

**WISCONSIN GROUNDWATER
COORDINATING COUNCIL**

REPORT TO THE LEGISLATURE

August 1996

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Geological and Natural History Survey (State Geologist) - James Robertson
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August, 1996

To: The Citizens of Wisconsin

The Honorable Governor Tommy G. Thompson
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Assembly Environment and Utilities Committee
Assembly Natural Resources Committee
Secretary Charles H. Thompson - Department of Transportation
Secretary William McCoshen - Department of Commerce
Secretary Alan T. Tracy - Department of Agriculture, Trade and Consumer Protection
Secretary Joe Lekan - Department of Health and Family Services
Secretary George E. Meyer - Department of Natural Resources
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GOVERNOR'S REP.

This is the 1996 Groundwater Coordinating Council (GCC) Report to the Legislature. The Council was formed in 1984 to help state agencies coordinate non-regulatory activities and exchange information on groundwater. The Council has served as a model for interagency coordination and cooperation among state government officials, the Governor, local government and federal government. It has achieved the distinction of being one of the few groups in the nation to effectively coordinate groundwater activities in their state from an advisory position.

The groundwater accomplishments by your state agencies during the past year include:

- * Approval of Wisconsin's "Generic State Management Plan (SMP) for Protection of Groundwater from Pesticides" by the U.S. EPA, Region 5. The generic SMP was cooperatively drafted by DATCP and DNR and reviewed by DHSS and other interested agencies. The plan presents a comprehensive review of Wisconsin's efforts to prevent groundwater contamination due to pesticides. The Wisconsin Generic SMP is the first to receive Region V EPA concurrence.
- * Publication of 72 summaries of groundwater monitoring and research projects funded through the joint solicitation process. Over the past two years DNR and UW Water Resources Center (WRC) staff, and principal investigators wrote 72 summaries of research and monitoring final reports. The summaries were published together in September 1995 in the DNR's "Wisconsin Groundwater Research and Monitoring Project Summaries". Copies of the document and all final reports are distributed by the WRC and the DNR.
- * Implementation of a major groundwater education campaign focused on Drinking Water Week, May 5-11. The GCC coordinated agency groundwater educational activities including press releases, public radio discussions, school notifications and assistance, and displays. The GCC also formally adopted groundwater educational goals and principles, standardized procedures for the review of groundwater educational materials and defined its role in groundwater education in Wisconsin.

We hope you, your staff, and the public will find this report a useful reference in protecting Wisconsin's valuable groundwater resource.

Sincerely,

Susan L. Sylvester, Chair
Groundwater Coordinating Council

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LIST OF ABBREVIATIONS AND ACRONYMS

ACCP	Agricultural Chemical Cleanup Program
ASCS	U.S. Agricultural Stabilization and Conservation Service
BMP	Best Management Practices
BSHWM	Bureau of Solid and Hazardous Waste Management
CERCLA	Comprehensive Environmental Response Compensation Liability Act
CDC	Center for Disease Control
COMM	Department of Commerce
CWGC	Central Wisconsin Groundwater Center
DATCP	Department of Agriculture, Trade and Consumer Protection
DHFS	Department of Health and Family Services
DHSS	Department of Health and Social Services
DILHR	Department of Industry, Labor and Human Relations
DNR	Department of Natural Resources
DOT	Department of Transportation
EIS	Environmental Impact Statement
EPA	U. S. Environmental Protection Agency
ERR	Emergency and Remedial Response
ERS	Division of Environmental and Regulatory Services
ES	Enforcement Standard
FY	Fiscal Year
GCC	Groundwater Coordinating Council
GEMS	Groundwater and Environmental Monitoring System
GIS	Geographic Information Systems
GMS	Groundwater Management Section
GRAC	Groundwater Research Advisory Council
GRN	Groundwater Retrieval Network
IWWS	Industrial Wastewater Section
LUST	Leaking Underground Storage Tank
LWRV	Lower Wisconsin River Valley
mg/L	milligrams per liter
MOU	Memorandum of Understanding
MWWS	Municipal Wastewater Section
NPM	Nutrient and Pest Management
NRCS	Natural Resource Conservation Service
PAL	Preventive Action Limit
PECFA	Petroleum Environmental Clean-up Fund
ppb	parts per billion
ppm	parts per million
SLOH	State Lab of Hygiene
SMP	State Management Plan
µg/L	micrograms per liter
USDA	U.S. Department of Agriculture
UW	University of Wisconsin
UWS	University of Wisconsin System
USGS	U.S. Geological Survey
VOC	Volatile Organic Compound
WGNHS	Wisconsin Geological and Natural History Survey
WHP	Wellhead Protection
WPDES	Wisconsin Pollution Discharge Elimination System
WRC	Water Resources Center
WUWN	Wisconsin Unique Well Number

