the economics of fertilization. This presentation discusses the bases of the new recommendations for corn and soybeans.

Profitable crop production requires that soils have adequate amounts of P. The need for periodic applications of P fertilizers is evident because many soils are naturally deficient in this nutrient and because it is removed with harvested products. These needs and expectations of increases in profitability have prompted producers to apply large amounts of P fertilizers and manure during the last two or three decades. Because of the relatively high residuality of P fertilizers (compared with nitrogen, for example), these practices have substantially increased available P in many soils. Three decades ago only 25% percent of the soil samples sent to the Iowa State University Soil Testing Laboratory tested above optimum for P or K. Currently, however, more than 50% of corn and soybean fields in major agricultural areas of Iowa test higher than optimum in P.

There is mounting evidence that, because of the large and sustained fertilizer applications, many producers could increase both the profitability and sustainability of crop production by reducing rates of P fertilization. There is also clear evidence that P in animal manures is an excellent source of P and its value for crops is essentially similar to that of commonly used fertilizers. Research results from long-term and short-term field experiments collected during recent years showed that yields of corn and soybean are seldom increased by fertilizing soils testing above optimum in P (16 to 20 ppm by the Bray-1 soil test or 11 to 14 ppm by the Olsen test for most Iowa soils). An example of the relationship between net economics returns to fertilization and soil-test P measured by the Bray-1 method is shown in Fig.1. Data in the figure and other results show that (1) large net returns from fertilization are likely when available P in soils is deficient, (2) applications of P fertilizer that increase soil-test levels from optimum to high or very high usually result in negative returns to investments in fertilizer, and (3) consideration of price ratios and uncertainty suggests that the long-term profitability of crop production is maximized by maintaining soil-test P values within the optimum class.

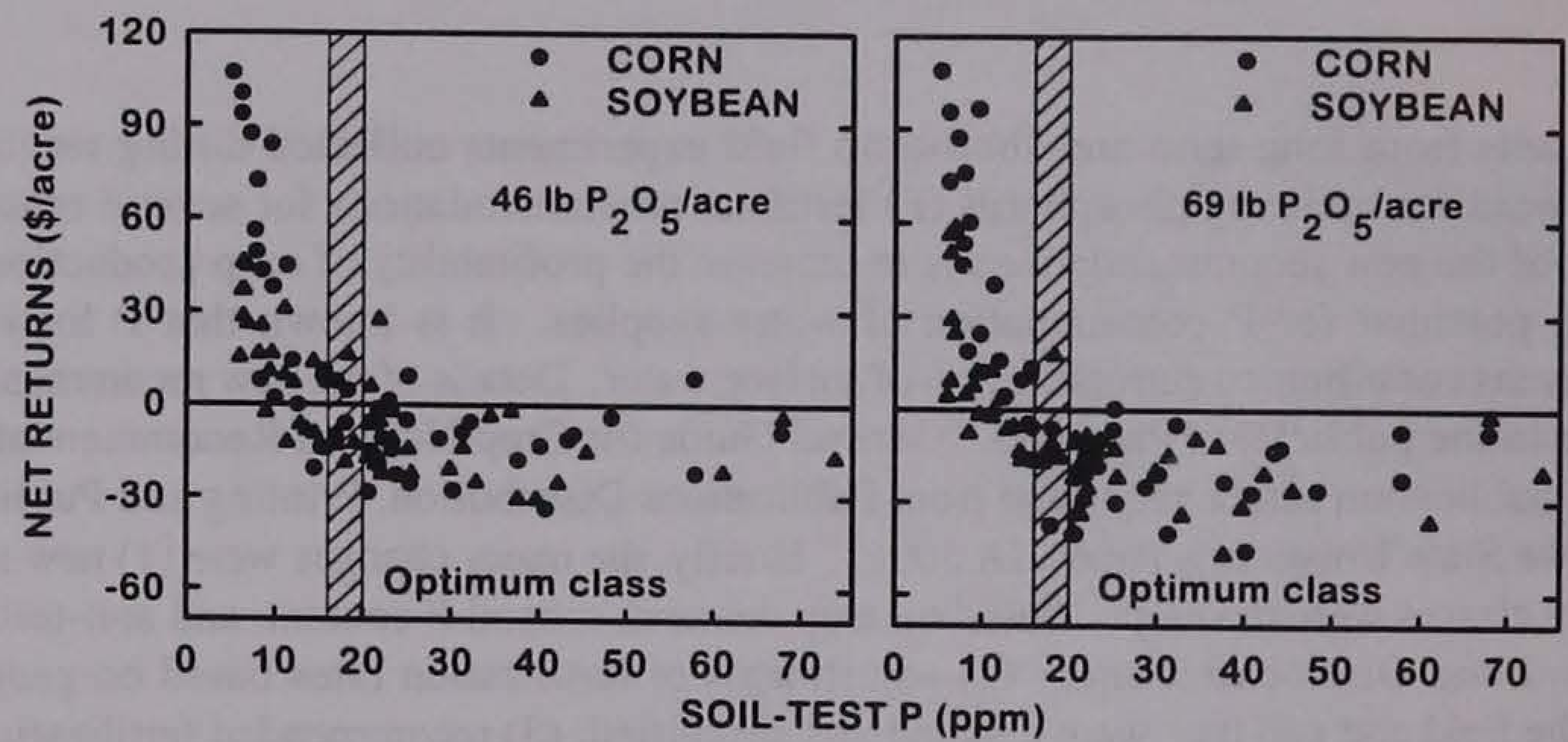


Fig. 1. Relationships between net returns to P fertilization and soil-test P for two fertilization rates across many field plots and years.

High and sustained P applications of fertilizers or manure are of especial concern for fields managed with reduced tillage, especially no-till and ridge-till systems. These conservation tillage systems reduce soil erosion and water runoff and should reduce losses of P to water surface supplies. One undesirable result of these systems is, however, that P accumulates at or near the soil surface. Data in Fig.2 shows the distribution of P in the profile of a soil managed with four tillage systems and with broadcast fertilization.

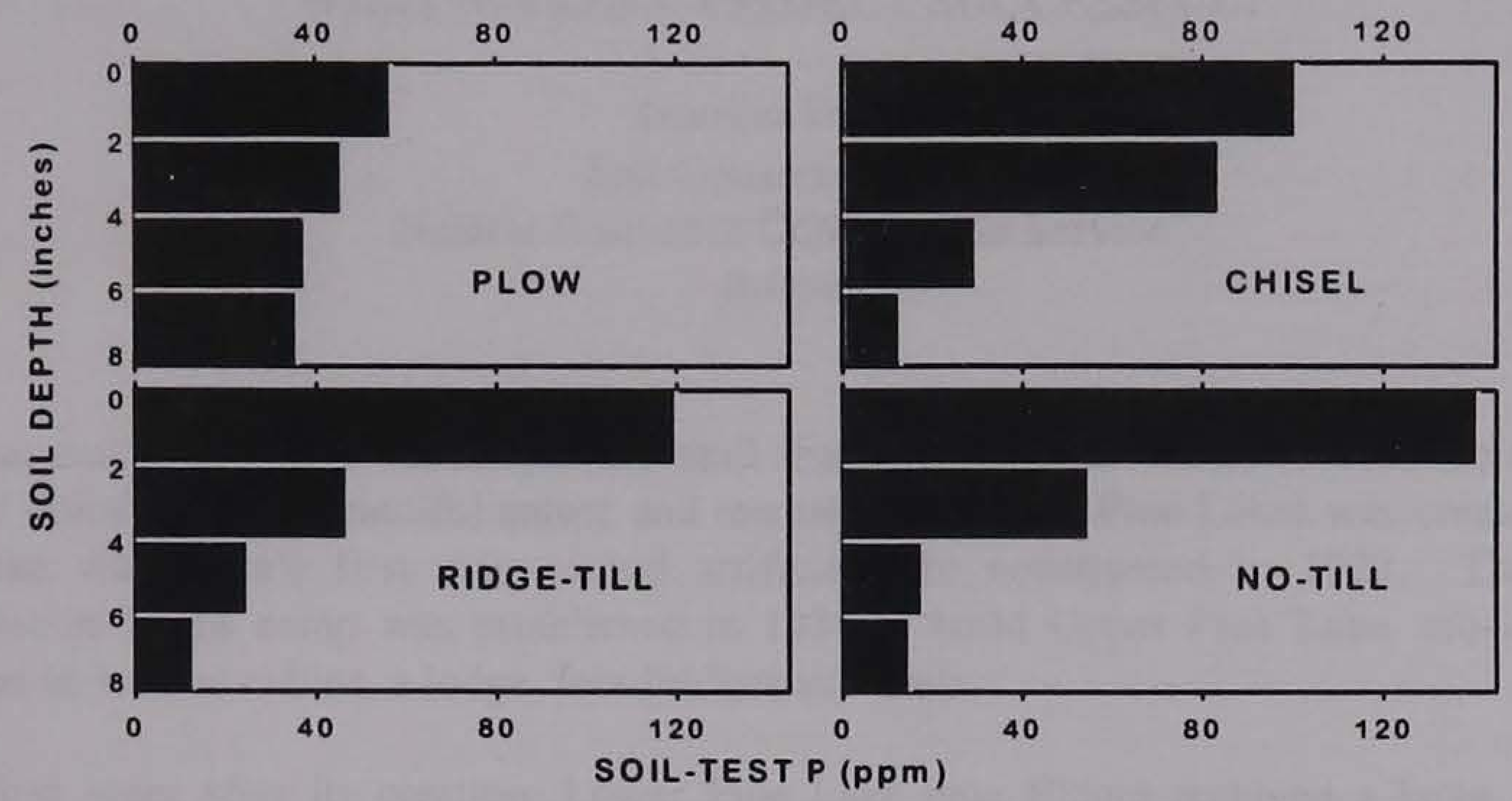


Fig. 2. Stratification of soil-test P in a Kenyon Iowa soil managed with four tillage systems after 12 years of broadcast fertilization for corn and soybean.

Thus, any benefit in reducing P losses could be lost or reduced when high rates of P fertilizer are broadcast onto the soil surface. Recent research shows that the concentration of soluble P in runoff water is often higher for no-tillage than for conventional tillage. The new recommendations do not specify a method of fertilizer application because the research shows that subsurface banding is usually not better than broadcast fertilization from an economics of crop production point of view. The results show, however, that subsurface banding of P fertilizers often increase P uptake by crops and is an efficient method of fertilizer application. This method of application may not result in major economic advantages for producers but will greatly reduce the potential for P contamination of surface water supplies because it can reduce markedly the concentration of soluble and total P in water runoff.

The new soil-test interpretations and fertilizer recommendations for P, if followed by producers, will result in increased economic benefits from crop production. At the same time, they will result in reduced potential for contamination of surface water supplies because it will reduce accumulations of P at or near the soil surface. Continued education and outreach efforts are necessary to demonstrate to producers that an implementation of these recommendations is in their interest and of all people of Iowa.

## PINE CREEK WATER QUALITY PROJECT FROM START TO FINISH: WHAT MAKES A PROJECT SUCCESSFUL?

Jennifer Welch
Soil Conservationist
Natural Resources Conservation Service
Boone

The local residents had a vision for the land that became Pine Lakes. With their land and financial donations, the beautiful nature and recreational area of Pine Lakes was created. Lower Pine Lake was Iowa's first state-owned artificial lake constructed in 1922. The Civilian Conservation Corps camp was established in 1934 to build Upper Pine Lake, erosion control structures as well as cabins, a lodge, foot bridges and trails.

In the first years after its creation, Lower Pine Lake near Eldora received a large amount of sediment from the agricultural watershed. Eleven years after construction of Upper Pine more than 30 percent of its original capacity had been lost to sediment. Poor water clarity, summer algal blooms and fish kills also threatened the lakes.

Local land and water officials predicted if soil conservation practices were adopted in strategic location in the 9,680-acre watershed, the lakes could be protected. If water quality problems were not corrected, the lakes would deteriorate and no longer support their desirable uses such as fishing and swimming. The watershed has gently rolling topography and erosive soils. Approximately 78 percent of the watershed is cropland and almost a third of that land is considered highly erodible land.

The first efforts to protect the lakes began in the 1930's and the most recent effort, the Pine Creek Water Quality Project, began in 1993. The five-year project used a watershed approach to water quality improvement. This approach integrates education and management techniques with technical and financial assistance for producers and landowners.

Approximately 80 percent of the producers in the watershed participated in the project. Currently, 60 percent of the cropland acres in the Pine Creek watershed are effectively treated. Of these acres, the most critical for the watershed were determined by the amount of sediment they deliver to Pine Creek and Pine Lakes. Critical areas were targeted for conservation practices to reduce soil erosion and sediment reaching the lakes. The amount of sediment being delivered to the lakes was reduced by 75 percent in several subwatersheds with implemented erosion control practices.

Comprehensive assessment and planning was used to identify high priority areas and practices needed in the watershed. The project was a multifaceted approach that integrated various avenues for producer and landowner involvement. Many farmers in the watershed were active participants in the water quality project. Greater than 50 percent of the cropland acres were enrolled in a three year comprehensive program that encouraged producers to make management changes. The producers received incentives to implement new practices in their operations such as nutrient and pest management, contour farming, and no-till. Cost share assistance was also available for producers to construct conservation practices in critical areas of the watershed.

Less common practices such as streambank restoration, riparian buffer strips of grass and trees along Pine Creek and shallow water impoundment structures were utilized in the watershed to make an impact on water quality. These and other practices have been used on tours and as demonstration sites to illustrate their effectiveness and encourage producers with similar resource needs to look at multiple options. A good method to achieve new practice adoption was for producers to see successful practices on a neighbors farm. Satisfied landowners and farmers are indispensable in the promotion of practice adoption in a watershed. Time is necessary for people to assimilate and accept new ideas before they are willing to make a change.

Informing producers about conservation practices that reduce environmental impact and save money enabled them to make a difference in their watershed. Workshops, tours and informational meetings, newsletters and displays were key components of the project's information and education program. To have continued success at protecting the soil and water resources, these practices still need to be promoted and implemented where appropriate. Sites within the watershed will be used for tours and educational outreach in conjunction with the Iowa Buffer Initiative.

Many of the management and construction practices take a high degree of commitment from the producer. It is a commitment not only to their farm and the environment but also to the community and everyone that benefits from the lakes. The results of this project could not have been achieved without the hard work and efforts of the farmers and landowners in this watershed. They have done the real work. Through the help of local, state and federal partners, the producers in the Pine Creek Water Quality Project have changed the landscape of this watershed.

# AN ASSESSMENT OF IOWA WATER QUALITY 10 YEARS AFTER THE IOWA GROUNDWATER PROTECTION ACT


**Richard D. Kelley**

**Environmental Program Consultant**
**University of Iowa Hygienic Laboratory**
**Iowa City/Des Moines, Iowa**


## SUMMARY


In the summer of 1997 a report entitled ASSESSMENT OF IOWA SAFE DRINKING WATER ACT MONITORING DATA: 1988-1995 was authored by G.R. Hallberg, D.G. Riley, J.R. Kantamneni, P.J. Weyer, and R.D. Kelley. The report was a joint investigation of the University Hygienic Laboratory, the Center for Health Effects of Environmental Contamination and the Iowa Department of Natural Resources. This report summarizes the analysis of chemical water-quality data collected from monitoring of Iowa Public Water Supplies (PWS) under the Safe Drinking Water Act (SDWA). This analysis was conducted to assist the Iowa Department of Natural Resources, Environmental Protection Division (IDNR-EPD) in determining possible temporal variations in water quality related to extreme hydrologic events (e.g., the Floods of 1993) and to evaluate options for future SDWA monitoring requirements. The project was supported, in part, by an USEPA Assistance Agreement to IDNR.

**Overview of the Data Base**: The SDWA data base utilized consists of the regular compliance monitoring data collected from 7/1/88 through 12/31/95. Only chemical parameters from finished water are reviewed. Data are included from approximately 2,100 discrete PWS IDs.

- Of the 450,000 analytical results, 75% are <MDL (method detection limit); or only 25% represent a quantified detection. Only 2.2% of all results were greater than an MCL.
- 20 of 21 Regulated VOC analytes have been detected in Iowa PWS, most at <1% frequency.
- Nine SOC Analytical Series have shown no or few detections over the entire period; these series might be reviewed for reduced monitoring.

**Temporal Analysis**:

- The historic SDWA data do not provide a consistent enough temporal record to evaluate contaminant trends year to year: 71% of ALL data are from 1993-1995; 98% of analyses for the regulated pesticides are from 1993-1995.
- The Floods and hydrologic conditions of 1993 had no discernible, significant effect on chemical water quality. Some apparent trends are related to longer term variations.

**SOC-VOC Occurrence and Comparison With Past Studies:** For a temporal perspective on SOCs and VOCs, the current SDWA data were compared to the first synoptic sampling of PWS, the "2303" survey conducted in 1986-87.

- THMs were the most commonly detected VOCs in 2303 and SDWA; atrazine was the second most commonly detected organic chemical, detected in 12% of PWS in both.
- The SDWA data show more PWS with detections of pesticides and VOCs; the differences between the data do not allow an evaluation of the significance of these differences. In SDWA, 18% of PWS had detections of VOCs (excluding THMs); the 2303 Survey showed 11%. In SDWA, 19% of PWS had detections of pesticides/SOCs; 2303 showed 14%.
- SDWA data show nearly 26% of PWS had a detection of a regulated SOC and/or a regulated VOC; only about 6% had detections of both.

**Water Quality, Water Source, and Vulnerability:** The SDWA data were evaluated in relation to various PWS vulnerability classification schemes and source waters to assess possible relations to guide monitoring requirements.

- SOC and VOC contaminants occur in every source water and PWS vulnerability category.
- The composite vulnerability classification scheme used by the IDNR-EPD has performed well and accounts for the vast majority of SOC and VOC detections in Iowa PWS, but the system does not readily allow further refinement.
- A history of $NO_3$-N concentrations >5 mg/L provides a conservative predictor for the occurrence of pesticides in groundwater systems (GWS); other criteria are also needed because low $NO_3$-N PWS also show SOC/VOC contamination.
- Surface water systems (SWS) and alluvial aquifer GWS are the most vulnerable to anthropogenic contaminants.
- In GWS, anthropogenic contaminants most commonly occur in systems using wells <150 feet in depth. Vulnerability of bedrock aquifers varies spatially related to regional hydrogeologic factors. Contaminants often extend to greater depth in eastern-northeastern Iowa.
- Individual VOCs are prevalent in different hydrologic environments related to their physical-chemical properties and different sources.
- Natural contaminants, such as Ra 226, tend to be greatest in systems using deeper wells in bedrock aquifers. Metals vary related to the nature of aquifer materials.

**Data Analysis and Other Monitoring Needs To Support SDWA:** As part of IDNR-EPD's efforts to improve the SDWA program, there are many considerations, such as: providing a balance between protection of public health and reducing the costs of monitoring for PWS utilities; and refining the system to provide more timely assessment of extreme events and water quality trends. Any changes require sound, scientific support including improved data assessment and enhancement of ambient monitoring programs for data on contaminant trends.

