BEST MANAGEMENT PRACTICE TEAM

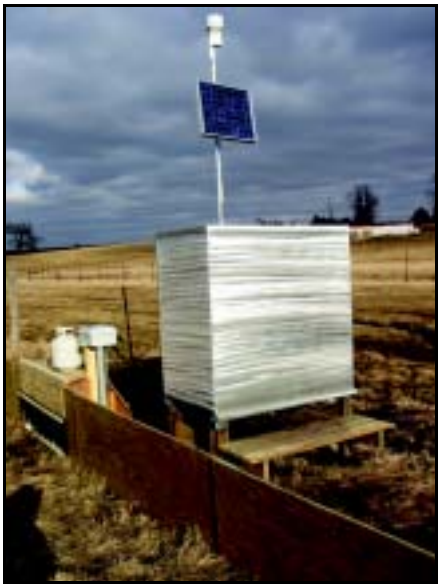
Mission

Evaluation monitoring provides critical information to the WDNR's nonpoint section to help formulate watershed management plans and evaluate the effectiveness of these plans. The monitoring also provides a unique, comprehensive data set of interest to the nonpoint research community at large. The objectives of the evaluation monitoring team are: (1) to efficiently manage projects from the conception and proposal stage to management and operation resulting in thoughtful and timely products from data summaries to published reports, and (2) to maintain a sufficient amount of funding and challenging work for the entire team. Through these objectives, it is our intent to continuously evolve data collection and analysis techniques, plan for future projects, enhance the skills and evolve data collection and analysis techniques, enhance the skills and growth of individual team members, and maintain a positive relationship with the cooperator.

Team Members

Judy A. Horwatich, Hydraulic Engineer
Peter E. Hughes, Hydrologist
John F. Walker, Research Hydrologist/Engineering
Steve R. Corsi, Hydrologist
Dave J. Graczyk, Hydrologist/Forestry
Todd D. Stuntebeck, Physical Scientist
Troy D. Rutter, Hydrologic Technician
Ellen J. Considine, Student Trainee (Hydrology)
Eric G. Booth, Hydrologic Technician
Laura E. Wagner, Hydrologic Technician
Mari Danz, Hydrologic Technician

"H" Flume for monitoring discharge at Discovery Farms in Buffalo County, Wisconsin.



Gaging station at the University of Wisconsin Research farm near Platteville, Wisconsin.

PROJECTS

EVALUATION MONITORING IN WISCONSIN PRIORITY WATERSHEDS

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEFS:

David J. Graczyk
Steven R. Corsi
Judy A. Horwatich

LOCATION:

Priority watersheds in Brown, Buffalo, and Sheboygan Counties

PROJECT NUMBER:

WI 17202

PERIOD OF PROJECT:

October 1990–Continuing

PROBLEM

An evaluation strategy is needed to assess the effectiveness of nonpoint-source pollution control measures in priority watersheds. Specifically, research is needed to determine the impact of management practices stream-water quality and biology. Several techniques need to be developed and/or refined, such as detecting trends in stream-water chemistry, sampling of fish and fish habitat, relation between fish/fish habitat and changes resulting from watershed management practices, and use of habitat models for determining impact of watershed management on fish populations.

OBJECTIVE

The overall objective of this project is to determine the trends in water quality for four sites during and after implementation of improved land-management practices in three priority watersheds and to use GIS to understand changes in land use/land cover.

APPROACH

Post-practice implementation monitoring will be done for Otter, Bower, Eagle, and Joos Valley Creeks, which are in the Sheboygan River, East River, and Waumandee River Priority Watershed Projects, respectively. The pre-practice implementation is complete for all of these sites. Continuous-record streamflow, water temperature, and dissolved-oxygen gaging stations were installed at each stream site. Water-quality samples will be collected during events and low flows and analyzed for selected constituents. Land-use inventories will be taken each year to help determine the cause of any changes in water quality. Monitoring at Bower Creek will be initiated again during the summer of 2003.

PROGRESS (July 2001 to June 2002)

Post-practice implementation monitoring for Otter Creek has been ongoing for two years. Water-quality loads were calculated for selected parameters and storm periods. All the data were summarized and published in

the report “Water-Resources Data–Wisconsin.” Land-use inventories were completed for each basin.

PLANS (July 2002 to June 2003)

Streamflow and water-quality monitoring will be continued at Otter Creek site through September 2002. Eagle and Joos Valley Creeks will be monitored for streamflow and water quality beginning in October 2002. At Otter Creek, water-quality samples will be collected weekly during the period of July–October. For other sites, water-quality samples are collected bi-weekly from April through October, and monthly from December through March. Samples will be collected at all sites during runoff periods. Land use will be updated for each basin. Bower Creek site installation and trouble shooting will begin in summer 2003 and be ready for monitoring the following year. Water-quality loads for selected parameters and storm periods will be calculated and compared to data collected in previous years. The data will be analyzed to determine if there are any apparent trends in water quality during implementation of best management plans. A report will be published on post monitoring of Brewery and Garfoot Creeks in the Black Earth Creek Priority Watershed Project.