EXECUTIVE SUMMARY

This is the Report to the Legislature by the Groundwater Coordinating Council (GCC) as required by s. 15.347, Wisconsin Statutes. The report describes the condition and management of the groundwater resource and summarizes the Coordinating Council's activities for fiscal year (FY) 1996.

In 1984, the Legislature enacted Wisconsin Act 410 to improve the management of the state's groundwater. The GCC is directed by s. 160.50, Wis. Stats., to "serve as a means of increasing the efficiency and facilitating the effective functioning of state agencies in activities related to groundwater management. The Groundwater Coordinating Council shall advise and assist state agencies in the coordination of nonregulatory programs and the exchange of information related to groundwater, including, but not limited to, agency budgets for groundwater programs, groundwater monitoring, data management, public information and education, laboratory analysis and facilities, research activities and the appropriation and allocation of state funds for research."

Membership of the GCC includes the Secretaries of the Departments of Natural Resources (DNR); Commerce (COMM) - formerly part of the Department of Industry, Labor and Human Relations (DILHR); Agriculture, Trade and Consumer Protection (DATCP); Health and Family Services (DHFS) - formerly the Department of Health and Social Services (DHSS); Transportation (DOT); the President of the University of Wisconsin System (UWS); the State Geologist; and a representative of the Governor. Members are listed on the inside of the front cover.

Since its last report, the Groundwater Coordinating Council has accomplished the following:

1. The GCC and the UWS Groundwater Research Advisory Council continued coordination of the annual solicitation for groundwater research and monitoring proposals among state agencies. Twenty-eight projects were funded in FY 96 by one or more of the following agencies: UWS, DATCP, DNR and DILHR. The projects funded are listed in Table 1. The locations of the field sites for the projects are shown in Figure 3. A joint solicitation for groundwater-related monitoring and research project proposals for funding in FY 97 was distributed in November, 1995. A copy of the joint solicitation is contained in the Appendix. A total of 35 project proposals were received. Eighteen new projects were selected by the UWS, DNR, DILHR, and/or DATCP for funding in FY 97 in addition to 10 projects which will carry over into the new fiscal year. The FY 97 groundwater monitoring and research projects and their funding agency are listed in Table 2. The GCC endorsed the UWS groundwater research plan for FY 97 as required by s. 160.50(1m), Wis. Stats.
2. The GCC coordinated efforts to distribute the findings of groundwater monitoring and research funded through the joint solicitation process. Over the last 2 years DNR and UW Water Resources Center (WRC) staff and principal investigators wrote summaries of 72 final reports. These summaries were published in the "Wisconsin Groundwater Research and Monitoring Project Summaries" in September 1995. See the Appendix for a list of the published summaries. The DNR and WRC eliminated the backlog of final reports for which summaries had not been prepared. Copies of all final reports and summaries are being distributed by the WRC and DNR. The WRC also made progress making the summaries accessible by computer through the National Library System and WisInfo online services.
3. The GCC completed a detailed documentation of the reasons for its creation, its charge, makeup, activities, history, meeting records, meeting attendance, and other specifics for the Office of the Lieutenant Governor in response to a questionnaire designed to evaluate advisory councils. 1995 Wisconsin Act 27 required the Office of the Lieutenant Governor to evaluate designated councils, offices, boards and commissions and recommend continuation, termination or transfer of their functions to another state body. The GCC is one of 144 organizations being evaluated. The GCC's response consisted of over 30 pages of detailed information plus a number of supplemental documents. A decision is expected in mid-FY 97.