- The SDWA data should be evaluated annually or at least bi-annually. Key PWS with consistent records could be tracked to assess temporal trends and PWS monitoring needs.
- IDNR-EPD should complete field assessments to provide separate evaluations of "physical" and "chemical-history" vulnerability of PWS to refine vulnerability evaluations.
- The Ambient Surface Water Monitoring Program and the Iowa Groundwater Monitoring Network could be strengthened to support SDWA, providing trend analysis for the most vulnerable sources. Additional sites and water-quality parameters would need to be added.
- Various special studies, such as the Big Spring basin program should also be utilized; they provide important perspectives to understand trends affecting PWS, as well.

**Data Quality and Analysis Issues**: In any data base of this magnitude there are various data quality problems and issues. The majority of data quality problems occurred prior to 1993.

- All laboratories and PWS should be reminded that: the Iowa Administrative Code requires that a laboratory *report all detections* within an analytical series; all results should be reported in mg/L (ppm) to avoid errors in the SDWA data.
- In future years, updates or corrections to the SDWA data base should also be submitted and made in the archive copy at the UHL to ensure compatibility and completeness.

# ISU'S NEW NITROGEN FERTILIZER RECOMMENDATIONS FOR CORN: A STEP TOWARD SITE-SPECIFIC MANAGEMENT

Alfred M. Blackmer
Department of Agronomy
Iowa State University

Iowa State University released new nitrogen (N) fertilizer recommendations for corn in May of 1997 (Pm. 1714). These recommendations are intended to help Iowa corn producers obtain the economic and environmental advantages of moving toward site-specific management of N.

The new recommendations encourage all producers to use the late-spring test for soil nitrate and the end-of-season test for cornstalk nitrate on some of their fields each year. These tests give site-specific feedback that producers can use to evaluate and improve N management on their fields. It is assumed that many producers will find it profitable to pay for this testing as part of crop management programs.

The new recommendations do not call for any immediate change in rate of N application, time of N application, method of N application, or form of N applied. It is assumed, however, that most producers will find that it is to their advantage to make gradual changes in N management based on the feedback they obtain from the soil and stalk tests. The new recommendations give producers the option of making such changes.

When all fertilizer N is applied before crop emergence, estimates of N fertilizer needs are given as ranges because research shows there is substantial variability in optimal rates of N fertilization. Optimal rates vary with prices for corn and fertilizer, time of fertilizer application, method of fertilizer application, amount and composition of plant material left by the previous crop, uniformity of fertilizer application, soil organic matter content, weather conditions during the six months prior to fertilization, potential impacts on environmental quality, and other factors. The ranges acknowledge that it currently is not possible to provide simple formulas that give appropriate weight to the relative importance of each factor when selecting a rate that should be applied for any particular field.

The idea of giving producers a range of N rates to choose from is not new. ISU's previous recommendations, for example, allowed producers to select their own yield goals, which essentially allowed them to select from a range in rates of N fertilization. A major problem with this method is that expected yield level is not a major factor affecting optimal rates of N application; focusing attention on yield goals makes it difficult to recognize and address the most important factors affecting optimal rates of N application. These include time of application, method of application, and weather.

ISU's new recommendations are intended to help corn producers discover the most important factors affecting optimal rates of N fertilization on *their* fields. The new recommendations encourage on-farm evaluation of N management to guide improvements in this management. This higher level of management should be considered an essential first step in any movement toward site-specific management of N.

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# BIOLOGICAL SITE ASSESSMENT: THE MECHANICS OF DATA COLLECTION, ASSEMBLY, AND ITS UTILITY

Todd Hubbard
Limnologist
University of Iowa Hygienic Laboratory
Polk County

Biological site assessment has been utilized to evaluate water quality throughout the world for several decades. The State of Iowa has had a patchwork approach to using biological indicators in the past. Many researchers in Iowa have collected data on a localized basis in an attempt to qualify conditions based on biology. However, to date there has not been an overriding approach in Iowa to evaluate conditions based on aquatic biological indicators. Consequently the Iowa Dept. of Natural Resources, in conjunction with the University of Iowa Hygienic Laboratory, has been working to establish biological criteria (biocriteria) for the state.

In 1994 data collection for the biocriteria project commenced. The reference sites are selected based on several variables (e.g. lack of point sources, wadeability, riparian condition, channel morphology, etc.). Assessments are conducted under base flow conditions with data collection addressing biological, chemical, and physical parameters. Biological data collection involves both quantitative and qualitative sampling of the invertebrate community and quantitative sampling of the fish community. Water chemistry includes both in situ measurements (e.g. pH, dissolved oxygen, etc.) and a lab component (e.g. nutrient analyses, pesticides, etc.). Physical variables of the stream and the bordering riparian zone (e.g. substrate embeddedness and composition, canopy cover, percent streambank slope, etc.) are also recorded.

The fieldwork component of data collection is only a precursor to a winter spent in front of the microscope and computer. Samples collected during the field season must be subsampled due to the large number of organisms and identified to the lowest practical taxonomic level. Staying abreast of current approaches to taxonomic classifications remains one of the most challenging aspects to producing accurate data. After samples have been identified, and confirmed by an outside taxonomic expert if necessary, indexes are constructed.

Numeric indexes are used to more easily translate such amorphous variables as feeding guild, taxonomic groupings, and physical habitat into meaningful tools. The development of indexes allows for a comparison between sites and thus can stratify sites based on the categories being compared. Moreover through the establishment of uniform state standards, with the possibility of accounting for regional variation, the potential for a more precise tool exists.

# TREES FOREVER IOWA BUFFER INITIATIVE: PUTTING THE TECHNOLOGY ON THE GROUND

Del Christensen
Watershed Specialist
Trees Forever

## Introduction

Iowans enjoy ample supplies of water for personal, agricultural and industrial uses, yet the quality of our water remains an important issue for the future. Rivers and streams are the major source of water for nearly 80% of Iowa's residents. Most of Iowa's streams and creeks flow through privately owned land and much of that land is currently used for intensive row crop production and livestock grazing. Farmers can and do use a number of upland conservation practices that protect water quality for themselves and their neighbors. A conservation practice that is less well known is riparian management which can involve establishing strips of grasses, shrubs and trees along streams as well as the stabilization of stream banks. When natural buffers are maintained between the stream and the farm fields, that area becomes a natural filter which protects the streams and our groundwater supply.

Trees Forever developed the Iowa Buffer Initiative to promote the latest technology in riparian management practices. This new technology, called Riparian Management Systems, was developed by the Agroecology Issue Team of the Leopold Center for Sustainable Agriculture and is currently in practice in the Bear Creek Watershed north of Ames. The riparian buffer model uses a combination of grasses, trees and shrubs and can help control erosion and increase wildlife habitat while reducing non-point source pollution. The goal of the Iowa Buffer Initiative is to place this technology in the hands and on the ground of rural landowners. The program involves establishing more than 100 riparian buffer project sites on private landowner properties throughout the state, raising awareness about the value of riparian management through field days and workshops and recognizing landowners who are already protecting their streams with tree and grass buffers.

## Unique Program Partnerships

Trees Forever is a statewide not-for-profit organization founded in 1989 and is now the largest volunteer based tree planting organization in the country. Trees Forever has been recognized nationally with the Arbor Day Foundation Award, Edison Institute Environmental Award, Chevrolet-Geo Award for Environmental Excellence, U.S. Department of Energy Award for Energy Innovation, the National Chevron Conservation Award and the State of Iowa Governor's Good Neighbor Award. Through unique partnerships, Trees Forever has established a successful track record of creating and implementing quality projects in over 400 Iowa cities and towns. These partners have included: IES Utilities, Peoples Natural Gas, Municipal Utility Companies, Iowa Department of Transportation, Iowa Department of Natural Resources, Iowa State University Forestry Extension and Landscape Architecture Extension to name just a few. The Trees Forever Iowa Buffer Initiative is just another example of turning unique partnerships into valuable action-oriented programs.

Trees Forever Iowa Buffer Initiative is made possible by a number of funding sponsors including: Novartis Crop Protection, Inc., Iowa Farm Bureau Federation, Iowa Department of Natural Resources Environmental Protection Division and United States Environmental Protection Agency. Key Research Partner for the program is the Agroecology Issue Team of the Leopold Center for Sustainable Agriculture. Other cooperating partners include: Iowa State University Forestry Department, Leopold Center for Sustainable Agriculture, National Soil Tilth Laboratory, Iowa DNR Forestry Division, Iowa Department of Agriculture and Land Stewardship, Conservation Districts of Iowa, Iowa State University Extension Service, Iowa Department of Transportation and Raccoon River Watershed Project.

## Primary Goals of Trees Forever Iowa Buffer Initiative

1) Help to develop ten highly visible demonstration sites each year for 5 years that showcase these new riparian management techniques.
2) Help to develop ten projects each year for 5 years in areas of high need, whether highly visible or not.
3) Coordinate a network of technical assistance to support landowners.
4) Recognize landowners who are already protecting streams and other waterways with tree and grass buffers.
5) Raise awareness about the value of riparian zone management and stream bank stabilization and their effect on water quality by holding field days for farmers, rural landowners and youth at project sites.

## Landowner Enthusiasm

Landowners want to see how new conservation practices perform on their own ground, not how it works in the lab or in a field on the other side of the state. To be able to take this technology and implement it throughout Iowa on a variety of landscapes is critical to the success of the program. Landowner enthusiasm for the Iowa Buffer Initiative is high for just that reason. Field days and recognition ceremonies are designed to reach those interested landowners. Another reason for landowner enthusiasm is the flexibility of the riparian buffer model. The buffer can include warm season or cool season grasses, shrubs and/or trees in a variety of combinations. These can be custom designed to meet the landowner's individual needs and the Iowa Buffer Initiative can help with those design questions.

## Continued Need For Technical Training Of Professionals

We recognized immediately that a need exists to train the field personnel connected with NRCS and other agencies who are involved in designing, cost sharing and promoting riparian buffer systems. To date, the Trees Forever Iowa Buffer Initiative has coordinated two workshops to provide intensive riparian design training to over one hundred conservation professionals. Demand for this type of training continues to increase and a number of other workshops are already being planned. Annual field days on the demonstration sites will also serve as educational opportunities for local farmers, landowners and youth.

French Author Victor Hugo once said, "There is one thing stronger than all the armies in the world, and that is an idea whose time has come." The Trees Forever Iowa Buffer Initiative, which has the potential to become a model for the National Buffer Initiative is just such an idea. The nation traditionally looks to Iowa for the lead on new farm management practices. The Trees Forever Iowa Buffer Initiative will provide the nation with a unique view as to how a public-private partnership can increase awareness and utilization of long-term land management practices and their impact on water quality, soil erosion, rural landscapes and wildlife.

# IMPLEMENTING THE DES MOINES METRO AREA URBAN WATER QUALITY PROJECT

Randy Cooney
Environmental Specialist II/Project Coordinator
Polk County

**Background:**
The Des Moines Metro Area Urban Water Quality Project is locally sponsored by the Polk Soil and Water Conservation District Commissioners. This project is supported in part or in total by the Iowa Department of Agriculture and Land Stewardship, Division of Soil Conservation, through funds of the Water Protection Fund or the Iowa Department of Natural Resources through a grant from the U. S. Environmental Protection Agency. Technical assistance is provided by the U. S. Department of Agriculture, Natural Resources Conservation Service.

Construction site erosion and its impact on streams, rivers, and lakes in the Des Moines metropolitan area is the focus for this cooperative water quality project. Informing and educating construction industry professionals about new and practical Best Management Practices is achieved through demonstrations sites, workshops, conferences, print materials, and countless hours of one on one contacts. Currently, the project is in its third and final year under the original grant agreement. The Polk SWCD commissioners have requested a minimum one year extension from the original funding sources. Meanwhile, the commissioners are preparing a long term strategic plan to insure the ideas defined in the project are continually expanded.

**Project Implementation:**
Year One was a time for renewing local support and commitment for the project. The metropolitan area in Polk County encompasses 16 communities and/or local governing bodies. Extensive time was required to contact original supporters while introducing the project ideas to several newly employed staff. Personal contacts were especially important to earn initial trust, respect, and to encourage active participation from local leaders. Ultimately, the value of solid relationships with these officials led to a better understanding of the challenges and expectations for each community. It also paved the way to meet construction industry professionals frequently working in each of the communities. Increasing local leadership, ownership, and action provided the foundation necessary for building the second year activities.

Establishing demonstration sites, workshops, conferences, tours, and making on-site visits began to take center stage during Year Two. Stepping up the outreach to developers, contractors, engineers, and other related professionals was at times overwhelming. Acting on referrals made by various city officials, we were able to get the attention of some major players in the metro construction industry. Once again reinforcing the value of the support gained during Year One. The 1997 Urban Erosion Control Conference, establishment of the Three Lakes Estates demonstration site, multiple on-site visits, and tours highlight the accomplishments for Year Two.

By mid-point of the scheduled three year project, the Polk SWCD commissioners began planning for a project extension and organizing a coalition to draft a long term strategic plan for urban water quality challenges in the District.

Although Year Three is relatively young, numerous accomplishments have been recognized. The first Project Partner Award was presented to Tim Erickson, developer for Three Lakes Estates, for his demonstration of various erosion and sediment control Best Management Practices . Articles in the Des Moines Register and the Blue Print, official publication for the Home Builders Association of Greater Des Moines, publicize the importance for local partnerships. One community has hosted a workshop and another community is planning one. Interest and partnering opportunities for other workshops is beginning to shape up. Planning is well underway for the 1998 Urban Erosion Control Conference. An agreement has been reached for a second demonstration site and communication has been phenomenal. A third potential demonstration site has been identified. Recently, the Project Advisory Committee toured eleven construction sites and recommended that similar tours should be made available to construction industry professionals. Many other action items are outlined in the Plan of Operations and stand a good chance of being implement during Year Three.

Momentum is clearly building in the project and the commissioners have no intention of slowing it down. They plan to evaluate the project, tweak it, and chart a course of action that continues to improve the soil and water quality throughout the steadily growing metropolitan area of Polk county. The key will be locally led conservation in partnership with traditional sources and new players alike.

# DEVELOPING URBAN CONSERVATION PROGRAMS AND URBAN-RURAL PARTNERSHIPS FOR WATERSHED PROTECTION IN IOWA

Wayne Petersen
Urban Resource Conservationist, NRCS
Johnson County

Programs to control erosion, improve water quality, restore wetlands, and address other natural resource protection needs have traditionally focused on the agricultural lands of Iowa's watersheds. Agricultural land will continue to be the priority for most soil and water conservation efforts but urban conservation work is beginning to take hold and grow in Iowa. This presentation will discuss the conservation needs of urbanizing areas in Iowa, some interesting new concepts and practices that emerging to meet urban needs, and efforts underway to educate the urban sector and build urban-rural partnerships for watershed protection.

Recent cutbacks in governmental spending to balance budgets has increased competition for "the shrinking pie" and has caused concern about maintaining funding for conservation programs. Resource protection should be a growth industry, though, because the public's demand for environmental protection and water quality improvement continues to grow. If budget deficits continue to shrink and the economy continues to be strong, there should be good potential for expanded funding for conservation in the future. To be positioned for expanded funding, we must broaden our base of support for current conservation programs and expand the customer pool we serve. The urban sector represents a vast, untapped market of demand and support for natural resource protection and watershed partnerships that we must reach out to.

There is much work to do in controlling erosion from construction sites and in improving the quality of urban non-point runoff. But equally important is the need to educate the urban sector on the land use that dominates most Iowa watersheds. It is critical that the urban sector gain a better understanding of agriculture and the societal benefits conservation farmers provide to downstream urban areas. As this understanding grows, urban support for conservation farmers and watershed protection will grow.

As work progresses in building urban conservation programs and building urban-rural partnerships for watershed protection, it will be critical to "marry" economic and environmental concerns. For too long, environmental protection and economic concerns have been considered incompatible, competing interests. We will talk about efforts underway - in both the urban and rural arenas - to demonstrate how protecting natural resources and enhancing environmental amenities makes good economic sense. Building urban-rural partnerships for watershed protection, protecting agricultural land, installing buffer systems, strategic ecosystem restoration, controlling erosion and runoff, and maintaining a strong economy can and must be symbiotic objectives for both the rural and urban sectors.

# DES MOINES WATER WORKS: MAPPING THE MICROBIAL AND CHEMICAL DYNAMICS OF URBAN CREEKS

Dennis R. Hill
Microbiologist
Des Moines Water works
Polk County

There are many stages of water purification that are employed by the Des Moines Water Works to convert the often muddy Raccoon River and Des Moines River waters into pure drinking water.

First, presedimentation using huge underground basins is accompanied by ferric chloride and granulated activated carbon treatment. The water then passes into other basins where lime is added to flocculate and remove more contaminants. Next the water is passed onto large sand bed filters for further fine floc removal. Finally, chlorine is added to kill any remaining disease organisms.

Throughout seasonal periods, we have discovered that water conditions may suddenly change and affect our system's efficiency. We successfully prevent harmful microorganisms from reaching our finished water, yet we long to determine all of the variables that affect our treatment methods.

One project to aid our efforts is composed of urban creek studies. This project was designed to determine the effects that our local urban creeks have on our rivers.

In an attempt to determine the microbial and chemical influence that the main urban creek watersheds have on our source water rivers, the Des Moines Water Works set-up sampling and testing programs. Our primary intent was to sample the creeks following low-rain and high-rain periods. The tests included total coliform and *E. coli* counts using IDEXX Colilert media and Quanti-tray 2000's, plus anion determinations using the Dionex ion chromatography instrument with an AS9-SC column, and ammonia determinations using an Orion model 95-12 ammonia electrode in accordance with the 19th edition of Standard Methods 4500 NH3 D method.

Our facility distributes water to a community of 300,000 people. We alternate between the Des Moines River and the Raccoon River for our main water supply, plus we continuously use from an infiltration gallery for 20% to 50% of our water volume.

Each of the two rivers has a primary urban creek draining a water shed that meanders through residential and business areas. Walnut Creek is multibranched and eventually empties into the Raccoon river two miles above our facility's water intake. Beaver Creek has one main creek channel, plus a small branch. It's mouth is located three miles above of Des Moines River water intake.

Both creeks have branches that extend beyond the residential areas into rural agricultural land.

Creek sampling was performed with two different approaches. Sometimes we did a basic study where just the creek mouth was sampled, plus the river upstream from the creek, and also our water intake downstream. At other times we did a complete or near complete study where the basic program was performed, plus several other creek sites.

Interesting data was generated, as we compared test result differences from one creek branch to another. Overall influence on the rivers by the relatively small creeks, was sometimes remarkable.

One creek and river assessment on June 25, 1997, followed a heavy rain. It was comprised of a Walnut Creek mouth sample, a Raccoon River upstream of Walnut Creek sample, and a Raccoon River downstream sample which was at our facility's water intake site.