REPORTS

Walker, J.F., Graczyk, D.J., Corsi, S.R., Wierl, J.A., and Owens, D.W., 2001, Evaluation of nonpoint-source contamination, Wisconsin—water year 1999: U.S. Geological Survey Open-File Report 01–105, 37 p.

Wierl, J.A., Giddings, E.M., and Bannerman, R.T., 1998, Evaluation of a method for comparing phosphorus loads from barnyards and croplands in Otter Creek watershed, Wisconsin: U.S. Geological Survey Fact Sheet 168–98, 4 p.

Corsi, S.R., Graczyk, D.J., Owens, D.W., and Bannerman, R.T., 1997, Unit-area loads of suspended sediment, suspended solids, and total phosphorus from small watersheds in Wisconsin: U.S. Geological Survey Fact Sheet 195–97, 4 p.

Rappold, K.F., Wierl, J.A., and Amerson, F.U., 1997, Watershed characteristics and land management in the nonpoint-source evaluation monitoring watersheds in Wisconsin: U.S. Geological Survey Open-File Report 97–119, 39 p.

Wierl, J.A., Rappold, K.F., and Amerson, F.U., 1996, Summary of the land-use inventory for the nonpoint-source evaluation monitoring watershed in Wisconsin: U.S. Geological Survey Open-File Report 96–123, 23 p.

Greb, S.R., and Graczyk, D.J., 1995, Frequency-duration analysis of dissolved-oxygen concentrations in two southwestern Wisconsin streams: Water Resources Bulletin, v. 31, no. 3, p. 431–438.

BEST MANAGEMENT PRACTICE EVALUATION

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEF:

John F. Walker

LOCATION:

Statewide

PROJECT NUMBER:

WI 17206

PERIOD OF PROJECT:

October 1989 to September 2002

PROBLEM

To date, the effectiveness of best management practices (BMPs) in Wisconsin has not been determined. The natural variability of water-quality data complicates the detection of changes due to BMP implementation. Research is needed to identify techniques for detecting changes due to BMP implementation and applying the techniques to before and after data.

OBJECTIVE

The objective is to investigate statistical analysis techniques for assessing trends in water quality due to BMP implementation. The effectiveness of BMPs in several rural basins in Wisconsin will be determined using the identified statistical techniques.

APPROACH

A comprehensive literature search will be conducted to identify viable statistical analysis techniques and needs for method modification or development. Data for several rural and urban basins in other states will be compiled and used to test the selected techniques. Storm loads of total-suspended solids and total phosphorus will be computed and used along with rainfall data and land-use information to assess the effectiveness of the BMPs in several basins in Wisconsin.

PROGRESS (July 2001 to June 2002)

Published annual report describing results of statistical analysis for data collected through the 1999 water year. Completed draft of report describing final results for the Black Earth Creek watershed.

PLANS (July 2002 to June 2003)

A Water-Resources Investigation Report will be published.

REPORTS

Walker, J.F., Graczyk, D.J., Corsi, S.R., Wierl, J.A., and Owens, D.W., 2001, Evaluation of nonpoint-source contamination, Wisconsin: water year 1999, U.S: Geological Survey Open-File Report 01–105, 37 p.

Wierl, J.A., Giddings, E.M.P., and Bannerman, R.T., 1998, Evaluation of a method for comparing phosphorus loads from barnyards and croplands in Otter Creek Watershed, Wisconsin: U.S. Geological Survey Fact Sheet FS–168–98, 4 p.

Owens, D.W., Corsi, S.R., and Rappold, K.F., 1997, Evaluation of nonpoint-source contamination, Wisconsin: selected data for water year 1995: U.S. Geological Survey Open-File Report 96–661A, 41 p.

Corsi, S.R., Graczyk, D.J., Owens, D.W. and Bannerman, R.T., 1997, Unit-area loads of suspended sediment, suspended solids, and total phosphorus from small watersheds in Wisconsin: U.S. Geological Survey Fact Sheet FS–195–97, 4 p.

Walker, J.F., Graczyk, D.J., Corsi, S.R., Owens, D.W., and Wierl, J.A., 1995, Evaluation of nonpoint-source contamination, Wisconsin: land use and best management practices inventory, selected streamwater-quality data, urban-watershed quality assurance and quality control, constituent loads in rural streams, and snowmelt-runoff analysis, water year 1994: U.S. Geological Survey Open- File Report 95–320, 21 p.

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Walker, J.F., 1994, Statistical techniques for assessing water-quality effects of BMPs, ASCE J. of Irrigation and Drainage Engineering, v. 120, no. 2, p. 334–347.