4. Through its subcommittees, the GCC continued to address important data management issues. An informational brochure is being produced that standardizes a procedure for assigning Wisconsin Unique Well Numbers (WUWN), a key step in tracking groundwater quality data. The brochure targets state, county, and local agency staff and various private industry staff. A work group began to address groundwater data integration issues which remain a high priority for the GCC.
5. Through its subcommittees, the GCC coordinated agency groundwater educational efforts focused on Drinking Water Week, May 5-11. Activities included press releases, public radio discussions, school notifications and assistance, and displays. The GCC also adopted groundwater educational goals and principles, standardized guidelines for the review of groundwater educational materials and defined its role in groundwater education in Wisconsin (Appendix).
6. Work progressed on the GCC-directed report on groundwater quantity. A draft report, prepared by DNR staff, which summarizes available information on groundwater quantity and provides options for managing problems (see also "Condition of the Resource: Groundwater Quantity") is near completion. One groundwater quantity-related monitoring project is being funded as a result of a groundwater quantity research priority added by the DNR to the 1996 joint solicitation package.
7. The GCC has continued to work with representatives of federal agencies to promote communication and coordination of federal and state groundwater activities. Representatives from the Natural Resource Conservation Service (NRCS), U. S. Agricultural Stabilization and Conservation Service (ASCS) and the U. S. Geological Survey (USGS) attend GCC meetings and serve as *ex officio* subcommittee members. The groundwater activities of the USGS are summarized in the Appendix.

INTRODUCTION

PURPOSE

The Groundwater Coordinating Council is required by s. 15.347, Wis. Stats., to prepare a report which "summarizes the operations and activities of the council ..., describes the state of the groundwater resource and its management and sets forth the recommendations of the council. The annual report shall include a description of the current groundwater quality of the state, an assessment of groundwater management programs, information on the implementation of ch. 160, Wis. Stats., and a list and description of current and anticipated groundwater problems." This report is due each August. The purpose of this report is to fulfill this requirement for FY 96.

The section, "Summary of Agency Activities" describes groundwater management programs and implementation of ch. 160, Wis. Stats., by the individual state agencies. "Groundwater Monitoring and Research" provides information on monitoring and research activities to address groundwater issues in Wisconsin and describes the condition of the groundwater resource. The activities of the Groundwater Coordinating Council and its subcommittees are described under "Coordination Activities" and in the minutes which are contained in the Appendix. The recommendations of the Council are contained in "Directions for Future Groundwater Protection."

SUMMARY OF WISCONSIN'S GROUNDWATER LEGISLATION

Wisconsin has a long history of groundwater protection. The culmination of this effort was adoption and implementation of 1983 Wisconsin Act 410, Wisconsin's Comprehensive Groundwater Protection Act which was signed into law on May 4, 1984. The law expanded Wisconsin's legal, organizational, and financial capacity for controlling groundwater pollution. The Groundwater Protection Act created chapter 160, Wisconsin Statutes, which serves as the backbone of Wisconsin's program. Chapter 160, Wis. Stats., provides a multi-agency comprehensive regulatory approach, using two-tiered numerical standards, based on the premise that all groundwater aquifers in Wisconsin are entitled to equal protection. There are a number of major components to Wisconsin's groundwater protection program:

- 1) Standards. Under chapter 160, Wis. Stats., the Department of Natural Resources (DNR) must establish state groundwater quality standards based on recommendations from the Department of Health and Social Services (DHSS). Standard setting is a continuing process based on a priority list of substances detected in groundwater or having a high possibility of being detected, established by the DNR in conjunction with other state agencies. The state groundwater standards are contained in chapter NR 140, Wisconsin Administrative Code. For each substance there is an enforcement standard (ES) which determines when a violation has occurred and a preventive action limit (PAL) which is set at a percentage of the ES. The PAL serves as a trigger for possible remedial action.
- 2) Regulatory Programs. Once groundwater quality standards are established, all state agencies must manage their regulatory programs to comply. Each state regulatory agency must promulgate rules to assure that the groundwater standards are met and to require appropriate responses when the standards are not met. The state regulatory agencies are the DNR (solid and hazardous waste, industrial and municipal wastewater, spills); the Department of Industry, Labor & Human Relations (DILHR) (private sewage systems, petroleum product storage tanks - now in the new Department of Commerce); the Department of Agriculture, Trade and Consumer Protection (DATCP) (pesticide use and storage and fertilizer storage); and the Department of Transportation (DOT) (salt storage). The implementation of the groundwater standards by the state agencies is described under "Summary of Agency Activities".