The Walnut Creek sample yielded nearly ten times the amount of total coliform bacteria, and five times the *E.coli*, than did the upstream Raccoon River sample. It influenced the Raccoon River (as reflected by the downstream sample), by increasing the total coliform count by 54%, despite the Raccoon River's large water volume. *E.coli* changes were not significant.

High urban watershed bacterial counts were common from other creeks studies that we performed also, including Beaver Creek. This, however, should not be interpreted to mean that rural microbial contributions are insignificant.

Nitrate levels were over five times lower in Walnut Creek than they were in the upstream Raccoon River sample. This fell in line with most other creek studies that we performed, where agricultural water sheds were the greater contributors of nitrate contamination, versus urban watersheds.

The flow rates of Walnut Creek and Raccoon River on this study's sampling day were 202 cu ft/second and 5260 cu ft/ second respectively. This means Walnut Creek represented only 1/26th (3.8%) of the resultant river's volume.

Several other studies were performed including the entire Walnut Creek water shed (up to 20 prechosen and mapped sampling sites), plus similar Beaver Creek studies (up to 12 prechosen and mapped sampling sites).

Different creek branches yielded significantly different bacterial and chemistry results, slowly constructing a picture of the watersheds and how they affect the water quality of our rivers. This was especially realized when the data was computer charted and graphed.

Because hundreds of thousands of people in the Des Moines area rely on an unpolluted water source for their health and industry, we continue our studies of the urban watersheds. We hope to someday, be able to use the data to improve our treatment process and perhaps the water quality of the rivers.

## STREAM BANK STABILIZATION WITH TREES? IT REALLY DOES WORK!

Jim and Jody Kerns
Clayton County Farmers
Edgewood

### History

In 1989 we purchased our farm as an investment to supplement our careers. Jim is a business owner of a locker plant in our community, and until a few years ago, Jody worked as an X-ray technologist, and has since become a full-time homemaker due to the addition of three children to our family. At the time of our purchase, 22 acres of rich crop ground laid adjacent to the Volga River, and was having significant stream bank erosion problems. The erosion began accelerating at a very fast pace during the flood years, and soon the FSA maps showed a decrease of several acres over a five year period, with no end in sight. As a young family who enjoys also using our farm for recreation, the sandbar on the other side of the river was very inviting, but unfortunately we had to give up our good soil producing ground to obtain it, and Jim wasn't excited about building a bridge to get there.

Once we realized we had a frustrating problem with no end in sight, we began to struggle with solutions. Not only has our farm become a support beam in our family as an economic investment and income source, but it provides us with many opportunities for family recreation as well as learning challenges for our children.

### In Search Of Our Perfect Solution

When we began searching out a solution to our ever growing problem, we set our priorities as economical, feasibility, environmental issues, natural aesthetics, and we needed something that we felt would give us good results-O.K., so we don't want much, huh? In 1995 Jody came across an article in the "Iowa Conservationist" magazine on controlling river bank erosion through a tree planting known as willow post. With being tree farmers, this concept really caught our attention, so we contacted Bruce Blair, our District Forester, and Jeff Tisl, our Natural Resource Conservation Service (NRCS) soil conservation specialist. After the four of us met, and discussed the concept, we all became quite interested. We found that using willow post to control river bank erosion can be extremely effective at approximately ¼ the cost of the traditional rip rap. It looked like the option we were seeking. We also decided instead of trying to crop the small amount of acres left, we would convert them to a wetland/prairie area. It's our vision that the loss of value in what was once crop ground can be reclaimed in the land value of establishing a private wildlife haven and the future crop trees.

**Forming Successful Partnerships To Ensure Water Quality And Project Success**

In our opinion, this can be the most important step taken towards achieving project success. As landowners without knowledge in the field of soil bioengineering, you desperately need to seek out professional help available through your local NRCS, and FSA offices, or Iowa State. Jeff Tisl, our NRCS specialist took our project under his wing, and became the "base" that each involved partner could turn to, and Jeff has done a great job of this! In the first phase of the project, every partner who could provide potential insight, advice, or project design, were invited to attend a planning session. This provided the start of a great working atmosphere between all involved partners. Feasibility of the project, methods to use, and each partner's role in the project were determined at this meeting. Everyone was also very respectful of our rights, concerns, and ideas as landowners, and in turn we also respected the vast amount of knowledge the people we were working with could offer towards this project. We trusted the experts to make the major planning decisions, while they tried to incorporate out concerns, and personal ideas into the plan. After several large manila envelopes in the mail, and an few phone conference calls (both very cost effective means of communication for a large group of partners), we came up with a plan and time schedule. We had all worked together as a team to combine the ideas of many individuals into the same goal, to design an effective willow post river bank stabilization, with adjoining riparian and wetland, while combining our personal goals and criteria.

**Let The Games Begin!**

The actual construction phase certainly proved to be the most exciting and rewarding. Jeff Tisl, spent many hours at the site, helping with installation and over-seeing that things were being done correctly. Jeff stated he found the hands-on to be an excellent experience for himself and really helped him obtain a higher level of knowledge on willow post stabilization. With the exception of the days we ran heavy equipment, our children all helped and played beside us each day. All of the partners involved realized the importance of this to us, and were extremely patient with our very young children.

In August of 1996 the earthwork for the wetlands and river bank shaping was completed, along with placement of geo-mat fabric, and toe rock rip rap for stream bank protection. As we progressed into this past Spring we prepared for the installation of the post, and as with anything, things didn't always go as planned. The first hurdle we encountered was the day the willow post arrived in late March, sometimes referred to as the "muddin" season. This slang word took on true meaning for us. Due to the location of the site, we were skeptical as to whether or not we should try getting the heavy load delivered to the site with the soft ground. The decision no longer became ours, when the large trailer of willow pulled into the driveway, the first thing it did was sink into the mud and become stuck! Our first experience with willows was having the joy of unloading 800 ten foot willow post, and 1200 willow stakes off of the trailer, and onto pickups and then delivering them to a nearby shed to keep them cool and shaded until they were ready to be installed. After a few hours of this the post all began to feel like trees.

Installation of the project was scheduled to take place the last week of April. We had a super equipment operator, who really worked well with us and our schedules. He became very important to the success of the project. Not only do you need to rely on him to be there when needed, but you put a lot of faith in this person when your placing the post while standing next to the swinging auger attached to his hand controls. The placement of the willow post went very smoothly and efficiently. With Jeff, the equipment operator, and ourselves, we were able to place all the post in 1½ days, or approximately 60 post per hour. After placing the post we then had to back fill the post holes with the dirt/mud around the post. Since this job required us to use our hands and feet, and dance around the post, we soon called this job the "Volga River Shuffle".

Next on the agenda was the placement of the willow stakes. After hefting around willow post for two days, we assumed that placing the 1200 willow stakes would be a fairly simple job. We were quite shocked to find out that pounding in each individual willow stake with a mall was actually a much more labor intense job than we ever imagined. We finally gave in and enlisted help from some high school boys, as we didn't think we'd ever accomplish this job on our own. There are methods of planting stakes using a water pressure hose to make the hole to place the stake, and as we discovered, this may not be a bad option to consider. To finish the stream bank we still needed to place and tie down cedar trees between the first and second row of willows. The cedars would provide some temporary stream bank protection until the willows took root. This was not one of the more labor intense jobs to be completed, but we soon found out it was the most painful.

With a completed stream bank we were well on the way to accomplishing our goals. Next was the planting of the woody riparian. With tree planting in our blood we thoroughly enjoyed this task. We planted 4000 trees and shrubs, and due to a time crunch, we began at noon, and finished at 10:30 that night. Thank goodness for tractor headlights. We wouldn't recommend planting in the dark to first time tree planters, but fortunately we had planted enough in the past that we were able to make it work, and still have straight rows the morning! To complete our project we had a few finishing touches, and then had to seed our prairie the first week in June

**Achieving Success!**

Throughout this first year our project had required more maintenance than if we had used traditional rock rip rap, the price one pays for striving towards natural aesthetics and cost effectiveness. There have been tree rows and prairie to mow, spraying the willows for spider mites, controlling beaver damage, and praying a lot that we didn't suffer a flood this first critical year. We were very fortunate to have suffered little damage this past summer. We did have sustained high waters over a two week period which ended up killing the first month's growth on the bottom two rows of willows, but the trees did sprout back nicely despite that early set back. We learned success couldn't have been obtained without the professional help each partner had to offer, whether big or small. Our planting techniques seem to be working quite effectively. The extra cost and time consuming steps have also proven invaluable. We discovered from our experiences that the geo-mat fabric was a valuable step, certainly worth the extra cost, and as painful as placement of the cedar were, seeing how well they silted in by the end of the summer proved the effectiveness.

**Summary**

By the end of the summer we were able to take our three children out to the project and not only enjoy our handiwork, but also the pride of standing at the river bank edge and realizing we had actually achieved our goals. For the first time in several years the strength of the river didn't carry our precious crop ground down stream with it. The joy received in watching our seven, five, and three year olds observing the trees grow that they helped plant, and searching through the prairie to see who can be the first to spot a new flower is a feeling beyond description, and just takes our personal success of this project to a level higher than what we had originally hoped to accomplish.

## AN EVALUATION OF STREAM WATER QUALITY IN AN AGRICULTURAL WATERSHED BASED ON THE RAPID BIOASSESSMENT OF THE RESIDENT BENTHIC MACROINVERTEBRATE COMMUNITY

Michael D. Schueller
Limnologist
University Hygienic Laboratory
University of Iowa
Iowa City

Nonpoint source pollution is perhaps the most difficult source of contamination in our environment to define and control. Estimates suggest as much as 70% of all pollution is attributable to nonpoint sources. Sediment derived from soil erosion is the primary nonpoint source pollutant in the state of Iowa. Nonpoint source nutrient and sediment loads originating from agricultural activities affect water quality both locally and far downstream. Therefore, the public and private sectors at local and national levels are addressing methods to reduce the rates of topsoil erosion and preserve and improve the integrity of the water quality and aquatic life in surface waters.

Improving and preserving the integrity of the surface waters in a primarily agricultural state is a difficult task. Several watershed projects currently underway in Iowa are investigating the relationship between land use and water quality. One such project is the Sny Magill Creek Nonpoint Source Pollution Monitoring Project. Sny Magill Creek is located in Clayton County in northeast Iowa. The watershed in which Sny Magill Creek lies is comprised of 22,780 acres, nearly all in agricultural use (26% row crops, 24% cover crop/pasture, 49% forested/forested pasture). This monitoring project has been underway since 1991, during which time state and federal agricultural advisors and planners have worked with landowners to implement various Best Management Practices (BMPs). BMPs are landuse practices that are designed to reduce the amount of sediment, nutrients, and animal wastes entering the mainstem stream and its tributaries.

Evaluating the effectiveness of landuse changes is the overall objective of the Sny Magill Creek monitoring project. There are many components (water chemistry, sediment loading, habitat assessment, fisheries, benthic macroinvertebrates) being evaluated to measure any changes in the overall aquatic environment of the creek. The focus of this presentation will be the relative health of the benthic macroinvertebrate communities in Sny Magill Creek and what that reveals about the water quality of the stream. Benthic macroinvertebrates are bottom dwelling organisms and are excellent indicator organisms because of their varying degrees of tolerance to organic pollution. Benthic monitoring for this project has been ongoing for six consecutive years. This presentation will be primarily a discussion of sampling and a comparative discussion of results from 1991-1997.

## LUCAS COUNTY LAKES WATER QUALITY PROTECTION PROJECT CHARITON MIDDLE SCHOOL SCIENCE CLUB - IMPACTING THEIR COMMUNITY

Lowell Wiele
Sponsor - Chariton Middle School Science Club
Lucas County
Chariton

### Background

The water quality in three man-made lakes, Ellis, Morris and Red Haw, east of Chariton in southern Iowa is declining.

Ellis and Morris lakes are the primary water supply for Chariton's residential, commercial and industrial use. Lake Ellis has a watershed of 810 acres. Lake Morris has a watershed of 4,448 acres. Lake Red Haw, in Red Haw State Park, is used as a recreational lake. It is also an emergency water supply source for Chariton. Lake Red Haw has a watershed of 1,018 acres.

Public consumption from these three lakes equals 400,000 gallons daily with about 80 percent being for residential use and 20 percent for commercial and industrial use.

The water quality of these three lakes is negatively affected by sediment, nutrients and animal wastes from surrounding farms.

The water quality project is in its third year of a four year effort to improve and protect the quality of these lakes through a variety of best management practices. These practices are designed to reduce agricultural pollution in critical areas. These critical areas include: highly erodible crop land, poorly managed pasture and hay land, and deteriorated stream corridors.

### Enter the Chariton Middle School Science Club

Once the Lucas County Lakes Water Quality Protection Project was approved and functioning it became necessary to monitor the water in the three lakes. The Chariton Middle School Science Club (CMSSC) had been monitoring the flow and stream profile of Little White Breast Creek for nearly 10 years. Also, the science club and the Chariton seventh grade science classes (125 students) had just begun conducting water and soil tests at Pin Oak Marsh in Lucas county. The late Joe Neat, District Commissioner, Lucas County NRCS, had been a cooperating scientist for the CMSSC's on going stream study. Neat knew the background and qualities of the science club and asked if the club would be interested in submitting a proposal to monitor the water quality for the new Lucas County Lakes Project. Representatives from the Lucas County NRCS, The Lucas County Lakes Project and the CMSSC met and discussed the concept.

Plans were laid, objectives and monitoring sites were agreed upon, funding was approved, and monitoring, testing and reporting of results were worked out. An agreement between the local NRCS, the DNR and the CMSSC was reached. The agreement emphasized that, while this is a monitoring plan, it is also an elaborate educational program for students and the community. The water monitoring project provides an outstanding opportunity for students to become involved in a "real life" project that has a direct impact and bearing on the quality of water in their own community. The students collect the samples from the designated sites and perform their own tests on the samples collected. By analyzing the samples the students validate their testing and analytical techniques. The entire process enables the club members to collect, observe, compare, draw conclusions, develop measurement and analytical skills, use a variety of equipment, maintain a journal, study trends, and conduct the administrative responsibilities involved in monitoring and reporting the results.

A summary of the monitoring objectives are as follows: (1) Provide complete and educational test results for students and the community; (2) Exhibit correlation between wetlands and water quality; (3) Allow students to conduct meaningful, real world, activities; (4) Implement public information programs regarding the watershed and the monitoring of the three lakes; (5) allow local students to take ownership in water quality improvements in their community.

The first year was primarily gathering baseline data from the three lakes. As structures and wetlands were constructed, and land management practices were implemented, students were able to compare the quality of the water to the baseline data gathered earlier. The club members became scientists doing a real life service for their community as the collected and tested the biweekly samples. The club developed a cooperative partnership with the Chariton water department as they cross-check their test results with similar tests the water department conducts at the Lake Ellis water purification site (control). The CMSSC's cooperative partnerships reach beyond the Chariton water department. The club works directly with and reports to the Lucas County NRCS. Quarterly and annual reports are sent to the DNR. The Iowa Environmental Council recognizes the club's involvement and has listed the CMSSC in its *Iowa Volunteer Water Monitoring Directory*. Geo-Chemical Engineering (Hollywood, Florida) has assisted and offered resources to the science club. *The Volunteer Monitor* (national water quality monitoring newsletter) has recognized the young scientists from the Chariton Middle School and their work involving the monitoring of the lakes included in the Lucas County Lakes Water Quality Protection Project.

## DETERMINING WATER QUALITY BY SURVEYING MACROINVERTEBRATES WITH SEVENTH GRADERS

John Zietlow
Science Teacher, West Delaware Middle School
Delaware County
Manchester

Education is always trying to find ways to unite what the students are learning in the classroom to the real world. By doing so students take ownership in what they are learning. Over the last two and half years, the West Delaware Seventh Grade in partnership with the local NRCS office and the Manchester Fish Hatchery has been testing the water quality for the Spring Branch Watershed Project.

The Spring Branch Watershed Project was started to help improve the water quality in the Spring Branch Creek watershed. The farmers in this 12,000 acre watershed are using farming practices to reduce the amount of pollutants that are entering Spring Branch Creek. Some of these pollutants include sediments, pesticides, and excess nutrient fertilizers. The goal of these farmers is to maximize profits by only using those chemicals and fertilizers that are needed which should reduce pollutant runoff from their fields.

Mike Freiburger, project coordinator, from the Delaware County NRCS office contacted the West Delaware Middle School to see if there were some students who could monitor water quality. That is when Hank Bramman and John Zietlow saw the opportunity for a group of seventh graders to use some of the knowledge they had received in the classroom and use that knowledge for a community project.

It was decided to test the water four times a year, once each season. The method of testing had to be something that a seventh grader could handle. The "Benthic Macroinvertebrate Tolerance Index" form the Illinois Rivers Project was chosen because of it's ease of use and of how it uses tolerance levels. Group 1 organisms are most intolerant to pollution which would indicate the best water quality. Group 2 would be moderately intolerant, Group 3 would be fairly tolerant, and Group 4 would be most tolerant to pollution. Using a weighted mathematical formula, the stream tester can determine the "Water Quality" from the following scale:

| | |
|---|---|
| 1.0 - 2.0 | Excellent |
| 2.1 - 2.5 | Good |
| 2.6 - 3.5 | Fair |
| Over 3.6 | Poor |

Once each season, the students sample Spring Branch Creek in two locations. The samples are analyzed to determine which organisms are present. The data is then entered into a computer spreadsheet to determine the water quality. So far 8 samples have been taken from Spring

Branch Creek. Many more samples will be needed to get a trend for how the watershed quality is doing.

On the following page is a copy of the "Benthic Macroinvertebrates" form which we use in our sampling. To receives more information about this and more water sampling forms, contact Dr. Robert Williams, Project Director for the Illinois Rivers Project at 1-618-692-3788 or e-mail rivers@siue.edu. Another resource person would be Dean Hartman at the Grant Wood AEA in Ceder Rapids at 1-319-399-6700.