Walker, J.F., and Graczyk, D.J., 1993, Preliminary evaluation of effects of best management practices in the Black Earth Creek, Wisconsin, priority watershed: Water Science and Technology, v. 28, no. 3–5, p. 539–548.

Walker, J.F., 1993, Techniques for detecting effects of urban and rural land-use practices on stream-water chemistry in selected watersheds in Texas, Minnesota, and Illinois: U.S. Geological Survey Open-File Report 93–130, 16 p.

Graczyk, D.J., Walker, J.F., Greb, S.R., Corsi, S.R., Owens, D.W., 1993, Evaluation of nonpoint-source contamination, Wisconsin: Selected data for 1992 water year: U.S. Geological Survey Open-File Report 93–630, 48 p.

WINNEBAGO COUNTY EDUCATIONAL PROJECT

COOPERATOR:

Winnebago County Land and Water Conservation District

PROJECT CHIEF:

Judy A. Horwatich

LOCATION:

Statewide

PROJECT NUMBER:

WI 17210

PERIOD OF PROJECT:

May 2001 to May 2002

PROBLEM

The city of Neenah is urbanizing in the Little Lake Butte Des Morts watershed and the Winnebago County Land and Water Conservation District is concerned about the effect this will have on the lake's water quality. The county is cooperating with the University of Wisconsin Extension to collect in-stream grab samples for the identification of runoff pollutants. This sampling has been a community effort by students and local volunteers for educational purposes. This project will help quantify their collected data.

OBJECTIVE

To monitor a stream that is representative of the Little Lake Butte Des Morts watershed. Also to provide data that could be used to calibrate a water-quality model.

APPROACH

Install a continuous recording stream flow gaging station at one site. Stormwater runoff samples will be collected during rainfall events. Discharge measurements will be made every 4 to 6 weeks and more frequently during high flows to define a stage/discharge relationship at the site.

PROGRESS (May 2001 to April 2002)

Water quality monitoring of the site has been completed.

PLANS (April 2002 to June 2002)

Continuous stream flow monitoring and discharge measurements will be made until the end of June. An analysis of the quantity and quality of the station needs to be completed.

INFLUENCES OF RIPARIAN CORRIDORS ON THE IN-STREAM HABITAT, FISH, AND MACROINVERTEBRATE COMMUNITIES FOR SMALL STREAMS IN WISCONSIN

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEF:

Judy A. Horwatich

LOCATION:

Statewide

PROJECT NUMBER:

WI 17213

PERIOD OF PROJECT:

July 2001–Continuing

PROBLEM

Riparian corridor land cover can play an important role in determining stream-water quality by reducing runoff, sediments, and nutrients, and by maintaining more stable flows, water temperature, and channel morphology. Numerous studies have also shown the importance of riparian corridors in determining in-stream habitat and aquatic biota, yet little is known about the influence of riparian corridor width, continuity, or proximity of an undisturbed riparian corridor to a sampling site versus these measures. A better understanding of these factors will assist resource managers in developing guidelines for establishing and maintaining riparian corridors for small non-urban streams in Wisconsin.

OBJECTIVE

The objectives of this project are to: (1) examine the influence of riparian corridor width on in-stream habitat and fish and macroinvertebrate communities, (2) examine the effect of distance to the sampling site from a disturbed versus an undisturbed riparian corridor on in-stream habitat and fish and macroinvertebrate communities, and (3) identify the influence of the continuity of an undisturbed riparian corridor to in-stream habitat, and fish and macroinvertebrate communities.

APPROACH

A subset of streams will be selected for this project from 160 small and 80 medium streams that are being sampled as part of Nutrient Impacts on Streams, a cooperative project between the USGS and WDNR. The first step will be to categorize all streams into four groups, based on the ecoregion (Omernik, 1987) in which they are located. Eighty sites will be selected for this study based on availability of digital orthophotography, similarities of slope and surficial deposits within ecoregions, and preliminary assessments of riparian corridor land cover using the WISCLAND satellite-derived land cover data. For the selected watersheds, riparian corridor land cover will be interpreted from digital and orthophotography. Streams within each ecoregion will be categorized into four groups based on the width of an undisturbed riparian corridor (narrow versus wide) and

distance upstream, from the sampling site to an undisturbed riparian corridor (near versus far). Multi-variate statistics will be used to look at relations between riparian-corridor width, proximity of an undisturbed riparian corridor to the sampling site, and continuity of an undisturbed riparian corridor versus in-stream habitat, and fish and macroinvertebrate communities.

PROGRESS (July 2001 to June 2002)

The 160 sampling sites have been selected for the Nutrient Impacts on Streams study. Eighty new sites on larger streams were selected. A preliminary design has been developed for the riparian corridor study based on the objectives and the type and location of the nutrient impact sites.

PLANS (July 2001 to June 2002)

Forty sites will be selected for this study based on availability of data and preliminary analysis of ancillary data, including ecoregion, watershed slope, surficial deposits, and land cover. Stream networks and riparian corridor land cover will be interpreted from digital orthophotography and summary statistics will be calculated for riparian-corridor width, proximity of the sampling site to an upstream undisturbed riparian corridor, and continuity of an undisturbed riparian corridor.

Typical stream buffering in Wisconsin.

FERTILIZATION AND RUNOFF FROM URBAN LAWNS

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEF:

Todd D. Stuntebeck

LOCATION:

Dane County

PROJECT NUMBER:

WI 17214

PERIOD OF PROJECT:

March 1994–Continuing

PROBLEM

Excessive phosphorus entering lakes is known to promote unsightly weed growth, decrease recreational uses, and ultimately speed the eutrophication process. Structural or "end-of-pipe" management practices designed to reduce phosphorus are generally expensive. Reducing phosphorus at the source may be a less-expensive alternative. Bannerman and others (1992), found that lawns in residential areas in a portion of the Lake Wingra watershed contribute a significant amount of the phosphorus load in storm runoff. Restricting fertilizer use in the watershed to phosphorus-free brands would seem to be a potentially inexpensive way to reduce phosphorus loads to Lake Wingra. However, there is little applicable field evidence supporting the hypothesis that runoff from fertilized lawns is greater in phosphorus concentrations than runoff from non-fertilized lawns.

In addition to the paucity of data for concentrations in runoff from fertilized versus unfertilized lawns, runoff volumes from lawns are also not well understood. Most studies of turf grass are done on field plots, which are well cared for and may not represent the average conditions of urban lawns. A better understanding of how much water runs off a typical urban lawn and under what conditions will help watershed investigators to improve their ability to predict the impacts of management decisions.

OBJECTIVE

Objectives are to: (1) determine if the concentrations of total phosphorus, dissolved phosphorus, suspended solids, and total solids in runoff from fertilized lawns are different than concentrations from lawns that are not fertilized, (2) use the concentration data in an existing Source Area Loading and Management Model (SLAMM) model to estimate phosphorus loads entering Lake Wingra from both fertilized and non-fertilized lawns, (3) determine the potential reduction in phosphorus loads to Lake Wingra by restricting fertilizer use in the watershed to phosphorus-free brands, (4) obtain rainfall and runoff data with site characteristic data for lawns from different soil types, and (5) use the concentration/runoff information to make improvements to the SLAMM model.

APPROACH

Lake Wingra Lawn Fertilization Study (Water-quality samplers only)—Lawn-runoff samples were collected from 30 water-quality samplers between May 1999 and September 2001. Fifteen of the samplers were located in lawns that were fertilized, and the other 15 were in lawns that were not fertilized. Samples were analyzed for total phosphorus, dissolved phosphorus, total solids, and suspended solids. Two tipping-bucket rain gages and three bulk-precipitation gages were located within the Lake Wingra watershed. Site characteristic data such as soil type and chemical contents, grass density, lawn slope, soil compaction, and infiltration capacity were measured for each of the 30 lawns. Several small experiments were conducted in order to better understand what happens when the bottles overfill and how much phosphorus is likely to come from grass clippings only.

Lawn Runoff Study (Volume/QW samplers)— Runoff volumes are being measured and water-quality samples are being collected for five specialized samplers in the Lake Wingra watershed. In addition to the runoff data, several explanatory variables will be measured for each lawn, including grass density, lawn slope, soil compaction, and infiltration rate. Using statistical regression techniques, an equation will be developed to help explain much of the variability in lawn runoff volumes. Sites will be operated through September 2003. Ten additional sites are planned to be added—five sites with sandy soil and five sites with clayey soil—to explain runoff characteristics in different soil regimes. We expect installation of the new sites starting in October 2002.

PROGRESS (July 2001 to June 2002)

Nearly 1,200 sample concentrations have been obtained for 42 runoff periods since May 1999. Soil samples have been collected and analyzed at two depths for each of the 30 lawns. Five volume samplers have been installed and operated on silt-loam soils. Collectively, these five samplers have recorded runoff data and collected water-quality data for over a dozen snowmelt and rainfall-runoff events.

PLANS (July 2002 to June 2003)

All of the data from the initial lawn-runoff study (water-quality samplers only) will be compiled and analyzed. A fact sheet describing the findings will be published. Ten additional lawn volume/QW samplers will be installed in sandy and clayey soils. A Fact Sheet will be published explaining the Lake Wingra Fertilization Study.

A typical water-quality sampler site showing lawn edging and sample bottle.

Instrumentation for the volume/water-quality sampler showing tipping bucket, cone splitter, sample bottle, and electronic datalogger.