# BENTHIC MACROINVERTEBRATE TOLERANCE INDEX

STREAM: SPRING BRANCH CREEK
SCHOOL: WDMS — SAMPLE NO. 1 = FISH HATCHERY
DATE: OCT.29,97 — SAMPLE NO. 2 = FISHERMANS ACCESS
TIME: 12:30
WEATHER: 48, Party Cl
WATER COND: CLEAR

| GROUP 1<br>MOST INTOLERANT | SAMPLE 1 | SAMPLE 2 | GROUP 2<br>MODERATELY INTOLERANT | SAMPLE 1 | SAMPLE 2 | GROUP 3<br>FAIRLY TOLERANT | SAMPLE 1 | SAMPLE 2 | GROUP 4<br>MOST TOLERANT | SAMPLE 1 | SAMPLE 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Stone Fly | 1 | 1 | Caddisfly | 1 | 1 | Black Fly | | | Worms | | |
| | | | Mayfly | 1 | 1 | | | | | | |
| Alder Fly | | 1 | Riffle Beetles | 1 | | Midge | | | Leech | | |
| | | | Water Penny | | | | | | | | |
| Dobsonfly | | | Dragonfly | | 1 | Sowbug | | | Left Handed | 1 | 1 |
| | | | Crayfish | | | | | | Pouch snail | | |
| Snipe Fly | 1 | | Cranefly | | | Scud | 1 | 1 | | | |
| | | | Clam/Mussel | | | | | | Blood Worm | | 1 |
| | | | | | | Right Handed/ | | | | | |
| | | | | | | Other snails | | | Midge | | |
| Best Water Quality | | | | | | | | | | | |
| # of taxa = | 2 | 2 | # of taxa= | 3 | 3 | # of taxa = | 1 | 1 | # of taxa = | 1 | 2 |
| X 1 = | 2 | 2 | X 2 = | 6 | 6 | X 3 = | 3 | 3 | X 4 = | 4 | 8 |

| | SAMPLE 1 | SAMPLE 2 |
|---|---|---|
| TOTAL OF ALL GROUP SCORES | 15 | 19 |
| TOTAL NO. OF DIFFERENT TAXA | 7 | 8 |
| TOT. GR. SCORE/TOT. # OF TAXA | 2.1 | 2.4 |
| WATER POLLUTION TOLERANCE SCORE | | |

**WATER QUALITY**

**1.0 - 2.0 = EXCELLENT**

**2.1 - 2.5 = GOOD**

**2.6 - 3.5 = FAIR**

**OVER 3.6 = POOR**

# THE EVOLUTION OF THE SNY MAGILL WATERSHED PROJECT

Eric Palas
Extension Program Specialist
Iowa State University Extension
Postville

Jeff Tisl
Water Quality Project Coordinator
Natural Resources Conservation Service
Elkader

Lynette Seigley
Research Geologist
Iowa Department of Natural Resources/Geological Survey Bureau
Iowa City

Since its inception in 1991, the Sny Magill Watershed Project has demonstrated the benefits of cooperative inter-agency efforts in protecting the water resources of Sny Magill Creek in northeastern Clayton County, Iowa. The U.S. Department of Agriculture initiated the Sny Magill Hydrologic Unit Area (HUA) to provide technical assistance, information and education, and cost share assistance to producers within the creek's 22,780-acre agricultural watershed. The assistance is offered to producers on a voluntary basis and is designed to reduce erosion and runoff of excess nutrients and pesticides that impair the quality of the stream. At the same time, a water quality monitoring program was developed to quantify the beneficial impacts that the HUA and landowner efforts would have upon water quality. This monitoring project was accepted into the U.S. Environmental Protection Agency's National Monitoring Program. In 1995, the State of Iowa developed the Sny Magill Creek Watershed Project. This project was formed to provide additional incentive funding to assist landowners in adopting a wide range of traditional and innovative Best Management Practices (BMPs).

Since 1991, a majority of the watershed's producers have adopted a diverse selection of BMPs. Iowa State University Extension (ISUE) reports that pesticide and nutrient loading has been reduced on 45% of the cropland acres through the delivery of an ICM assistance program. The Natural Resources Conservation Service (NRCS) estimates that sediment delivery to the stream has been reduced by 40%. Early monitoring results suggest that some water quality improvements are occurring.

## Nutrient and Pesticide Management

ISUE's role in the Sny Magill Project has centered on the area of nutrient and pesticide management. Efforts have focused on crop management programs that encourage the more efficient use of agricultural chemicals, increase the use of on-farm resources, and maintain or increase producer profitability.

During the initial stages of the project, an integrated crop management (ICM) program was offered. Involved producers enrolled over 3000 crop acres and reduced nitrogen applications by nearly 40,000 pounds during the 1994 crop year. Returns to producers averaged $13.85 per acre. While the program was successful from a reduction standpoint, there was concern over whether producers would continue to implement practices following completion of the project.

An alternative effort, the Nutrient and Pest Management Incentive Education program (NPMI) was developed and implemented in 1994. To enhance long-term adoption of practices, it encourages participating farmers to learn the basics of managing their own nutrient and pest management programs. Workshop sessions involve reading soil maps and soil test reports, fertilizing for realistic yield goals, as well as determining manure inventories and legume fertility credits. The program allows cooperators to develop, write, and implement their own nutrient, manure utilization, and pest management plans.

The NPMI program represents an alternative effort based on the lessons learned from initial project efforts. There is growing interest in implementing this program, or components of it, in projects across Iowa and other states.

### BMPs to Reduce Sediment

The project offers both technical and financial assistance to producers to assist them in adopting BMPs that are designed to reduce soil erosion, but not at the expense of profitability or productivity of the producer. For example, a common BMP used by producers in the watershed is tile outlet terraces. Even with financial assistance, some limited resource producers found it impossible to afford their share of the cost of installation. Additional efforts were made to ensure that adoption of an erosion reducing BMP would not lead to any significant reductions in productivity.

A variety of "traditional" sediment reducing BMPs have been applied in the watershed since 1991. These practices include conservation cropping (rotations), conservation tillage, grade stabilization structures, pasture and hayland management, terraces, timber management plans, and water and sediment control basins.

Part of the reason why special water quality projects have been created was to develop, test, and promote innovative water quality practices. Efforts in the Sny Magill watershed have been made to demonstrate alternative forms of streambank stabilization techniques.

Traditionally, the primary solution to streambank erosion problems has been installing rock rip-rap based practices. There is debate over the cost effectiveness, aesthetics, and long-term sustainability of such practices, but since few alternatives existed, the rock rip-rap based systems were installed by default. In 1995 the Sny Magill Creek Watershed project initiated a series of installations using alternative forms of streambank stabilization practices. A total of six different systems have been installed, with one more scheduled for 1998. These installations have used different combinations of willow stakes, warm and cool season grasses, erosion control fabrics, and limited rock rip-rap only when necessary. Plans are to monitor the installations, assess their effectiveness, and use them to develop additional alternatives.

## Water Quality Monitoring at the Watershed Scale

Under Section 319 of the Clean Water Act, the U.S. EPA developed the National Monitoring Program to evaluate how improved land management at a watershed scale reduces water pollution. The Sny Magill Watershed, part of the National Monitoring Program, is monitoring the land and water resources before, during, and after changes in land management occur in the watershed to determine if the land-based activities in the Sny Magill watershed have improved water quality. A paired watershed approach is being used; Bloody Run Creek, the adjacent watershed to the north, is serving as the control watershed. The project is evaluating the overall health of Sny Magill Creek, going beyond the traditional physical/chemical monitoring to also include evaluation of habitat along the stream corridor and the fish and benthic macroinvertebrate populations in the stream.

At this time, results from the monitoring are mixed. Relative to Bloody Run Creek, Sny Magill Creek has shown improvements in the benthic macroinvertebrate populations and a decline in pesticide detections and turbidity levels. The fish and habitat assessments, however, give no indication of improving water, and nitrate and sediment loads have yet to decline in Sny Magill Creek.

Several lessons have been learned from the monitoring program: (1) despite well-designed monitoring, climate remains an uncontrollable variable that complicates attempts to link water quality improvements to changes in land treatment; (2) by monitoring a variety of parameters, some results suggest improved water quality while others do not; (3) documentation of reductions in sediment loads in surface water related to land treatment changes will continue to be a challenge in Iowa because of the large volumes of historical sediment stored in the various drainage networks; and (4) the water quality response to land treatment changes at the watershed scale does not occur in the short term, rather there needs to be a continued commitment to long-term monitoring to successfully link land management changes to water quality improvements.

## Summary

The Sny Magill project has been active for seven years and has undergone a great deal of change in that time. Flexibility has been a key to the success of the project. As the project has evolved, innovative BMPs and monitoring techniques have been developed to meet the needs of the projects, its partners, and the participating producers. The benefits of the project, its lessons learned, and the relationships of the partners can serve as a model for efforts across Iowa and other states.

Acknowledgements: *Support for the water-quality monitoring is provided, in part, by a grant from the U.S. EPA Region VII (Nonpoint Source Program), and is administered by the Iowa Department of Natural Resources.*

# HOW I USE PRECISION FARMING ON MY FARM AND HOW IT MAY IMPACT WATER QUALITY

Stewart Baldner
Dallas County Farmer
Dallas Center

When I first began to read about precision farming using global positioning technology I never thought about the effect it may have on water quality.

I am using grid sampling and variable rate technology (VRT) on my farm. Grid sampling is geo-referenced soil testing using satellites technology. VRT uses the information from the geo-referenced soil tests to apply a varying rate of fertilizer across a field rather than a set rate.

This has not only reduced my fertilizer cost \$5 to \$25 per acre, but has also reduced the amount of total product applied. In some cases it has cut it over 50%. This is a win win situation for both the farmer and the consumer.

There may be more benefits from this new technology as we continue to learn more about it.

# OVERVIEW & STATUS OF STATE PROGRAMS REGULATING ANIMAL FEEDING OPERATIONS

Ubbo Agena
Department of Natural Resources
Water Resources Section
Des Moines

In recent years, Iowa's water pollution control program dealing with confinement animal feeding operations has undergone considerable change, and further changes are likely. This presentation will review the current status and changes made in Iowa's program and discuss activities currently underway, which may influence the program's future direction.

Beginning in the late 1980's, significant changes began taking place in Iowa's confinement livestock industry. During this period, the state began to see increased construction of new confinement operations, mainly involving hogs and, to a lesser degree, poultry. Accompanying these increases were trends toward greater size in individual operations, increased use of lagoons and earthen basins for manure storage, construction being concentrated in small geographic areas, and increased use of contract feeding. During this period, the number of operations issued construction permits by the Department of Natural Resources (DNR) increased significantly, going from an average of less than 10 operations permitted annually during most of the 1980's to 170 being permitted in 1994.

As the number of confinement operations receiving permits increased, many people began to express concerns over potential environmental and other impacts associated with these operations. As would be expected, individuals expressing the greatest concerns generally lived near these operations, although over time the concerns spread statewide. Public pressure for increased state regulation of large confinement operations began in the early 1990's, and resulted in a bill placing restrictions on the size of confinement operations being debated in the Iowa House in the closing days of the 1994 legislative session. Although ultimately defeated, this bill showed that confinement feeding was becoming a major statewide political issue.

In early summer 1994, Governor Branstad appointed a 20-member committee to evaluate current state environmental laws and rules dealing with confinement feeding operations and recommend if, and if so, how such laws and rules should be modified. This committee held a number of meetings during 1994 and obtained input on confinement feeding issues from various sources, including state agencies, university staff, agricultural organizations, and the general public. In late 1994, the committee submitted to the Governor a report calling for significant revision of various aspects of the existing state laws and rules regulating confinement operations.

Also in 1994, the Iowa Legislature established an interim study committee to evaluate and recommend changes in the state's laws and rules impacting confinement operations. Although this committee met several times during 1994, it was unable to reach consensus on recommendations to forward to the General Assembly, and instead agreed the report developed by the Governor's committee should be used as the starting point for legislative action. During the 1995 legislative session, revision of state environmental laws regulating confinement animal feeding operations was a major agenda item. After considerable discussion and debate, the Legislature passed and sent the Governor for signature a bill making major changes in the state's approach to regulating confinement operations. This bill, known as House File 519 (HF 519), became law on May 31, 1995, when signed by the Governor.

While identification of all provisions of HF 519 is beyond the scope of this presentation, its major features included:

- defined "small animal feeding operations" as operations with an animal weight capacity of less than 200,000 pounds for all species other than cattle (for cattle the weight is 400,000 pounds), and prohibited DNR from requiring small operations to obtain permits; for larger operations DNR has responsibility for establishing permit requirements through its rules;
- expanded the list of facilities benefiting from separation distances requirements such that requirements now apply to neighboring residences, public use areas, commercial enterprises, educational facilities, and churches; in addition, the types of structures subject to distance requirements was expanded to cover more types of manure storage structures as well as confinement buildings;
- established a Manure Storage Indemnity Fund, funded by fees collected from current and past permit applicants and from penalties the state collects from animal feeding operations for violations of the law or regulations; fund is to be used to reimburse counties for costs incurred in cleaning up confinement feeding sites which close without removing accumulated manure and become county property as a result of non-payment of property taxes;
- incorporated into state law many of the minimum manure control requirements previously found in DNR rules, including the no-discharge standard for manure control from confinement operations;
- required confinement operations applying for a construction permit to also develop and submit manure management plans for DNR approval, and to comply with the provisions of these plans in land application of manure; a major feature of these plans is the requirement that total nitrogen application on fields receiving manure not exceed crop nitrogen needs;
- required copy of permit application and manure management plan be submitted to board of supervisors in county operation will be located; prohibited DNR from issuing permit within 30 days and required DNR to issue permit within 60 days of receiving complete application; and,
- prohibited DNR from issuing additional permits to operations if a person having an interest in the operation has an enforcement action pending or has been classified as a habitual violator (three-strikes provision).

Although HF 519 established an overall framework for the state's regulatory program, many of the program's details were left for DNR to develop through adoption of revised rules. HF 519 required DNR to consult with an advisory committee in developing and implementing this program, and specified the membership of this eight-member committee. Beginning the summer of 1995, DNR worked closely with this advisory committee, known as the Animal Agriculture Advisory Committee (AACO), to revise the Chapter 65 Animal Feeding Operations rules. Public comments on proposed revisions to these rules were received in early winter 1995, and the revised rules became effective March 20, 1996. Again, while discussion of all provisions of the revised rules is beyond the scope of this presentation, major features include:

- new or expanding confinement operations using anaerobic lagoons or earthen manure storage structures are required to obtain construction permits from DNR if their capacity is 200,000 pounds or more (400,000 pounds for cattle), while operations using formed manure storage structures are required to obtain permits if their capacity equals or exceeds 625,000 pounds (1,600,000 pounds for cattle);
- detailed criteria and procedures for developing manure management plans are established; and requirements for developing manure management plans are extended to new confinement operations using formed manure storage structures and having an animal capacity between 200,000 and 625,000 pounds (cattle operations using formed storage are exempt);
- specific design and construction standards are established for a variety of manure storage structures, including requirements for determining if tile lines are located in the vicinity of anaerobic lagoons or other earthen manure storage structures and removing such lines, if found;
- restrictions on use of spray irrigation are established, including minimum separation distance requirements from residences and other protected facilities; and,
- the engineer's responsibilities for ensuring structures are properly constructed are significantly increased, including requirements that the engineer or his/her designee supervise during critical points of construction and certify compliance of constructed facilities with the approved design plans.

Although a number of bills to further regulate confinement operations were introduced in the Iowa Legislature in 1996; no changes in HF 519 or other legislation modifying its requirements were adopted.

During 1996, investigations by DNR staff identified a number of design and construction problems at several existing confinement feeding operations. Although DNR required these operations to implement corrective measures, DNR's investigations also indicated a need for rule revisions to reduce the potential for encountering such problems in the future. As a consequence, in early 1997 DNR asked AACO to recommend appropriate rule changes. After holding a series of meetings to obtain input, in June AACO presented its recommendations to DNR. As DNR disagreed with some of AACO's recommendations, in September DNR presented the Environmental Protection Commission (EPC) both its recommendations and the AACO recommendations (where they differed). Final action adopting the rule revisions occurred in December 1997, with the revisions scheduled to become effective January 21, 1998. Major areas covered by these revisions include clarification of the soils and water table information which must be submitted in permit applications, more detailed design and construction standards for liners used to control seepage from earthen manure storage structures, minimum construction standards for concrete manure storage structures, and banning spray irrigation of manure within the drainage area of agricultural drainage wells (ADWs).

In the 1997 legislative session, several bills dealing with animal feeding operations were adopted. One prohibited individuals having an enforcement action pending or classified as a habitual violator from beginning construction or expansion of any confinement feeding operation, including operations for which a permit was not required. The other dealt mainly with ADWs, but included provisions prohibiting the construction or expansion of earthen wastewater structures within the drainage area of ADWs and requiring closure of ADWs which have existing earthen wastewater structures within their drainage area.

What does the future hold for state regulation of animal feeding operations? Although the answer to that questions is currently unknown, it appears additional changes are likely.

One issue currently receiving considerable attention is the role local governments should have in regulating confinement operations. As state law restricts counties from zoning agricultural operations, it has generally been assumed counties have no authority to regulate large confinement operations. However, this assumption is currently being tested in the courts, as a result of three ordinances adopted by the Humboldt County Board of Supervisors and upheld in district court. Of these, the ordinance of greatest concern to the livestock industry is one that requires large operations to provide financial assurance, in terms of bonds or other means, to cover costs of site clean up should the operation close. The Iowa Supreme Court is now considering the legality of these ordinances, with a decision expected in early 1998.

Regardless of the Supreme Court's decision on these ordinances, the issue of local control and numerous other issues related to state regulation of confinement feeding operations may again be considered in the 1998 session of the Iowa Legislature. In combination, a number of factors make further legislative consideration of these issues likely, including pressure from a number of citizens groups for increased regulation of confinement operations, demands by local officials for a greater role in the regulatory process and particularly in siting of large confinement facilities, and indications that the Governor's Office and both major political parties are likely to support some modifications in existing laws.

Issues which may receive consideration include, but are not limited to: giving local governments a greater regulatory role; modifying the nuisance lawsuit provisions of current law to increase the likelihood that neighbors to large confinement operations can prevail in such lawsuits; prohibiting or sharply restricting the use of anaerobic lagoons or other earthen manure storage structures; restricting or banning manure application on frozen or snow covered ground; and requiring large confinement operations to inject or immediately incorporate manure into the soil.

In addition to potential legislative action, DNR has identified additional areas where changes in the Chapter 65 rules are considered necessary, with action to initiate development of such rule changes expected in early 1998. A major thrust of such rule revisions is expected to better define which categories of operations must comply with current design standards. However, other issues will also likely be considered.

At present, the regulation of confinement feeding operations has largely been considered a state issue. However, there are indications this also may change. In recent years, large confinement swine operations have begun to locate in states which historically have had few, if any, large operations. In turn, this has begun to raise the environmental concerns associated with confinement operations to a national level. As a consequence, the US Environmental Protection

Agency (EPA) has begun a review of its existing livestock waste regulations and programs to determine what changes, if any, should be made to better address issues related to confinement operations. The eventual outcome of this review is currently unclear.

In addition, at a national level Senator Harkin has introduced legislation to establish a federal program to regulate large confinement facilities, with many of the program's features patterned after existing Iowa law. As drafted, primary responsibility for implementing the national program would rest with UDSA's Natural Resources Conservation Service and the US EPA. Again, the future of this legislation is unknown.

In a related matter, during 1997 the National Pork Producers Council has been working with the US EPA, the USDA, and several state departments of agriculture and state pollution control agencies to develop a model state pollution control program for pork production. The results of this effort, which should be completed shortly, is intended to provide a blueprint which states could use in developing individual state programs. Goals of such a program include establishing effective regulatory programs in all states, and in doing so, preventing swine operations from seeking to locate in states having lower environmental requirements. Although development of the model program is nearly complete, the likelihood that individual states will use it to develop their own programs is uncertain.

Before closing, it should be noted that while virtually all of the attention in recent years has been on confinement feeding operations, some of the activities currently underway or being considered are also likely to impact open feedlots. In Iowa, this would be appropriate, since the state has a number of open feedlots which have not taken steps to prevent manure runoff into state waters.