IMPACT OF PHOSPHORUS AND NITROGEN CONCENTRATIONS ON THE BIOLOGICAL INTEGRITY OF WISCONSIN STREAMS

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEFS:

David J. Graczyk
Dale M. Robertson

LOCATION:

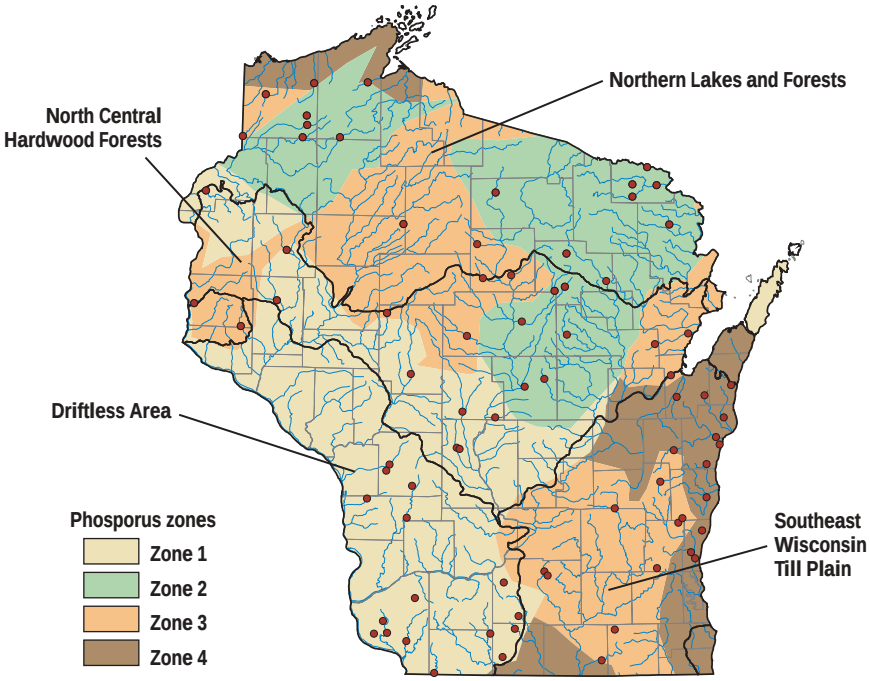
Statewide

PROJECT NUMBER:

WI 17223

PERIOD OF PROJECT:

March 2001 to June 2004



PROBLEM

Excessive nutrient (primarily phosphorus and nitrogen) loss from the watershed is frequently associated with water-quality problems in Wisconsin's water bodies. The implementation of the WDNR's proposed agricultural performance standards and prohibitions should decrease the risk of excessive nutrient loss from croplands and livestock operations. Landowners would be asked to limit their amount of commercial fertilizer use and reduce the impacts of manure storage and spreading. Implementation of TMDLs and the enforcement of phosphorus criteria would also reduce the problems caused by nutrients. The expected water-quality improvements due to the application of agricultural performance standards may vary due to possible differences in nutrient responses in each water body. In order to evaluate the environmental benefits of the proposed performance standards and phosphorus criteria, sufficient data need to be collected in various types of streams to define the nutrient response.

OBJECTIVE

The objectives of the project are to: (1) determine what phosphorus and nitrogen concentrations impair the biological integrity of a stream, (2) develop a database that can be used to refine the phosphorus criteria for Wisconsin streams, (3) determine how watershed characteristics affect the relations between phosphorus and nitrogen concentrations in streams and the biological integrity of the streams, and (4) improve our biological assessment of nutrient impairments by developing a nutrient index of biological integrity.

APPROACH

The approach for the project is to statistically determine significant relations exist between a stream's nutrient concentrations, biological integrity, and watershed characteristics. Multivariate statistical analyses will be used to sort out the importance of the many different variables. Since these nutrient relations are

expected to vary with stream size and the location of the stream in the state, streams will be grouped by size, and by four nutrient ecoregions and four nutrient zones. Streams will be divided into those with smaller watersheds of 4 to 50 square kilometers, those with larger watersheds (greater than 50 square kilometers) but are wadeable, and those with larger watersheds (greater than 50 square kilometers) but are not wadeable.

The variables in the statistical analysis will include indicators of biological integrity, habitat characteristics, nutrient concentrations, and specific watershed characteristics. The biological indicators will include fish abundance and diversity, macroinvertebrate diversity, and periphyton biomass. Water samples collected from the stream will be analyzed for total phosphorus, dissolved phosphorus, nitrate, total Kjeldahl nitrogen, ammonia, turbidity, conductivity, and suspended chlorophyll *a*. Watershed characteristics will include drainage-area size, stream gradient, climate data, land use, annual runoff, surficial deposits data, soil types, soil erodability, and riparian buffer data.