In summary, although in recent years Iowa's regulation of animal feeding operations has undergone considerable change, further changes appear likely.

## LIQUID ASSETS

John Miller
Livestock and Grain Farmer
Black Hawk County

### History

In the 1960's I farmed like my dad. A few acres of corn, a little oats, and a lot of hay and pasture for cattle and hogs. The fields were black in the spring. You certainly didn't want a single stalk showing to indicate you were a "sloppy" farmer. Hogs were raised on legume pasture and you cleaned up the yearly manure with a fall plowing. So much for the manure. Hogs went to a new legume seeding each year, so a number of fields got a fertility "kick". These field "hog lots" were always close to the building site.

In the 1970's the fences came out, the cows disappeared, and the swine herd moved into all of the old cattle and hog buildings. Now, the manure spreader and a honey wagon became more important and manure handling came on the schedule on a more frequent basis.

Manure storage in old buildings began with pigs on expanded steel mesh suspended over dirt floors. The dirt floors quickly gave way to cement lined shallow pits with one to six months storage. Manure storage and handling now was part of "the main event".

What really came to the forefront for me in the 70's was the huge responsibility I had as a farmer to be the caretaker, the spokesman, the defender of many things that occupy the same territory in which I grew crops and livestock. I had to husband everything into a workable, profitable unit. And, I couldn't add on the additional costs of producing a product responsibly to the consumer.

### Integrated Crop Management

What had been a few acres of corn and some hogs in the 60's became much more significant numbers in the 70's. With the responsibility this brought, we put together an Integrated Crop Management Program with a hired consultant in 1979. ICM is a practical approach to farming that keeps at the forefront the two very important ingredients of profitability and sustainability. It avoids confusing gross profits and net profits.

With ICM, we put together a manure management plan that complemented the crops we were raising. Nutrient analysis was done on a regular basis on the hog manure so we knew what we had from a fertilizer standpoint. That value could probably best be referred to as part of our liquid assets.

Together with the nutrient analysis, we took a look at our 12 different soil types and the task of defining realistic yield goals. My soils have a yield potential ranging from 80 to a 170 bushels per acre. You didn't want to put on 150 pounds of nitrogen from any source on bean stubble that had raised 50 bushels of beans and had a yield potential of 140 bushels of corn. You can't haul a two ton load on a one ton truck any more than you should fertilize for two hundred bushel yields if the soil capability is only 140 bushels.

The third item in the mix, was an accurate job of soil testing to find out what nutrient levels existed. Whether soil testing was done by soil type and history or some type of grid was immaterial as long as the end result was accurate.

When we put these three items together: manure analysis, realistic yield goals, and soil testing, we came up with a knowledgeable plan that allowed us to use all of our manure profitably and protect the environment by not over applying.

Sometimes the best interpretation of a soil test may be to put money into a tractor cab instead of fertilizer. Early on, my soil tests showed that manure was hauled as manure, not as fertilizer, and was dumped in the closest field to the buildings. A tractor cab would possibly have contributed to a more tolerable ride to a far field where the fertilizer need was much greater.

In some cases, a good soil test, well probed, accurately analyzed, with an unbiased recommendation may show that lime is the need - not fertilizer. Haul the manure where it is needed.

The Integrated Crop Management program covers a variety of production areas in addition to soil testing and fertilizer recommendations. These include seed selection, weed and chemical management, machinery management, conservation, and above all, record keeping. It is a very individualized program that is highly management intensive. ICM is site specific and seeks to maximize the TOTAL, not just the components. The TOTAL picture is why it fits so well with livestock production and the handling of manure. Manure is valuable, it's not a waste!

In the total picture of profitability and a sustainability that sustains the farmer, and his WHOLE community of soil, water, air, plants and animals, what is the value of an ICM program?

In the simplest, record based form, farmers who have followed the recommendations of a qualified ICM provider have realized a $2 to $5 dollar return for each dollar invested in the program. If you pay $4.00 an acre for the services, you would probably expect to see a $8 to $20 return on that investment.

The Butler County ICM Project had 50 farms of varying sizes. The farmers age range was almost 60 years. And when the analysis was done, these 50 farms saved about $500,000 or an average of $10,000 per farm by using ICM procedures. In that project, each acre returned about $22 extra profit.

This project demonstrated that a good ICM program could help sustain the farmer and his community by making the operation more profitable, but also help in sustaining the natural surrounding environment by limiting the nutrients that might end up in the water.

## Conclusion

Where am I today in manure management? Very much like I have been for almost 20 years. Let me conclude by listing the following points:

1. Manure management is not a specialized topic. Its part of the total picture. Everything has a trade off. You can't just look at manure, or manure equipment, or odor, or drainage wells, or lagoons, or deep pits, or fertilizer value or profits. It's a whole complex picture with vast interrelationships.

Today, wind direction, neighbors, residue cover, field slope and grade, and soil type are part of the considerations in this management.

2. Our program today is still based on matching our crop acreage to the number of hogs produced. If we had more hogs we would have to add more acres to benefit from the manure those hogs produce.

3. We're after net profits. We don't need to be the county corn yield champion. We're after farm net profits and so we have to be as good a crop producer as we are a livestock producer as we are a resource protector. Why get more land or more hogs if we can't make money on what we have? How can we truly say we made a profit from hogs if part of our social and environmental community suffers because of our actions?

4. Farmers, as well as everyone else have a responsibility, to protect the ground and shallow subsurface waters from which 80 percent of Iowans get their drinking water.

# LONG-TERM TRENDS IN NITRATE-N CONCENTRATIONS: BIG SPRING AND BEYOND

Robert D. Libra and Robert D. Rowden
Iowa Department of Natural Resources-Geological Survey Bureau
Creston

## Introduction

The agricultural practices, hydrology, and water quality of the 267 $km^2$ Big Spring groundwater basin in Clayton County, Iowa, have been studied by the Department of Natural Resources-Geological Survey Bureau since 1981 (Figure 1). Landuse within the basin is almost entirely agricultural, with about 300 farms. Small dairy and hog operations are common. Typically 40-50% of the basin area is planted to corn, about one-third to alfalfa, and about 10% of the basin is pasture and woodlands. Historic water-quality data had shown increases in nitrate in the groundwater of the basin (from about 3 mg/L to just below the U.S. E.P.A. drinking water standard of 10 mg/L as $NO_3$-N) paralleling a three-fold increase in nitrogen fertilizer use from the mid-1960s to the early 1980s (Hallberg et al., 1983, 1984; Figure 2).

A network of monitoring sites was established to track water quality in the groundwater basin. Sites include Big Spring, the groundwater outlet for the basin; tile drainage outlets; numerous surface waters sites; and private wells. The network, which at times included 50 sites, is designed in a "nested" fashion, so that water quality from areas ranging from less than 1 square mile (i.e., tile outlets from individual fields) to over 1,000 square miles (i.e., the Turkey River, which receives the groundwater and surface water from the basin) are monitored (Littke and Hallberg, 1991).

Initial monitoring in the basin showed that atrazine is present (>0.1 µg/L) year-round in surface- and groundwater, except during extended dry periods; that detectable concentrations of several other herbicides generally occur during the spring application period, but also occur year-round following runoff events; and that the mass of nitrate-nitrogen discharged from the basin is typically equivalent to one-third of that applied as fertilizer, and exceeds one-half in wetter years (Hallberg et al., 1983, 1984, 1989; Libra et al., 1986). Denitrification and instream nitrogen uptakeoccur before surface waters exit the basin, suggesting that even more nitrogen is lost from agricultural practices (Crumpton and Isenhart, 1987).

## Education and Demonstration Efforts

In an effort to reduce fertilizer and chemical losses from agricultural land, a multi-agency group initiated the Big Spring Basin Demonstration Project (BSBDP) in 1986. The project integrated public education with on-farm research and demonstration projects that stressed and monitored the environmental and economic benefits of prudent chemical management. Refined and expanded education and demonstration work continues under the auspices of the Northeast Iowa Demonstration Project. These efforts have resulted in an agronomic success story. During the past 15 years, inputs of purchased fertilizer nitrogen have declined by about 33%, while yields have been maintained. Over 40% of producers also decreased their rate of atrazine applications. This "win-win" situation currently saves producers $360,000 annually on their nitrogen fertilizer bills, while cutting the basins N-load by 400 thousand pounds.

### Water Quality Responses

Figure 3 shows annual basin precipitation, annual groundwater discharge from Big Spring, and annual flow-weighted mean nitrate and atrazine concentrations and loads. The flow-weighted mean is the mean concentration of a contaminant per unit volume of discharge, and the load is the weight of contaminant discharged. The similarity of the discharge and precipitation plots show how responsive the groundwater system is to changes in precipitation. On an annual basis, nitrate concentrations are strongly affected by climatic conditions that control recharge. Concentrations increase and decrease with the overall volume of water moving through the soil and into the groundwater system. From WY 1982 to WY 1989, $NO_3$-N concentrations at Big Spring generally declined from 8.8 to 5.7 mg/L, and nitrogen loads decreased from 873 thousand to 195 thousand pounds, while annual discharge declined from 46 to 15 million cubic meters (mcm). While some of the decrease in nitrate concentrations may reflect reductions in application rates, the effects of the reductions cannot be separated from the decrease caused by the decline in water-flux through the hydrologic system. From WY 1990 to WY 1991, annual discharge increased from 21.5 to 52 mcm while annual $NO_3$-N concentrations increased from 8.2 to 12.5 mg/L and nitrogen loads increased from 388 thousand to 1.45 million pounds. These significant increases in nitrate concentrations resulted from both the increased volume of water passing through the soil and groundwater system, and the leaching of unutilized nitrogen left over from the drought years. Any improvements in water quality that may have resulted from reduced nitrogen application were again obscured by these extreme climatic variations. Water Year 1993 was by far the wettest year recorded at Big Spring. From WY 1992 to WY 1993, annual discharge increased from 46 to 72 mcm, and annual nitrogen loads increased from 1.22 million to 1.8 million pounds. Nitrate concentrations decreased from 12.0 to 11.4 mg/L. This was the first year of monitoring that nitrate concentrations decreased as annual discharge increased. This decline may be due to extreme leaching of nitrogen during WYs 1991-1992. It is also possible that the gradual reductions in nitrogen applied within the basin are beginning to cause improvements in the water quality of Big Spring.

When attempting to relate changes in nitrogen inputs to changes in water quality, the historical record of nitrogen application suggests an additional complication exists. Applications increased sharply in the 1970's, more than doubling in the decade before monitoring began at Big Spring (Figure 2). How this rapid increase affected nitrate concentrations at Big Spring during the first few years of monitoring is unclear. If nitrogen inputs had not decreased during the 1980's, what nitrate concentrations would have resulted?

Unlike nitrate, annual mean atrazine concentrations do not increase and decrease with the water-flux through the Big Spring hydrologic system (Figure 3). Concentrations and loads do tend to increase with increased runoff, on a short-term basis. Atrazine concentrations increased from 0.2 to 0.7 μg/L from WY 1982 to 1985, and loads increased from 14 to 48 pounds, as discharge declined. The increases in annual atrazine concentrations following WYs 1988 and 1989, and the decreases in concentrations and loads from WYs 1990 and 1991 to WYs 1992 and 1993, are probably related to changes in the timing and intensity of rainfall and in the relative proportion of infiltration- versus runoff recharge comprising Big Spring's discharge. Pesticide degradation rates vary with environmental factors, such as soil moisture (U.S. E.P.A., 1986). The increases following the drought years may be due to the mobilization of atrazine that did not degrade during the previous dry conditions, and the decreases following WY 1991 may reflect the smaller-than-normal mass of herbicide available for mobilization to groundwater, because of the enhanced hydrolysis and microbial activity during the wet WY 1990-1991 period.

During 1983, the Payment-in-Kind (PIK) set-aside program provided the opportunity to evaluate the results of a one-year reduction in nitrogen applications of about 40% in the basin, or greater than that which has accrued year-by-year over the last decade (Figure 2). Statistical analysis of the relationship between discharge and nitrate concentrations at Big Spring suggests the significant decline in concentrations during 1985 was related to the major reduction in nitrogen inputs during 1983 (Hallberg et al., 1993).

## Long-Term Nitrate Trends and Basin Size

Figure 4 shows trends in discharge, and nitrate and atrazine concentrations, from Big Spring (BSP) and four other sites, ranging in size from less than 1 square mile (L22T, a tile outlet) to about 1,500 square miles (TR01, the Turkey River at Garber). RC02 is 70 square mile watershed that accounts for most of the surface water leaving the Big Spring basin, and L23S is a 5 square mile tributary watershed. While concentrations differ, similar annual trends in nitrate are apparent at all scales of monitoring and are driven by climatic variations, with higher concentrations occurring during wetter years (Rowden et al., 1995). An exception to this trend is water year 1993, when the extreme volume of precipitation, infiltration, and runoff appears to have diluted nitrate concentrations at all sites. Groundwater sites (L22T and BSP) exhibit higher nitrate concentrations than similarly sized surface watersheds, as the in-stream processes that consume nitrate in streams (Crumpton and Isenhart, 1987) are not operating in the groundwater. These same processes result in lower concentrations at the larger surface watershed monitoring sites. Note that land use has a limited effect on concentrations in these surface watersheds, as differences in land use are not great among the sites. Differences in concentrations between L22T and Big Spring do reflect land use differences. Through most of the monitoring period, the land drained by L22T was essentially all cropped to corn receiving N-fertilizer inputs. The resulting concentrations at L22T are indicative of ground water that has recharged through this land use. In contrast, concentrations at Big Spring are indicative of recharge through a mixture of land uses, which typically is 40-50% corn. The ratios of nitrate concentrations at L22T to those at Big Spring reflect this. Except for water-years 1989-1991, when a dramatic change from drought-to-wet conditions occurred, the ratio varied from 1.5 to 2.

## Long Term Nitrate Trends: Big Spring and Beyond

The monitoring at Big Spring represents the nations longest look at agricultural impacts on groundwater quality, and has generated an important record of surface water quality as well.

Data from the basin, the adjacent Sny Magill and Bloody Run watersheds ( Siegely et al., 1996) and the Turkey River, shows that similar seasonal and annual trends in nitrate concentrations occur in both surface water and groundwater in northeast Iowa. Investigations in other parts of Iowa have included long-term, frequent (weekly to bi-weekly) monitoring of nitrate concentrations in several of the states major surface watersheds. These include The Des Moines River Water Quality Network, which monitors sites from above Saylorville Reservoir to below Red Rocks Reservoir (Lutz, 1995); and The Coralville Reservoir Water Quality Study, which monitors sites along the Iowa River above and below Coralville Reservoir (Johnson and McDonald, 1997). Figure 5 shows annual mean nitrate concentrations at one site from the Des Moines (Des Moines River below Racoon River) and Iowa River (inflow to Coralville Reservoir) networks, along with data from Big Spring and the Turkey River. Annual mean concentrations show similar trends, with higher concentrations occurring during wetter years. 1993 is again an exception to this trend. Concentrations in the rivers varied from 1-3 mg/L nitrate-N during the drought of 1989, to 8-10 mg/L during the following wet years. Concentrations are higher in groundwater from Big Spring, relative to the surface waters, again because of the lack of in-stream processes in the groundwater. Annual means for the river sites are fairly similar, typically within 2 mg/L nitrate-N. The average of annual mean concentrations during the 1984-1995 period were 5.4 mg/L for the Iowa River, 6 mg/L for the Turkey< and 6.5 mg/L for the Des Moines River.

Figure 6 shows nitrate-N loads for these sites, on a pounds per acre of watershed basis, for the period 1984-1996. N-loads are considerably more variable year-to-year and between sites, relative to concentrations. This results from a "multiplier" effect in wetter years, when higher concentrations are present in a larger volume of flow. N-loads for the river sites were less than 2 lbs/acre during the drought of 1989, but were 30-45 lbs/acre during the floods of 1993. Average loads in the rivers for the period are quite similar, varying from about 15 lbs/acre for the Turkey to about 17 lbs/acre for the Iowa. Loads at Big Spring averaged about 13 lbs/acre, and are typically lower than the river sites. Exceptions occur during drought, such as 1988 and 1989.

### Trends in Iowa's Nitrate Contribution to the Mississippi River

Total annual Nitrate-N loads from the three river sites have varied from 3,500 to almost 200,000 tons, and averaged about 76,000 tons during the 1984-1995 period. The three river sites have a combined drainage area of over 14,500 square miles. This is slightly over one fourth of the state, and is about 37% of the part of the state that drains directly to the Mississippi River. If N-loads in Iowa's other Mississippi tributaries are similar, the data from these three rivers provide an estimate of Iowa's nitrate-N contribution to the Mississippi River. Figure 7 shows estimates for the 1984-1995 period. The annual N-loads to the Mississippi were calculated with a drainage-area weighted average of the loads from the three river sites. Estimated annual N-loads vary 50-fold, from less than 10,000 tons in 1989 to 500,000 tons in 1993. An annual average of about 205,000 tons is estimated for the 1984-1995 period. Additional contributions to the Mississippi occur from the 30% of the state that drains directly to the Missouri River. For a perspective on the above estimates, the U.S. Geological Survey estimated nitrate-N inputs from the Mississippi River to the Gulf of Mexico. Their estimates average about 1,000,000 tons for the 1980-1994 period, and vary from about 450,000 tons for 1988 to 1,650,000 tons for 1993.

## Summary

Trends in nitrate concentrations in Iowa's hydrologic system, as measured at field-to river basin-size scales, show quite similar trends on an annual basis. Concentrations and particularly loads are higher in wetter years. Absolute concentrations also depend on land use factors, and for surface waters basin size. Annual variations in N-loads vary by well over an order of magnitude. Long term monitoring is needed to identify the magnitude of such variations, and to establish reasonable averages for nonpoint source contaminant concentrations and loads.

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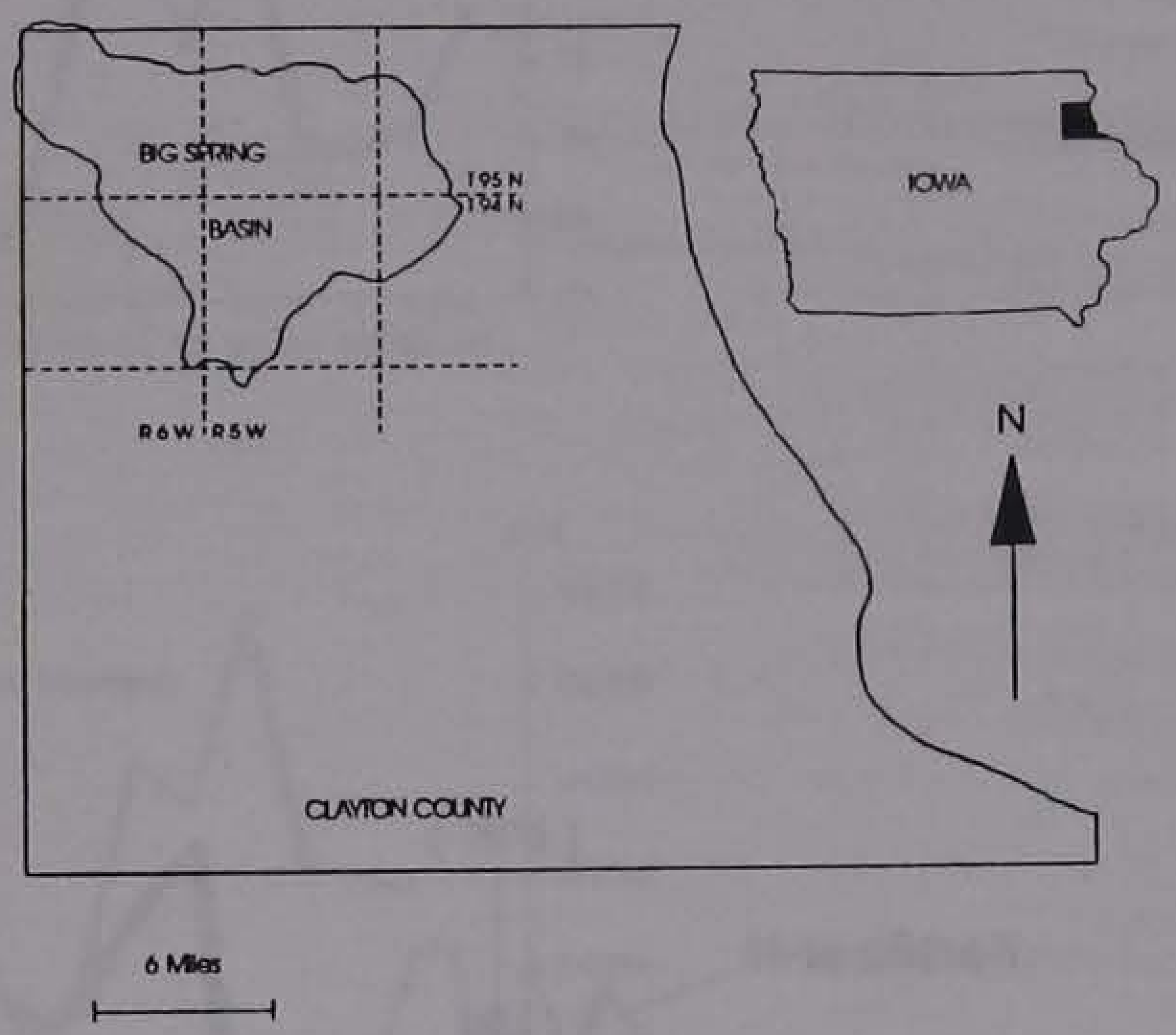


Figure 1. Map showing the location of the Big Spring basin.

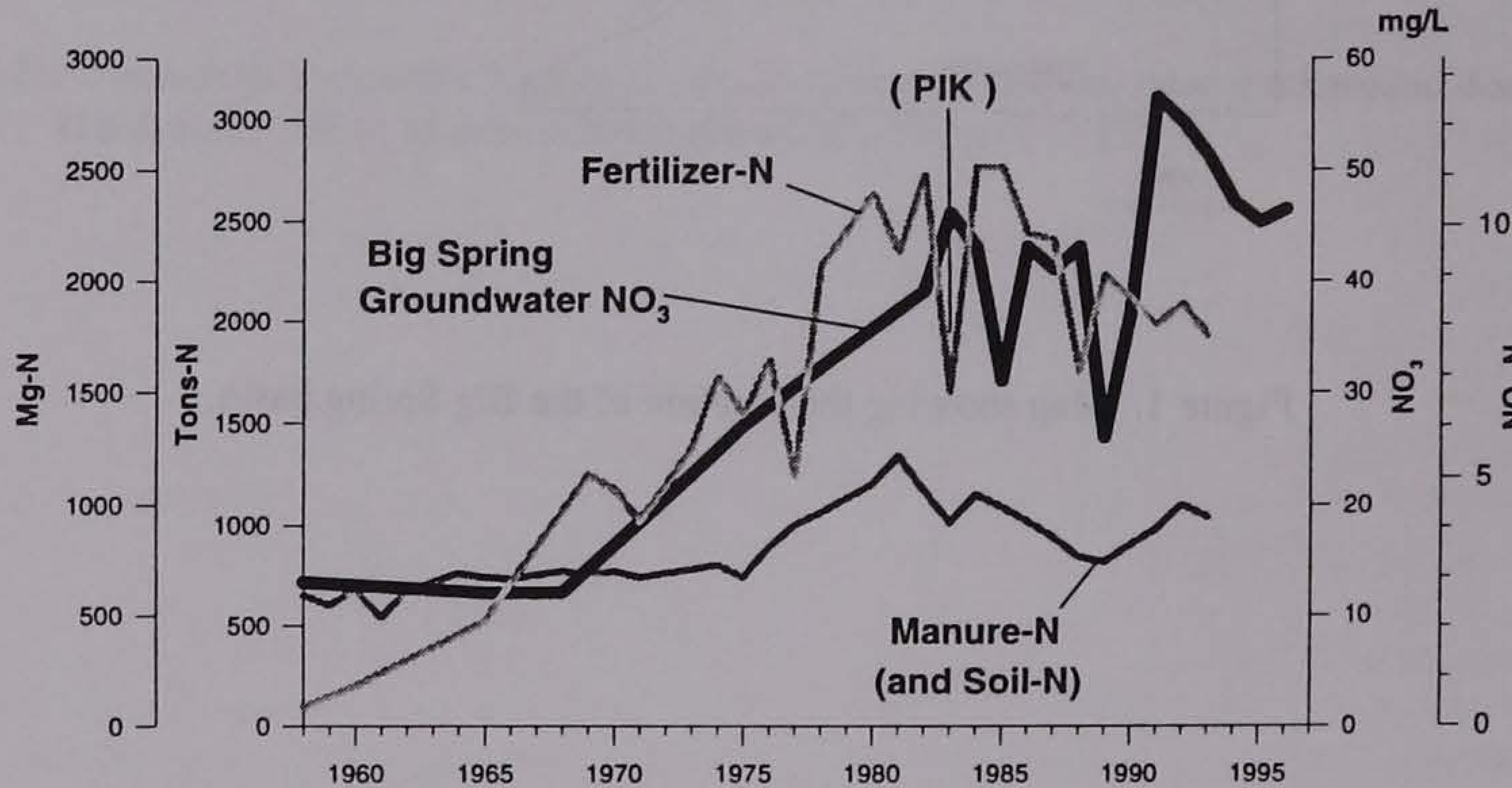


**Figure 2.** Annual fertilizer- and manure-nitrogen inputs and annual groundwater nitrate-nitrogen concentration from the Big Spring basin.

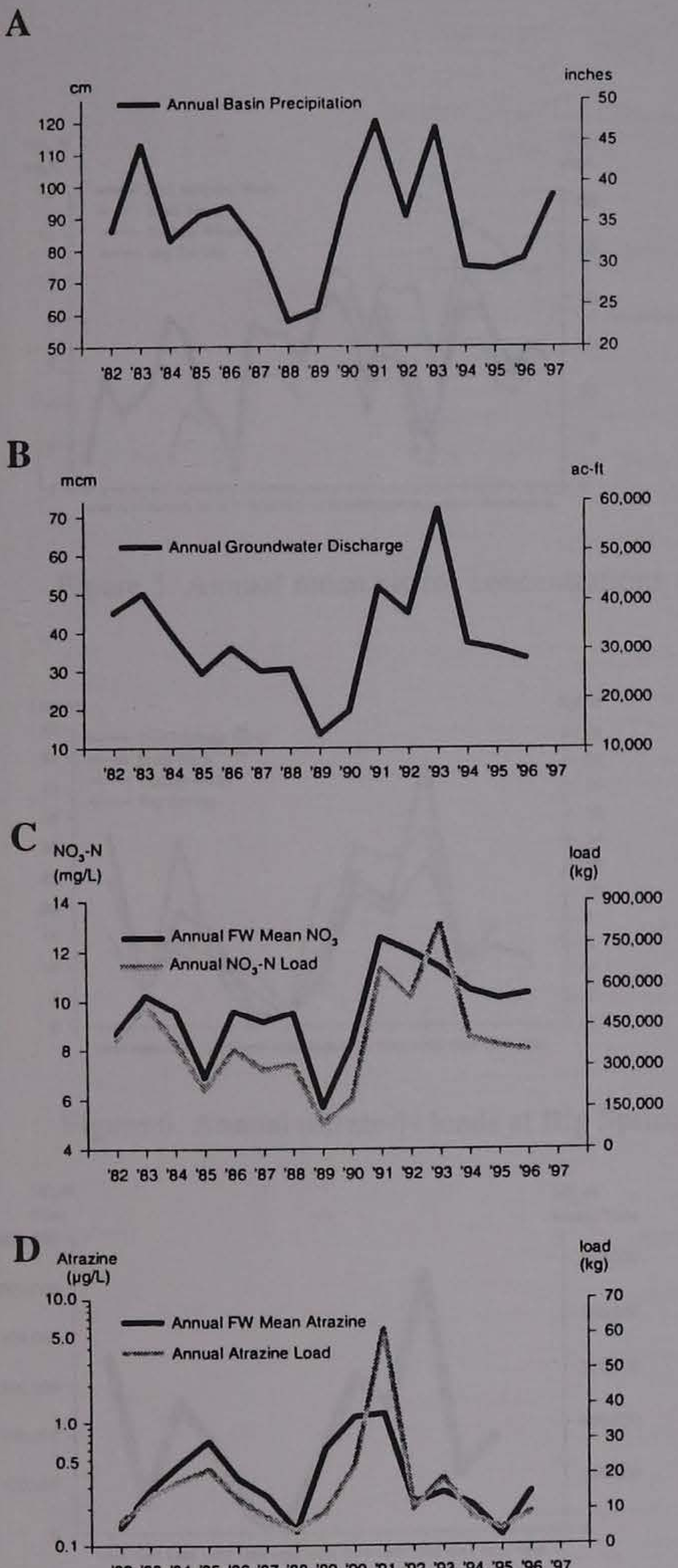


Figure 3. Summary of annual A) basin precipitation, B) groundwater discharge, C) flow-weighted mean nitrate concentration and nitrogen load, and D) flow-weighted mean atrazine concentration and load from Big Spring groundwater.

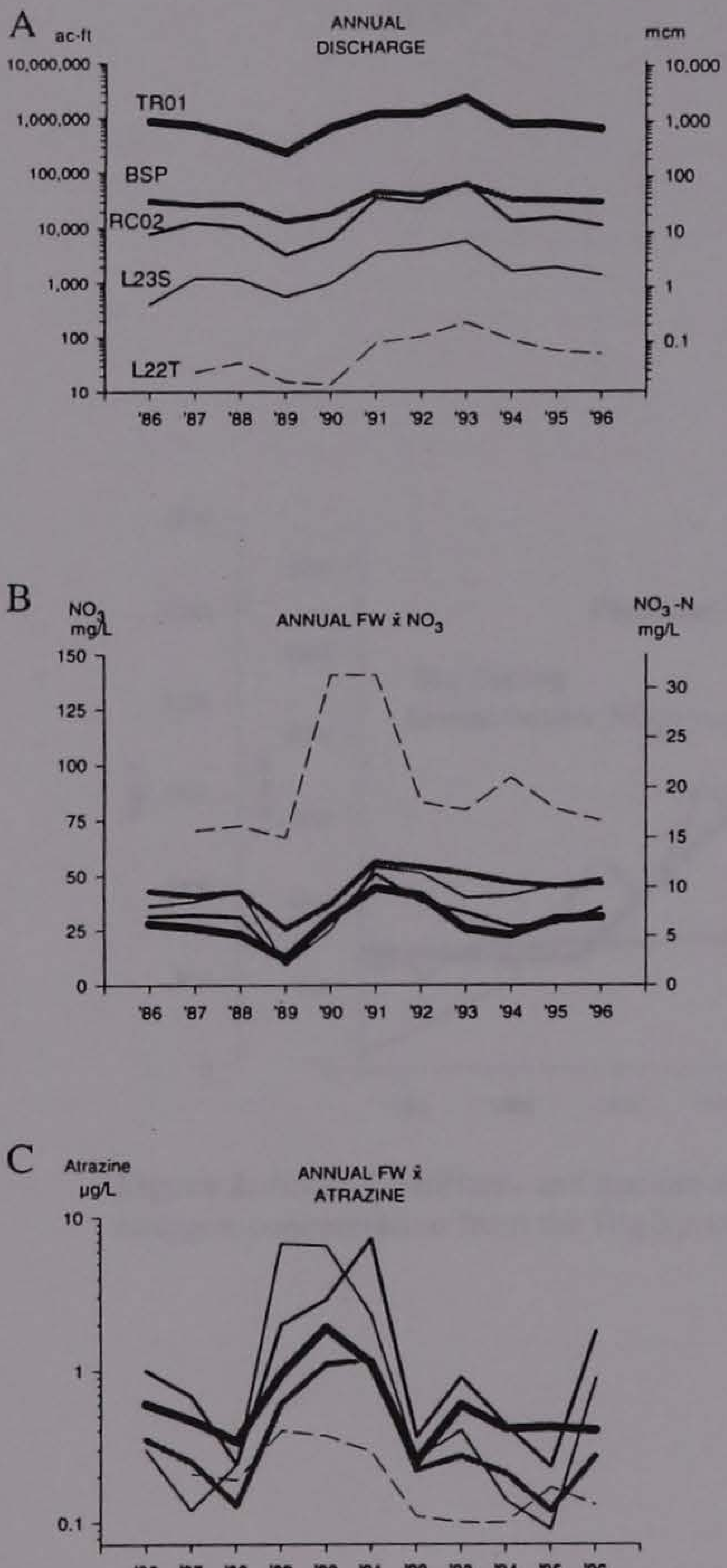


Figure 4. Summary of annual A) discharge, B) flow-weighted mean nitrate concentrations, and C) flow-weighted mean atrazine concentrations from Big Spring basin monitoring sites.

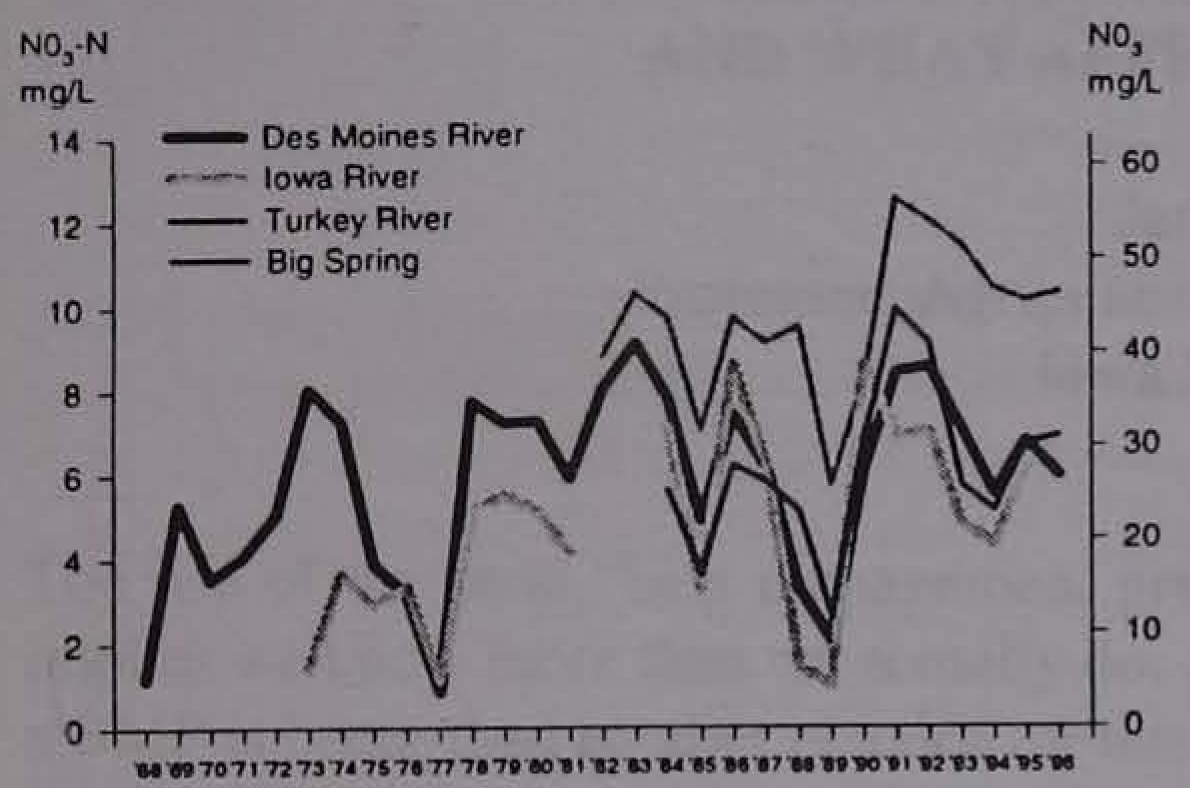


Figure 5. Annual mean nitrate concentrations at Big Spring and three Iowa Rivers.

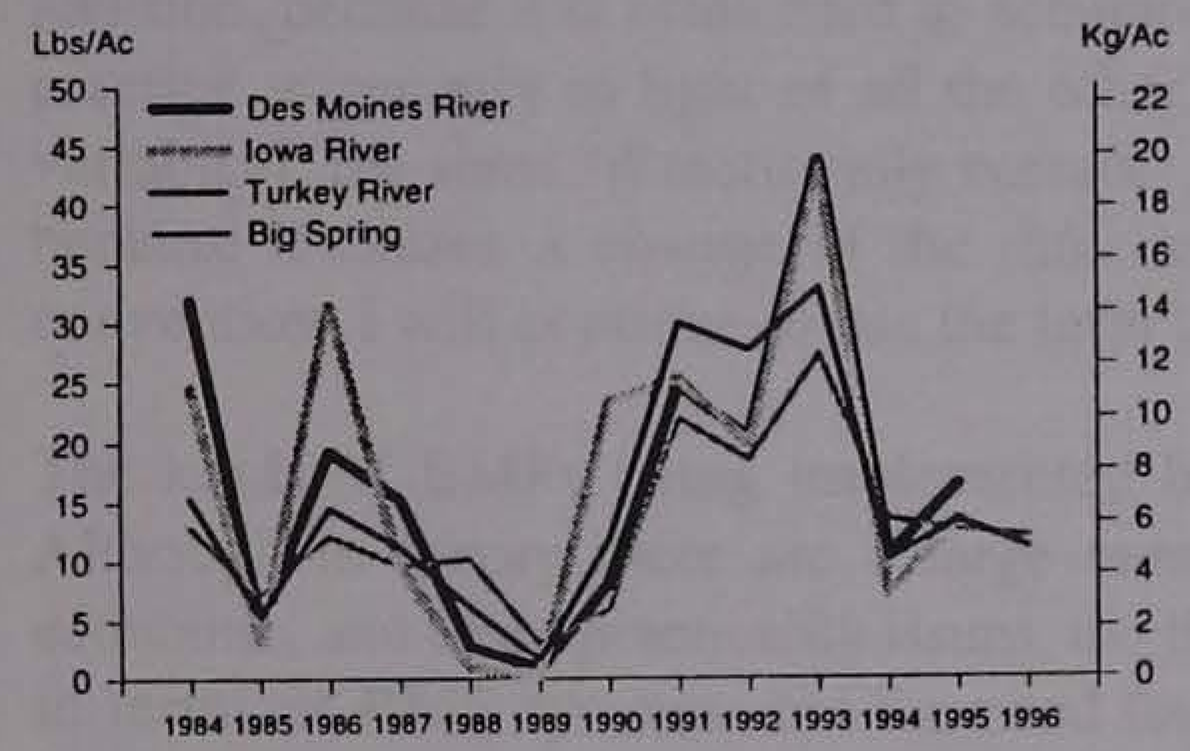


Figure 6. Annual nitrate-N loads at Big Spring and three Iowa Rivers.