Approximately 160 small streams will be monitored in the first year of the study. Approximately 80 larger wadeable streams will be monitored in the second year of the study and approximately 40 larger nonwadeable larger streams will be sampled in the third year of the study. Sites will be selected from streams where the fish community and habitat had been sampled over the last five years by the Wisconsin Department of Natural Resources and will be attempted to be equally divided among ecoregions and nutrient zones. The fish and habitat data in the wadeable streams were collected using similar protocols at all sites and the data are stored in a readily accessible database.

A total of six water-quality samples will be collected between the months of May and October at each site. Nutrient concentrations will be determined from samples collected at each stream by standard sampling methods. A flow measurement will be collected at the time of the water-quality grab sample.

PROGRESS (July 2001 to June 2002)

Samples were collected at 158 smaller streams in four ecoregions and four phosphorus zones in July through October, 2001 and in 78 larger wadeable streams in May and June, 2002. Samples were analyzed for nutrients and chlorophyll *a*. Field measurements included stream discharge, water temperature, dissolved oxygen, pH, turbidity, conductance, and stream clarity. Most of the sites were sampled for attached algae by the Wisconsin Department of Natural Resources.

The median total phosphorus and total nitrogen concentrations for small streams in NLF ecoregion were significantly lower than those in the DFA ecoregion, which were significantly lower than those in the SWTP and NCHF ecoregions. The median total phosphorus and total nitrogen concentrations for small streams in phosphorus zone 2 were significantly less than those in phosphorus zones 1, 3, and 4.

All data collected in 2001 were summarized and published in the report "Water Resources Data–Wisconsin, Water Year 2001."

PLANS (July 2002 to June 2003)

Samples will be collected at 78 wadeable streams with drainage basins greater than 50 square kilometers for the months of July through October. All data collected in 2002 will be summarized and published in the report "Water Resources Data–Wisconsin, Water Year 2002."

HYDROLOGY AND WATER-QUALITY IMPACTS OF DIFFERENT PASTURE MANAGEMENT PRACTICES IN SOUTHWESTERN WISCONSIN

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEF:

David J. Graczyk

LOCATION:

Sauk County

PROJECT NUMBER:

WI 17229

PERIOD OF PROJECT:

October 1997 to September 2003

PROBLEM

Nonpoint-source pollution is a major concern in Wisconsin. There are approximately 24,000 dairy farms in Wisconsin which may be sources of sediment, nutrients, and pesticides to surface and ground water. Managed Intensive Rotational Grazing (MIRG) is a system that uses pastures as a major source of feed for milking cows. MIRG farmers rely on pastures for their dairy herds' forage needs and move their cows to a new pasture at least once a week. In 1992, roughly 7 percent of Wisconsin dairy farms used MIRG but in 1994, 14 percent of Wisconsin dairy farms used MIRG. MIRG can be used as a best management practice (BMP) and may reduce the amount of sediments, nutrients, and pesticides to receiving waters. In a study in Oklahoma, rotational grazed pastures evidenced a reduction in average annual runoff and sediment discharges when compared to a continuously grazed basin.

This study will compare surface-water runoff and water quality from three small pastured watersheds. The pastures will be located at the USDA Dairy Forage Research Center at Prairie du Sac.

OBJECTIVE

The overall objective of this study is to determine differences in quantity and quality of surface-water runoff from three different pasture-management strategies. These strategies consist of a variety of practices which are available to pasture managers, both during the growing and dormant seasons. Combinations of management practices have been chosen to represent commonly used strategies. In addition to examining differences in overall management strategies, differences related to individual seasonal practices will be determined. A secondary objective will be to determine a water budget for each pasture. The water budget will be determined by measuring surface-water runoff and precipitation. Evaporation and transpiration will be estimated by using empirical equations and ground-water flow will be estimated as a residual.

APPROACH

The management practices to be examined include: (1) intensive rotational grazing and continuous grazing

during the growing season, (2) pasture "stockpiling" during late summer and continued grazing throughout the summer, and (3) two outwintering practices and no outwintering. An artificial hydraulic control was installed at each pasture outlet. The control is a three-inch Parshall flume. Each site will use a pressure transducer to measure stage and a CR-10 data recorder. Daily, monthly, and annual surface-water runoff will be calculated at each pasture. A tipping-bucket rain gage was installed at each site. Evapotranspiration will be estimated using empirical equations. Air temperature and solar radiation will be collected at one of the pastures for use in the evapotranspiration calculation. Meteorological data collected at the USDA Research Station will supplement data collected at this pasture. Ground-water flow will be calculated as a residual. An ISCO automatic water-quality sampler was installed at each site. The sampler will collect discrete samples. These samples will be composited on a flow-weighted basis. One composite sample per rainfall or snowmelt event will be sent to the Wisconsin State Laboratory of Hygiene for analysis. All events will be monitored. Approximately 5–10 samples per pasture will be collected. All samples will be analyzed for soluble reactive phosphorus, total phosphorus, ammonia nitrogen, nitrate and nitrite nitrogen, total Kjeldahl nitrogen, total suspended solids, and volatile suspended solids.