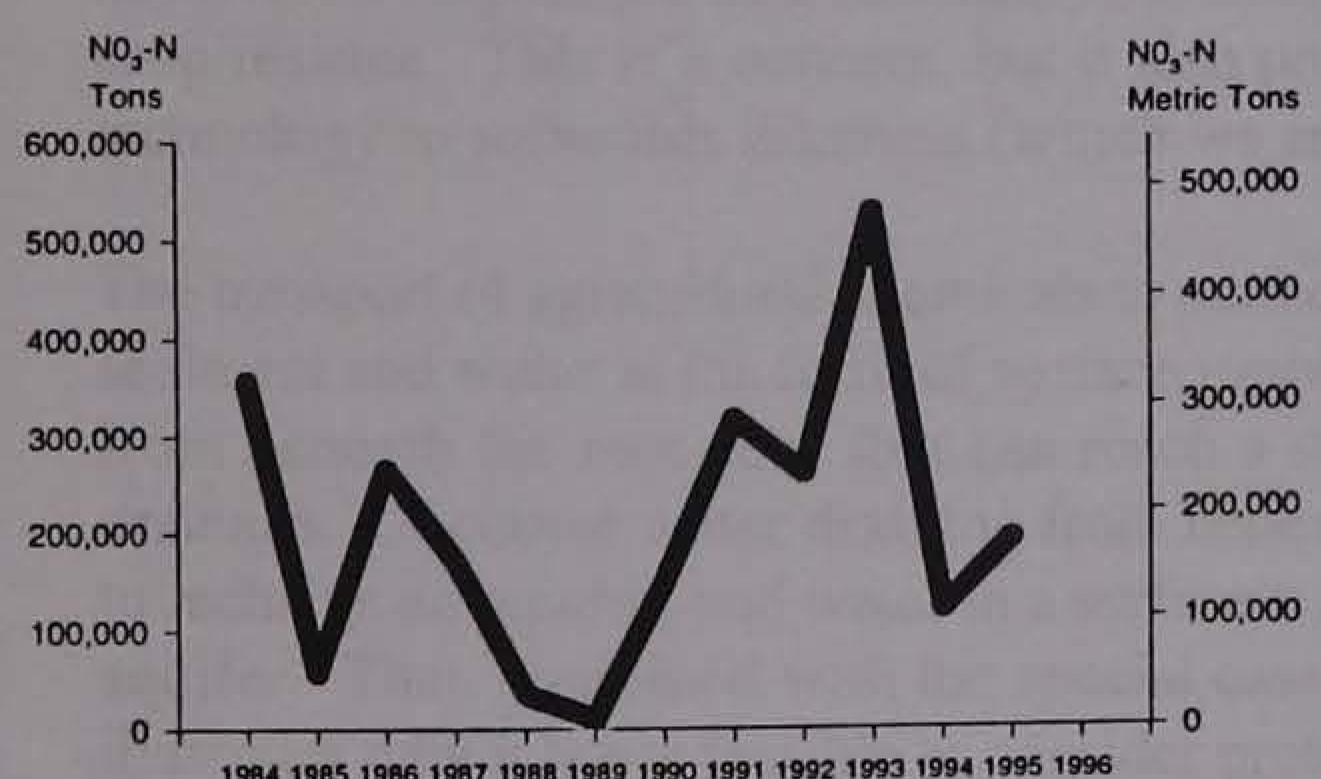


Figure 7. Estimated nitrate-N contributions from Iowa's Mississippi River tributaries.

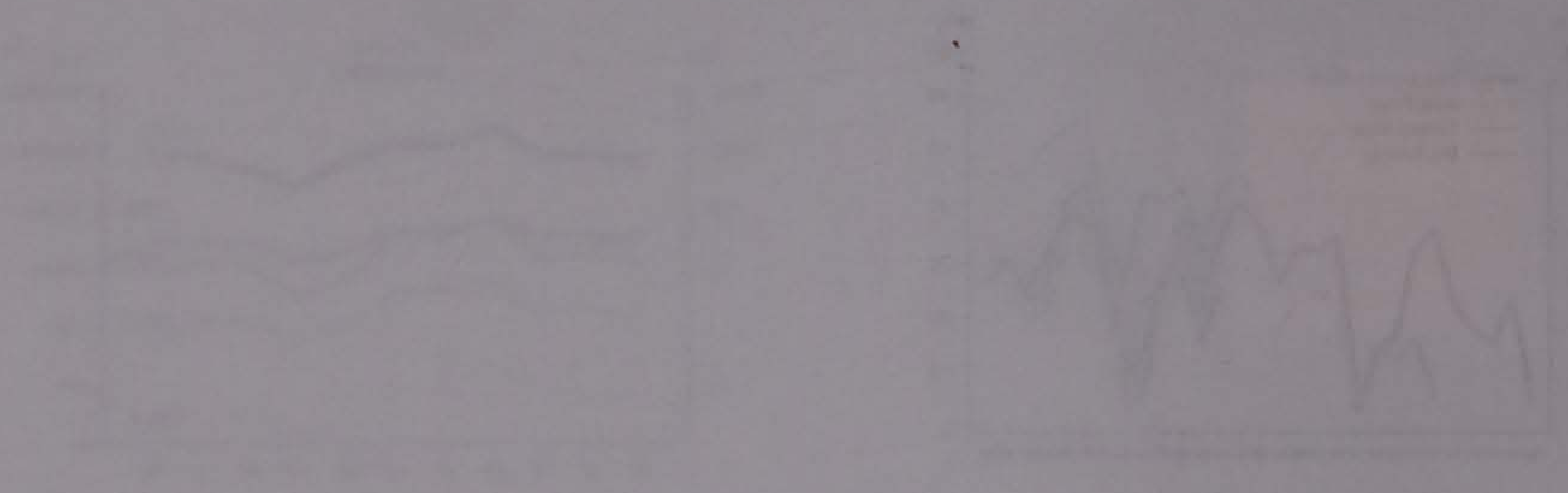

Figure 5. Annual mean nitrate concentrations of Big Spring and three Iowa Rivers.

Figure 6. Annual nitrate-N loads of Big Spring and three Iowa Rivers.

Figure 7. [illegible]

# HOW GOOD ARE BMP'S BEING USED AND WHAT AFFECTS THEIR EFFICIENCY

James L. Baker
Professor, Agricultural and Biosystems Engineering
Iowa State University

The use of the term "best management practice" (BMP) with respect to water quality probably implies we know more than we actually do. In most cases, we know that a practice we might term a BMP is better than another practice (or results in improved water quality relative to the lack of the practice) for a given set of conditions. However, we don't know that it is the "best" management practice (particularly as we look to new developments in the future), and there even may be some other sets of conditions where the water quality benefits do not exist. Thus terms like "improved" management practice or "best-available" management practice might actually be better choices. In addition, because it is often hard to accurately quantify the effects of an "improved" management practice, especially in light of all the other factors affecting its efficiency (e.g., soil and weather variables), the term "directionally correct" has been used by some to say that a practice is good because it causes a change in the direction of improved water quality. However, bowing to convention, I will continue to use the term BMP.

The kinds of BMPs being implemented by producers can be classified as in-field or off-site. Although in theory there are a large number of potential BMP's, when you factor in social, economic, and other practicality issues, the list is not all that long. Actually one should be thinking in terms of BMP systems, but the need for compatibility between practices often imposes more limitations. A good example is that conservation tillage and chemical incorporation are particularly good practices for controlling soil erosion and chemical losses in surface runoff, respectively; however, incorporation of a chemical with tillage also can result in incorporation of soil-protecting crop residue. This is a concern, but it also provides an opportunity for the engineer to develop a technology to solve this dilemma (which we are trying to do).

The transport of agricultural chemicals to surface water resources such as rivers can take place with sediment and water in the form of surface runoff from treated fields as well as with drainage water from beneath the root zone that can reach a stream or river via base-flow or artificial subsurface drainage. Of course water draining from beneath the root zone has the potential to move on down to recharge an aquifer, and water in a surface water resource has the potential to recharge an alluvial aquifer. That, combined with the special cases of losing streams, sink-holes, and drainage wells, illustrates why it is not feasible to consider protection of surface water exclusive of groundwater or vice-versa. To develop effective nonpoint source pollution control alternatives, it is important to understand the three major sets of factors important in determining chemical losses: chemical properties, hydrologic conditions, and management practices. The two primary chemical properties that affect chemical fate and transport are persistence and soil adsorption. The longer a chemical persists as such (i.e. resists transformation/degradation and/or removal by several processes including volatilization and plant uptake), the greater the chance for off-site movement with sediment and water. The interaction between soil and a specific chemical, in the way of soil adsorption, determines the major mechanism of movement or loss. For chemicals termed strongly-adsorbed, losses would be mainly with sediment. For chemicals termed moderately-adsorbed, losses would be mainly with surface runoff water. And for chemicals termed non-to weakly-adsorbed, losses would be mainly with leaching or subsurface drainage water.

Hydrologic factors, particularly the soil's infiltration rate relative to rainfall intensity which determines the timing and volume of surface runoff, affect chemical losses by affecting the carriers (i.e. water and sediment). For transfer of chemicals into surface runoff, it is believed there is a thin "mixing zone" at the soil surface from which chemicals are released. For water that does infiltrate into the soil, the volume and route of water moving through the root zone affects chemical leaching losses. Because chemical loss is the product of the carrier (be it subsurface leaching water, surface runoff water, and/or sediment) and concentration in that carrier, mitigation practices can be chosen to affect the volume of the carrier(s), the source of the chemical, or both. The decision on practices to be used must consider the type of pollutant (and its properties), the source of the pollutant, the soil and climatic conditions that exist, and the economics of implementation (costs and benefits). Because the implementation of a single practice is rarely sufficient to control the pollutant of concern, as previously noted, a "system" of practices is often needed. To be efficient, this system may best include a combination of in-field (e.g., cropping, tillage, and rate, timing, and method of chemical application) and off-site practices (e.g., vegetated filter or buffer strips and constructed or restored wetlands).

## In-Field Practices

The crops grown on agricultural lands affect the hydrology and chemical inputs and thus volumes of carriers and chemical concentrations in the carriers from those lands. Although economics plays a large role in crop selection, close-grown crops such as grasses and forages generally result in both lower runoff volumes and sediment concentrations as well as lower chemical concentrations, compared to row-crops. Tillage, as it affects hydrology, erosion, and chemical application can affect chemical losses. Comparisons are made between the various forms of conservation tillage and the moldboard plow system, in the past often termed conventional tillage. To be classified as conservation tillage, at least 30% of the soil surface after planting must be covered with residue from the previous crop; no-till is the extreme form of conservation tillage with no soil or residue disturbance between harvest and planting. In general, soil losses decrease exponentially with residue cover (e.g., for a given soil, soil loss may decrease by half for each additional increment, such as 15%, in residue cover) such that for no-till, where residue cover after corn after probably ranges from 50 to 90%, soil losses are normally only 10% of those for moldboard plow. Data for annual runoff volumes show that conservation tillage generally decreases runoff in the range of 0 to 25% relative to the moldboard plow, although sometimes the reduction is much greater in certain situations. However, due to increased roughness and porosity caused by mechanical tillage, generally for the first rain or two after tillage, runoff is less for the tilled area versus the untilled area. This does have water quality consequences since chemical runoff losses generally are the greatest for the first runoff event after application, and decrease with time during the growing season as the chemical dissipates and also moves downward out of the thin mixing zone.

Another complicating factor with conservation tillage, as noted earlier, is the conflict between the water quality benefits of the soil incorporation of chemicals and the desire to leave crop residue on the soil surface to protect against erosion. Losses of surface-applied nutrients and herbicides are much higher compared to soil incorporation. In addition, with herbicides, there is concern for the fate of broadcast sprayed materials that are intercepted by surface crop residue and prevented from reaching the soil surface. Volatilization or evaporation from the crop residue is one concern. Herbicides also wash off crop residue fairly quickly with rain, and if that wash-off water becomes part of runoff, herbicide concentrations may be higher for conservation tillage. The rate of chemical application obviously will have an effect on the source and concentration of chemical in agricultural drainage. For example, in a natural rainfall study on the effect of atrazine application rates on the amount lost with sediment and water in surface runoff, it was found that concentrations and losses were roughly proportional to the amount applied, averaging about 3% for all rates. In studies of herbicide banding, where the area treated, and therefore the whole field rate, was reduced by a factor of two or three, leaching losses of atrazine and cyanazine with subsurface drainage also were proportionately reduced.

For nutrients, surface runoff and subsurface drainage losses of N and P increase with the rate applied, although not always in direct proportion due at least in part to: 1) the "buffering capacity" of the soil and 2) the natural occurrence of N and P. Concentrations and leaching losses of $NO_3$-N as a function of N applied to continuous corn were found to decrease by a factor of two going from 400 to 200 lb/ac applied, and then to decrease by two again going from 200 to 100 lb/ac applied. It was also found that concentrations and losses in tile drainage water were decreased by a factor of two when the N rate was cut in half in corn rotated with oats or soybeans. In a more recent five-year study of both continuous corn and a corn-soybean rotation, average $NO_3$-N concentrations in subsurface drainage decreased nearly linearly with N application rate down to 100 lb/ac for continuous corn and 50 lb/ac for corn-soybean.

The timing of chemical application relative to expected storm events is important because increased time intervals between chemical applications and runoff or subsurface drainage events can significantly decrease chemical losses if rapid dissipation (mainly for pesticides) or crop uptake (mainly for nutrients) occurs. In addition to the timing of a chemical application relative to runoff or subsurface drainage events, timing of nutrient applications with respect to crop needs also is important, particularly for $NO_3$-N and potential leaching losses. In field and lysimeter studies, improved N management systems of lower total rate/split applications (versus a higher rate/single application) reduced $NO_3$-N concentrations in subsurface drainage by roughly one-third.

Method of application in terms of formulation, additives, or placement can affect the "availability" of the applied chemical to move or be lost with surface runoff or subsurface drainage. It was found that losses of pesticides formulated as wettable powders were generally greater than for other formulations. Use of microencapsulation, such as for alachlor, or starch to produce a "slow-release" herbicide, have been promoted because of the potential reduction in the availability of a pesticide at any one point in time to be lost with surface runoff or subsurface drainage. The use of additives in the form of nitrification inhibitors with ammonium-based N fertilizers is expected to reduce N leaching losses by maintaining the applied N in the soil-adsorbed $NH_4^+$ cation form as opposed to the non-adsorbed and very mobile $NO_3^-$ anion form.

The placement of agricultural chemicals relative to the thin mixing zone, mentioned earlier, is important in determining surface runoff losses. In a study of herbicide incorporation by disking, it was found that atrazine, alachlor, and propachlor losses with runoff water and sediment were reduced by a factor of three for incorporation versus a surface broadcast application. Furthermore, losses were at least another factor of three higher when the herbicides were surface broadcast on soil compacted with tractor traffic. One problem that does exist with incorporation is that incorporation with tillage also can destroy soil protecting surface crop residue. Some new tillage tools do have the potential for herbicide incorporation without significant crop residue incorporation.

With respect to $NO_3$-N leaching and N fertilizer placement, work has been done to determine if it is feasible to manipulate the soil during N application to force the major portion of infiltrating water to move in zones remote from the zone of N fertilization. A field-scale machine has been built and is being tested that places liquid N fertilizer in a line, cutting and smearing any macropores within a few cm, compacting the soil above the line, and finally doming a small amount of soil at the surface over the line. Results from preliminary leaching measurements are encouraging.

## Off-Site Practices

Agricultural pollution is a landscape-level problem whose solutions likely will require the reconfiguration of agricultural landscapes through a combination of in-field and off-site approaches. In-field approaches, as just discussed, include reduced inputs of nutrients and pesticides, BMP's to reduce soil erosion and chemical transport, and improved cropping systems. However, ongoing research increasingly suggests that the reduction of some nonpoint source contaminates to acceptable levels in agricultural landscapes can not be accomplished solely by the adoption of better in-field farming practices and improved cropping systems. Off-site approaches also will be needed, such as vegetated buffer strips and restored or constructed wetlands.

Vegetated buffer strips can be situated as riparian zones, on field borders, or sometimes within fields themselves on the contour or as grassed waterways. They have the potential of influencing both surface runoff and shallow subsurface drainage. The vegetation and rooting system slows overland flow and increases infiltration and removal of chemicals dissolved in that flow. The surface roughness and reduced flow velocity reduces the carrying capacity for sediment; and sediment, and chemicals adsorbed to it, is deposited. In addition, depending on their chemical and physical properties, some chemicals are removed from overland flow through adsorption to in-place soil and/or living and dead vegetation. The differences between riparian zones, contour buffer strips, and grassed waterways will be manifested in the effects of differences in relative areas of drainage to the vegetated area, the length of travel through the vegetated area, and the degree of concentration (or depth) of flow. Therefore, the topography and relative geometry of the source area and the vegetated area will be important.

In the Corn Belt, one of the most promising strategies for reducing agricultural chemical contamination of surface and ground water is the construction or restoration of wetlands in agricultural watersheds specifically as sinks for agricultural chemical contaminants. Wetlands are areas of intense biological activity and there is considerable opportunity for chemical transformation and loss as water moves through these systems. Studies suggest that wetlands may act as sinks for a variety of compounds, and wetlands may be especially effective as sinks for $NO_3$-N loads from cultivated fields. In particular, constructed wetlands which are integrated into new or existing drainage systems, may have considerable potential to remove $NO_3$-N from shallow subsurface drainage. Studies suggest that a mature, one acre wetland could remove significant amounts of the $NO_3$-N lost in water draining approximately 100 acres of corn at moderately high N application rates.

## Integration of Pollution Control Practices

One of the major problems facing agriculture is how to integrate off-farm environmental considerations into on-farm decision making. Agricultural management planning decisions can be based on a variety of spatial scales including field-scale, farm-scale, and watershed-scale. At the traditional field-scale, only in-field BMPs normally are considered. Currently, there is a move to do management planning at the whole-farm scale. Within whole or consolidated farm plans, there is more opportunity to include off-site approaches. However, it is not possible to effectively site or place these off-site practices for water quality improvement without considering a larger scale, that of the watershed. The watershed is the natural landscape unit for decision making because it is a hydrologically integrated unit and planning at this scale can integrate considerations regarding sources of contaminants, transport of contaminants, and placement of off-site buffers and sinks, such as wetlands, to intercept and remove contaminants. At this scale, recommendations can be made for siting off-site practices in the most effective location within a watershed, without regard to farm boundaries. Watershed-scale planning makes it possible to target efforts for the greatest improvements in water quality. However, watershed-scale planning is much more complicated than field- or farm-scale planning. It requires the cooperation of all land owners in a watershed, and some land owners in the watershed will be affected more than others.

# PREEMPTIVE WATERSHED PROTECTION: THE THREE MILE LAKE EXPERIENCE

Jerry Neppel
Extension Program Specialist and Project Coordinator
Iowa State University
Adair and Union County

Paul Goldsmith
District Conservationist
Natural Resources Conservation Service
Union County

Susan Brown
Extension Program Specialist for Water Quality
Iowa State University

## Project Overview

Three Mile Lake is a newly constructed regional water resource in south-central Iowa, Union and Adair counties. The 880-acre reservoir provides a drinking water source, through the Southern Iowa Rural Water Association, to a seven county area. It is also important to the local economy as a recreation area. There is strong support for the development and protection of the lake in the local community.

Landuse in the 22,730 acre watershed above Three Mile Lake is agricultural, with about 52% cropland and 21% pasture. About eighty-six percent of the farms in the watershed have livestock.

The Three Mile Project was initiated to assist watershed producers implement crop and livestock management practices that will help control agricultural nonpoint source pollution. This nonpoint source pollution constitutes the primary threat to the lake's long-term water quality. Funding from several sources provides educational programs and financial and technical assistance.

The major funding source is a USDA Hydrologic Unit Area (HUA) project. Three Mile Lake was in the planning stage when this HUA was initiated, making it one of the first preemptive watershed protection projects undertaken with USDA support. The drawdown gate on the dam was closed September 28, 1995, filling the reservoir by May 1996.

## Identification Of The Problem

The Union Soil and Water Conservation District (SWCD) and an advisory committee composed of several watershed landowners with assistance of Natural Resources Conservation Service (NRCS) staff began a water quality initiative in 1988 for Three Mile Creek Watershed. This group identified four potential problems that could affect the water quality of the future Three

Mile Lake: soil erosion on cropland, gully erosion on non-cropland, fertilizer and chemical runoff from cropland, and animal manure runoff. Water quality initiative objectives were established based upon the identified problems. Funding sources to meet these objectives were identified and applications for funding submitted. Ultimately, funding from several sources was secured and blended into the project to create a comprehensive Water Protection Plan to address all potential water quality issues.

The Union and Adair SWCDs working with the Union and Adair Farm Service Agency County Committees, Iowa State University Extension (ISUE) and NRCS were approved for the USDA HUA project in 1991. The Three Mile Creek Watershed was also approved for an Iowa Department of Agriculture-Division of Soil Conservation Water Protection Fund (WPF) project in 1990. The WPF application was designed specifically to fill gaps in the watershed plan that the HUA project funding could not address. Both projects had an initial life span of five years and have been subsequently renewed. In addition, a U.S. EPA Section 319 Nonpoint Source Pollution Prevention grant administered through the Iowa Department of Natural Resources was approved for the watershed beginning in 1995. This grant is used to provide information marketing assistance for the project.

Initially, the WPF was to be used to provide technical assistance, fund Best Management Practice (BMP) demonstrations, and assist with implementing refined crop and manure management practices. However, after the implementation of the project began, a need for cost sharing on pasture management and manure management practices was identified. These needs were met through the WPF. The flexibility of this program was important to help make the overall project a success.

## Design And Development Of The Plan Of Work

The objectives and goals of the HUA plan of work have remained unchanged since 1991. Objectives were established early in the planning stage that were broad and had measurable goals. During the process of developing the plan of work, an effort was made to build consensus among supporting groups to encourage these groups to assist with project implementation. Action items over the life of the project have changed to account for accomplishments and a shift in priorities with the progression of the project.

The BMPs selected emphasized in the project reflect the major land uses and resource concerns in the watershed. These include pasture and forage management because beef cow/calf operations are important farm enterprises in this watershed. Also, there has been a conversion of pastureland to row cropland, with increased potential for sediment delivery to the lake. Project planners believe that improving pasture profitability will slow this land use conversion on these generally more fragile areas.

## Implementation Of The Plan

An overall project goal was to provide landowners with the financial and technical and educational resources to implement practices to positively impact the water quality in Three Mile Lake. Another goal was to make the project as user friendly as possible. Bringing together several programs and funding sources required excellent communication skills, a desire to work together for the improvement of water quality, and flexibility. The HUA and the WPF provided funds to supply technical assistance including an NRCS project coordinator and an ISU Extension project coordinator. Cost share funds to implement BMPs were provided by the HUA through the USDA Agricultural Conservation Program (ACP) and by the Iowa WPF. The WPF allowed the project to cost share on non-traditional practices that were not eligible for funding through ACP. The EPA 319 grant supported an extension information specialist, and products such as newsletters, field demonstrations of BMPs and project displays. A major goal of project information marketing is to build public support for the lake, and for the watershed farmers who have voluntarily refined their land use practices to help protect water quality.

Flexibility with implementing the plan has been a key to success. The major project sponsors met regularly to review work accomplishments, evaluate overall project objectives and goals and make recommendations for changes in the work plan. By doing this, the water protection plan is a dynamic tool able to meet the needs of the landowners and operators in the watershed.

## What Changes Have Taken Place?

Results of this intensive technical and financial assistance are apparent in the watershed. Eighty percent of the watershed now has soil erosion rates at or below the tolerable soil loss level. Since 1991, eighty-one producers have implemented at least one soil and water conservation practice--reducing soil erosion on 12,565 watershed acres. They have built 52,000 feet of terraces and 50 ponds to reduce soil erosion and trap sediment. Crop residues on 11,700 acres of cropland have increased on average from 14% to 40% on corn following soybeans, and from 22% to 46% on soybeans following corn.

Twenty-seven producers have implemented nutrient and/or pest management programs on 6,418 acres. Average nitrogen use has been reduced eleven pounds per acre per year on 5,752 acres. Cooperators have also reduced phosphorus application an average of two pounds per acre per year on 6,177 acres. Results from the mid-project producer survey comparing activities in 1995 to 1991 showed that more watershed producers are giving credit for the nitrogen supplied by alfalfa to the succeeding corn crop.

Local producers have improved management of their permanent pastures to increase the productivity of the pasture. Local producers responded favorably to a project-sponsored pasture management demonstration. More than 600 producers and other interested participants have viewed the demonstration since 1991. Applications for cost share of grazing management systems have averaged about two per year. Considering a mid-project producer survey completed in 1996, 38% of the respondents who had pasture indicated they made at least one change in their pasture management since 1991.

Local urban and rural non-farm residents have increased their understanding of farming activities used to protect water quality. Outreach to the general public occurs through an annual farm-city tour. About 100 local town and rural non-farm residents participate every year to learn about the voluntary activities watershed producers are implementing to protect water quality.

## Continuing The Local Momentum After The Project Is "Done"
## (Keeping the Fire Going After the Water is Present)

Information and education activities such as news releases, newsletters, field days, tours and workshops help the project reach a large audience. Townspeople and lake visitors as well as farmers are more aware of the project through these methods and are more aware of BMPs used in protecting water quality. The project helps the public take note of the BMPs above Three Mile Lake as they enjoy its amenities. Road signs identifying the watershed boundary on major roadways will remain as a constant reminder of the importance of the watershed to those who drive through it.

Field demonstrations have been effectively used in the watershed to allow local producers see BMPs in place under conditions similar to their own. They are able to ask questions of the cooperator and observe the practice over several years. The pasture management demonstration is an excellent example of this educational tool. Some of the field demonstrations will continue after the project is done because the cooperator is interested in continuing to gather data. The project staff designed the demonstrations to be user-friendly so that farmer-cooperators could continue it on their own after the project has ended.

The project has provided one-on-one technical assistance, which is necessary to ensure producers receive the information they need to implement BMPs on their own farms. Every farm has a different set of resources and each producer has his or her own goals. Through the project group workshops have trained producers to identify agronomic pests, learn scouting techniques, determine economic thresholds and provided hands-on experience. These learning opportunities will help ensure producers continue to critically evaluate crop production problems before making a decision that may impact water quality. One-on-one technical assistance will continue to be available through NRCS field staff and through programs such as ISU Extension's Statewide Manure Management Initiative.

Youth involvement to protect water quality has taken on many forms. The local SWCDs have sponsored teachers to attend environmental workshops in order to increase the amount of environmental education taking place in the classrooms. Project staff give presentations in local schools about water quality and the environment. A locally organized children's water festival will be held in the fall of 1998. It is hoped the water festival will become an annual event at Three Mile Lake.

Project staff are also educating local FFA members on improved crop management practices. For example, FFA members have learned how to collect and evaluate the late spring soil nitrate test and fall cornstalk nitrate test procedures which are key to optimizing nitrogen fertilizer input decisions. Whatever their future choice of careers, experience like this will impact these young adults' understanding of the link between environmental stewardship and profitability in crop and livestock management.

# DES MOINES RIVER WATER QUALITY NETWORK: THIRTY YEARS OF SURFACE WATER QUALITY MONITORING

Donna S. Lutz
Assistant Scientist
Civil & Construction Engineering Department
Iowa State University

## Abstract

ISU's Civil and Construction Engineering Department has conducted water quality monitoring in Central Iowa for the Army Corps of Engineers since 1967. What was initiated as a preimpoundment study of the Saylorville Reservoir project has expanded into a comprehensive water quality-monitoring project of the central portion of the Des Moines River basin. The necessity for long-term monitoring will be addressed as well as the need for auxiliary information that will make a data set useable far into the future. Key findings will be presented as well as summaries of long-term data for a few selected parameters.

## Des Moines River Water Quality Project

With a database spanning over 30 years this project serves as a diary of water quality in Iowa. The project has documented the first wave in water quality enhancement from better wastewater management of point source pollution and should be able to document the second wave of improvements as we mitigate non-point sources.

## Beginnings

Initiated in July 1967 as a preimpoundment study for Saylorville Reservoir (which was completed in 1977), the project scope expanded to included Red Rock Reservoir in 1971. Today it's one of the longest running water quality monitoring programs in Midwest.

We have about 10 years of preimpoundment data which showed that the Des Moines River at Boone was a good indicator of preimpoundment conditions of the river downstream where the reservoir was to be built, thus the later differences between the river above and below the dam could be attributed to the reservoir. It became clear that long-term monitoring would be needed to address the concerns that surrounded the construction of Saylorville Reservoir. And it also became evident that similar water quality information would be invaluable farther downstream at Red Rock Reservoir (constructed 1969).

## Now

Currently, have 7 regular sampling sites and sample 22 times per year, however, sampling was conducted weekly (52 weeks per year) for the first 17 years of the study. Sites are above and both reservoirs, below the City of Des Moines and on the Raccoon River, a major tributary. We have gathered information on over 100 parameters (currently we monitor about 50) including physical parameters such as water temperature, chemical parameters such as nitrite plus nitrate nitrogen, biological parameters such as fecal coliform bacteria.

Over the 30-year period of record about 360,000 individual pieces of data have been collected from routine monitoring events. Data are conveyed to Corps and DNR and other interested parties. Rapid reporting is essential for short-term needs. Sampling event data are faxed within 24 hrs, bacteria data within 48 hours. Data are available through monthly and annual reports and through a project website. The data set is archived in STORET and Corps Paradox databases.

### Why so much data?

Some of you at this point may be saying why so much data, well it takes a lot of data to reach conclusions regarding any environmental system, especially surface water, because of the magnitude of natural variation. Precipitation and river flow can have large impacts on parameter concentrations, especially for particulate parameters like suspended solids by increasing runoff or can decrease parameter concentrations through dilution, such as ammonia and chlorophyll pigments. There can be seasonal considerations like photoperiod and ice cover. Thus, it's becoming increasingly apparent that long term monitoring is needed.

Charles Goldman, who studied Lake Tahoe, found that it took 15 years of Secchi disc data before he could demonstrate a declining trend in the transparency of the lake. Information is better than speculation; data provide historical record and give perspective to current findings. Many of the current environmental problems would not be as controversial if there had been long term data from which trends and effects could be determined.

### Why Monitor Water Quality At All?

Because to make policy and management decisions we need to:

- know the effect of the impoundments on the river
- be aware of any long term trends

And we need to maintain water quality for:

- water supply
- recreation/aesthetics (fishable, swimmable)
- economy, sector of local economy built around each lake's recreation

Also, we, as public servants, have a responsibility to public. The public demands water quality information.

### Major Findings

Significant findings of the study have been:

- that non-point sources are the main component to contamination, especially by particulate parameters;
- that improvements to the Des Moines wastewater treatment facilities have reduced ammonia nitrogen loadings in the Des Moines River downstream;

- that there appears to be no trend (either decreasing or increasing) in nitrate nitrogen concentrations over the 30 year period;
- and that gas supersaturation-induced gas bubble trauma in fish is occurring below Red Rock Reservoir.

## How To Keep A Data Set "Alive"

Many of you are involved in your own environmental projects and I wanted to go over some aspects of a historical data set that often get overlooked. Without this supplemental information you data is less useful as a historical record because the data can not be properly interpreted.

**Sites:**

- exact location
- periodic description, photographs

**Parameters:**

- complete id, sulfur (as S) vs. sulfate (as SO4)
- units, be consistent throughout record
- significant numbers, record only significant numbers
- precision, give some indication on how sure you are that this number reflects reality (+/- 95% confidence interval)
- methods, list all methods, date and document method changes
- instrumentation, list types of instruments used, date and document method changes
- laboratories, list all labs used, date and document any changes
- get a copy of lab quality control plan
- request original lab analytical results and supporting documents
- is result from a single test, an average of replicates??
- was analysis done within quality specifications??
- Submit split samples to lab and document these duplicate results as part of your quality control plan

What may seem easy to decipher now, may be impossible to someone who reviews your data in, let's say, 15 years. If any of the above information is incomplete or lacking a prudent researcher may not use your information. And what a waste that would be.

**Sources for further information:**

Des Moines River Water Quality Network
(on the World Wide Web) http://www.cce.iastate.edu/~lutz/dmrwqn.html

Lutz, D. Schulze. February 1997. Annual Report, Water Quality Studies-Red Rock and Saylorville Reservoirs, Des Moines River, Iowa. Engineering Research Institute, Annual Report. ISU-ERI-Ames-97187, Iowa State University, Ames, Iowa

Sources for further information:

## DNR PROGRAMS RELATED TO WATER QUALITY

Tom Oswald
USDA, NRCS, Liaison to IDNR
Des Moines

**Abandoned Wells** - Brent Parker: 281-7814
**Agricultural Drainage Wells** - Jack Riessen: 281-5029
**Animal Waste** - Bob Palla: 281-8868
**Clean Lakes Program** - Don Bonneau: 281-8663
**Feedlots** - Bob Palla: 281-8868
**Fish Management** - Marion Conover: 281-5208
**Flood Plain Management:**
- **Flood insurance and local FPM ordinances** - Bill Cappuccio: 281-8942
- **Floodplain development permits** - Jeff Mumm: 281-8942 or Jeff Simmons: 281-8968
- **Dam Safety** - Dave Allen: 281-6930

**Forestry Programs** - Mike Brandrup: 281-8657
**401 Water Quality Certification** - Margaret Clover: 281-6615
**Geographic Information Systems** - Calvin Wolter: 281-8928 or Todd Bishop: 281-5815 or Bernie Hoyer: (319)-335-1571
**Groundwater Monitoring** - Paul VanDorpe: (319)-335-1580
**Groundwater Vulnerability Map** - Bernie Hoyer: (319)-335-1571
**Groundwater Hydrology** - Art Bettis: (319)-335-1578
**Hydrogeology** - Bob Libra: (319)-335-1585
**Municipal Sludge Land Application** - Billy Chen: 281-5638
**Nonpoint Source Water Pollution Control Program** - Ubbo Agena: 281-6402
**National Pollutant Discharge Elimination System (NPDES):**
- **Municipal** - Reza Khosravi: 281-6128 or Chuck Furrey: 281-4067
- **Industrial** - Steve Williams: 281-8877

**Private Well Water Construction** - Brent Parker: 281-7814
**Property Tax exemption request for pollution control property** - Mike Hameed: 242-6199
**Septic Tanks & Commercial Haulers Licenses** - Jan Myers: 281-5638
**State Revolving Fund (wastewater construction loan assistance)** - Terry Kirschenman: 281-8885
**State Revolving Fund (water supply loan assistance)** - Dennis Alt: 281-8998
**Stormwater General Permits** - Ruth Rosdail: 281-6782
**Surface Water Monitoring** - John Olson: 281-8905 or Tom Wilton: 281-8867
**University of Iowa Hygienic Lab (UHL)** - Wallace Building reception: 281-5371
**Wastewater Facility Construction and Operation** - Wayne Farrand: 281-8877
**Water Allocation and Use** - Mike Anderson: 281-6599
**Water and Wastewater Operator Certification** - Dennis Alt: 281-8998
**Water Quality Standards** - Ralph Turkle: 281-7025
**Water Supply Viability Assessments** - Dennis Alt: 281-8998
**Water Testing (public water supplies)** - Dennis Alt: 281-8998

**Well Closure** - Paul VanDorpe: (319)-335-1580
**Wellhead Protection Plan** - Carol Thompson: (319)-335-1581
**Well Permits:**

- **Public water supply wells** - Roy Ney: 281-8945
- **Private wells** - Brent Parker: 281-7814

**Wetlands:**

- **Regulatory requirements** - Margaret Clover: 281-6615
- **Federal Section 404 permits (filling/draining wetlands & other waters)** - Corps of Engineers: (309)-788-6361
- **Wetland delineation for USDA programs** - local NRCS office

Unless noted, all area codes are 515.

DNR administers other programs that might be useful to you. You can visit DNR's World Wide Web Home Page for additional program and staff information at http://www.state.ia.us/dnr/

## RACCOON RIVER VALLEY WATERSHED PROJECT ROUNDTABLE

Moderator

Rodney Williamson
Iowa Corn Growers Association
Program Director
506 West Towers, 1200 35th Street
West Des Moines, IA 50265
515/225-9242

Panelists

Larry Thomsen
West Central Cooperative
Executive Vice President, Agronomy/Petroleum
406 1st Street
Ralston, IA 51459
800/522-1946

Tom Halbur
Farmer & Carroll County Farm Bureau President
15491 250th Street
Manning, IA 51455-8646
712/658-2477

Katie Owens
Farmer & Calhoun SWCD Commissioner
3911 Jennings Avenue
Lake City, IA 51449
712/464-7642

Tom Paulsen
Carroll Area FFA Instructor
Carroll High School
2809 North Grant
Carroll, IA 51401
712/792-8015

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