PROGRESS (July 2001 to June 2002)

Three small basins were monitored for continuous streamflow and rainfall. Four runoff samples collected at site 1, six runoff samples at site 2, and one runoff sample at site 3. Water-quality-constituent loads and subsequent yields were calculated at all three sites. Runoff events include summer thunderstorms and early winter rainfall and snowmelt events. Suspended solids yields were compared at the three sites. The median yields for suspended solids were the greatest at site 1 (5.77 lb/acre), at site 2 the median suspended solids yield was 1.53 lb/acre, and at site 3 the suspended solids yield was 0.24 lb/acre. A nonparametric Wilcoxon test was done to determine if the median yields were statistically the same or the alternative hypothesis that the medians were less than or greater than each other. The median suspended solids yields were statistically significantly different than each other when comparing site 1 with site 2 and site 3. The median yields were not statistically different from each other when comparing site 2 and site 3. The ammonia nitrogen yields ranged from 0.004 lbs/acre (site 3) to 0.008 lb/acre (site 1). None of the median ammonia nitrogen yields were statistically significantly different from each other at the 5-percent probability level. The total phosphorus median yield was 0.016 lb/acre at site 1, 0.005 lb/acre at site 2, and 0.007 lb/acre at site 3. The total phosphorus yield at site 1 was statistically significantly different from the median total phosphorus yields at site 2 but not at site 3 at the 5-percent probability level. All data was summarized and published in the report "Water Resources Data–Wisconsin, Water Year 2001."

PLANS (July 2002 to June 2003)

Monitoring at all three sites will be continued. Water-quality samples will be collected at the three sites for all storms that produce runoff and water-quality loads and yields will be calculated for each storm. Animal grazing will be allowed according to the Managed Intensive Rotational Grazing for each site. Yields will be compared at each site before grazing was started at each basin and after grazing was started. In addition site 1 (no out-wintering of animals) and site 2 and 3 (where out-wintering is part of the grazing plan) will be compared with each other to determine if differences can be found. All streamflow and water- quality data will be published in the annual report "Water Resources Data–Wisconsin, Water Year 2002."

DISCOVERY FARMS

COOPERATOR:

Wisconsin Department of Natural Resources

PROJECT CHIEF:

Todd D. Stuntebeck

LOCATION:

Buffalo County

PROJECT NUMBER:

WI 17239

PERIOD OF PROJECT:

July 2001 to June 2003

PROBLEM

Agricultural nonpoint pollution in the form of nutrients, sediment, and pesticides threatens many of Wisconsin streams and lakes. Understanding how to help reduce these pollutants while allowing farmers to remain economically viable provides a great challenge.

OBJECTIVE

Under the new Wisconsin Agriculture Stewardship Initiative, groups will work together to develop science-based, productive, and profitable approaches to farming. Projects will be conducted on numerous "Discovery Farms" which will represent diverse land characteristics and management styles. Information learned from these projects will then be shared with the agricultural community to allow them the tools to remain competitive in today's market while taking environmentally sound approaches to farming.

APPROACH

Stream Buffer Investigation—Traverse Valley Creek on the Joe Bragger Farm, Buffalo County—A "paired-watershed" study design will be applied in which a control site will be compared to a treatment site. The basis of this approach is that water-quality relation can be established between the treatment and the control site before BMPs (Best Management Practices) are implemented. When BMPs are implemented at the treatment site, the established relation will change if the BMPs have had a significant impact on water quality. The monitoring period will last approximately five years, with two years of pre-BMP data collection, a one-year implementation/transition period with no sampling, and a two-year post-BMP sampling phase. At this time, a specific BMP has not been decided; however, it will likely focus on buffer strips.

Four gaging stations will be installed on or near the Bragger Discovery Farm: one each on two tributaries to Traverse Valley Creek and two on nearby hillslopes. The two stream gages will be equipped to monitor water levels, water temperature, and precipitation; and to collect automated, refrigerated water samples, while the hillslope gages will be equipped to measure flow and samples. Surface-water samples will be collected from the stream sites during baseflow periods and storms. Baseflow samples will be collected at each monitoring station on a bi-weekly basis starting after the gages are installed. Samples will be analyzed at the Wisconsin State Laboratory of Hygiene for total phosphorus, total dissolved phosphorus, suspended solids, volatile suspended solids, total suspended sediment, nitrate plus nitrite, total Kjeldahl nitrogen, ammonia, chloride, fecal coliform bacteria, alkalinity, conductivity, and pH. Flow-composite, automated, water samples will be collected for all storms with a significant overland-runoff component. Samples will be triggered by a combination of precipitation and water-level increases, and will be analyzed for the same constituents as baseflow samples.

In addition to the paired-watershed design, several other investigations will be conducted on various aspects on the farm. These studies may include, but not be limited to: a whole-farm mass balance of nitrogen and phosphorus, comparisons of stream gage-measured sediment loads versus RUSTLE II predicted values, development, calibration, and verification of a phosphorus-loss risk index, development, calibration and, verification of a hydrologic and chemical model (surface and ground water), and cow diet/manure implications.

PROGRESS (July 2001 to June 2002)

Both of the stream gages at the Bragger Discovery Farm became fully operational in September 2001. Since then, 9 baseflow and 13 storm samples have been collected at each site. A cursory review of the collected data shows that nitrate concentrations in the north basin are significantly higher than those in the south basin. The north basin has much more cropped agriculture than the south basin. It has also become apparent that aspect to the sun is very important for winter/spring snowmelt: north-facing slopes melt much more slowly than do south-facing slopes. This phenomenon has important implications for the hydrologic models that will be created. For this reason, each of the hillslope gages will be placed on slopes of different aspect.

PLANS (July 2002 to June 2003)

Two flumes will be installed on two forested hillslope drainages at the Bragger Discovery Farm—each on slopes of different aspect. The purpose of these gages will be to determine how much stormwater, and associated chemicals, comes from these steep, unfarmed areas. Based on a nearby study, it is suspected that these areas act as significant recharge zones for ground water.

An additional monitoring site will be included in this project sometime after July 2002. Specific sites to be monitored and the research to be conducted on each site has not yet been determined.

Baseflow and storm sampling will continue on the Bragger Discovery Farm.

Streamgage at North Tributary to Traverse Valley Creek, showing flume with wing walls and instrumentation shelter.

QUANTIFICATION OF CONSTITUENT LOADS FROM FARM FIELDS AT THE PIONEER FARMS IN WISCONSIN

COOPERATOR:

State of Wisconsin Pioneer Farm

PROJECT CHIEF:

David W. Owens

LOCATION:

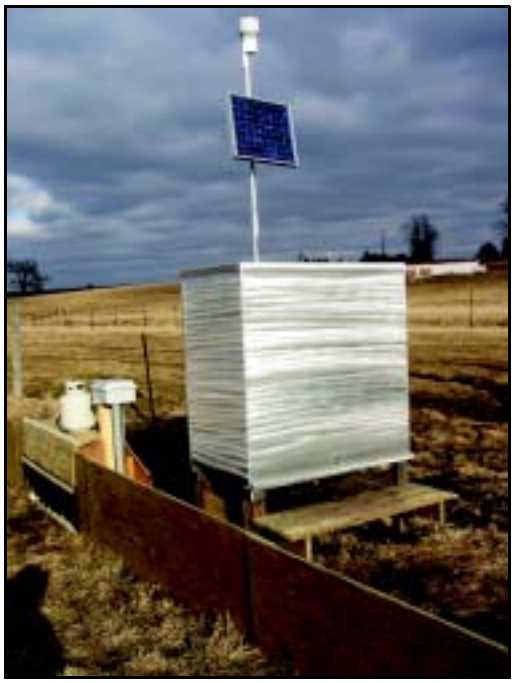
University of Wisconsin,
Platteville Experimental Farms

PROJECT NUMBER:

WI 17240

PERIOD OF PROJECT:

October 2001 to October 2003



Gaging station at the University of Wisconsin–Platteville experimental farms.

PROBLEM

Wisconsin has many operating farms throughout the state where Best Management Practices (BMPs) could be implemented. These BMPs are designed to protect the environment and enhance the farm operations. Many farmers, however, do not want to implement BMPs without knowing the cost and benefits of each BMP. The Pioneer Agricultural Stewardship Farm located at the University of Wisconsin, Platteville Farm has been established to evaluate and promote management practices within the context of the farming systems in order to develop compatible methods and technologies that will help farmers achieve their economic goals while protecting and enhancing natural resource.

OBJECTIVE

The main objective of this project is to provide field level water quality and quantity data from rainfall and snowmelt runoff events. This data will be used to (1) verify the Wisconsin Phosphorus Index, (2) verify the Revised Universal Soil Loss Equation (RUSLE) and Revised Universal Soil Loss Equation II (RUSLE II) (3) establish "base-line" in stream conditions and (4) evaluate individual BMPs such as infiltration trenches and/or rotational grazing practices.

APPROACH

Water quality monitoring stations will be installed at several sites throughout the experimental farm. These sites include five field level stations and one in-stream station located downstream of the experimental farm. The stations will monitor runoff volume and will collect water quality samples throughout the runoff event. These samples will be analyzed for solids, nutrients, bacteria and selected pesticide concentrations. Stations need to be designed to collect data during snow-melt runoff events.

PROGRESS (October 2001 to June 2002)

Four field level water-quality sampling stations were installed during the winter. Event monitoring started in mid-March 2002.

PLANS (July 2002 to June 2003)

Install in-stream and field level control sampling stations. Maintain and operate monitoring stations.