- 3) Aquifer Classification. One of the most important features of Wisconsin's groundwater law is an item that was omitted. When Wisconsin was debating the groundwater protection legislation, the U. S. Environmental Protection Agency (EPA) tried to develop a nationwide groundwater approach. A keystone of EPA's proposal was aquifer classification - a scheme whereby each aquifer would be classified according to its potential use, value or vulnerability and then would be protected to that classification level. This entails "writing off" certain aquifers as industrial aquifers not entitled to protection and never again usable for human water supply. Wisconsin said "no" to aquifer classification. The philosophical underpinning of Wisconsin's groundwater law is the belief that all groundwater in Wisconsin must be protected equally to assure that it can be used for people to drink.
- 4) Monitoring and Data Management. At the time the groundwater legislation was created, there was concern that Wisconsin needed a groundwater monitoring program to determine whether the groundwater standards were being met. Therefore, a groundwater monitoring program was created under s. 160.27, Wis. Stats. Money from the Groundwater Account of the Environmental Fund has been used for problem-assessment monitoring, regulatory monitoring, at-risk monitoring and management-practice monitoring, as well as establishment of a data management system for collection and management of the groundwater data. See the "Groundwater Monitoring and Research" discussion (p.32) in this report for further information.
- 5) Research. Although all state agencies must comply with the groundwater standards, the processes by which groundwater becomes contaminated, the technology for clean-up, the mechanisms to prevent contamination and the environmental and health effects of the contamination are often not well understood. In addition, the basic data on geology, soils, and groundwater hydrology is often not available. The UWS and the state agencies have recognized that additional efforts in these research areas are badly needed. The Governor and the Legislature included a new groundwater research appropriation for the UWS beginning with the 1989-1991 biennial budget. During the past year, the UWS, DATCP, DILHR, and DNR participated in a joint solicitation for groundwater-related research and monitoring proposals for funding during fiscal year 1997. See the "Groundwater Monitoring and Research" section for more details.
- 6) Coordination. In establishing the groundwater law, the Legislature recognized that management of the state's groundwater resources was a responsibility divided among a number of state agencies. Therefore, the Groundwater Coordinating Council was created to advise and assist state agencies in the coordination of non-regulatory programs and the exchange of information related to groundwater. The Coordinating Council has been meeting since 1984. See the "Coordination Activities" discussion (p.66) in this report.
- 7) Local Groundwater Management. The Groundwater Protection Act clarified the powers and responsibilities of local governments to protect groundwater in partnership and consistent with state law.
 - a. Zoning authority for cities, villages, towns and counties was expanded to "encourage the protection of groundwater."
 - b. Counties can adopt ordinances regulating disposal of septage on land (consistent with DNR requirements); cities, villages or towns may do so if the county does not.
 - c. Counties can regulate (under DNR supervision) well construction and pump installation for certain private wells.
 - d. Property assessors must consider the time and expense of repairing or replacing a contaminated well or water supply when assessing the market value of real property; they must consider the

"environmental impairment" of the property value due to the presence of a solid or hazardous waste disposal facility.

The following report is intended to update the Legislature and Governor on the status of the state's groundwater program and the activities of the Groundwater Coordinating Council.

SUMMARY OF AGENCY ACTIVITIES

The groundwater management efforts undertaken by the member agencies of the Groundwater Coordinating Council during the past year show that Wisconsin continues to have a strong commitment to protection of its groundwater resource.

DEPARTMENT OF NATURAL RESOURCES

The DNR has statutory authority as the central unit of state government to protect, maintain and improve groundwater within the state (s. 144.025(1), Wis. Stats.). The DNR establishes the groundwater quality standards for the state under authority of s. 144.025(2)(b) and ch. 160, Wis. Stats. The DNR also has specific groundwater-related regulatory programs.

During most of FY 96, regulatory programs to protect groundwater were the responsibility of one of three Bureaus: Water Supply, Wastewater Management, and Solid and Hazardous Waste Management (BSHWM). In addition, the Groundwater Management Section (GMS) of the Bureau of Water Resources Management assisted in coordinating groundwater activities of the DNR, as well as other state agencies. The GMS is responsible for adoption of groundwater standards contained in ch. NR 140, Wis. Adm. Code, development of an annual groundwater monitoring plan, coordination of the joint solicitation for groundwater-related monitoring and research proposals, review and management of groundwater monitoring projects, coordination of groundwater components of basin plans and of nonpoint source priority watershed projects, coordination of wellhead protection activities, and maintenance of a data management system for groundwater data. Near the end of FY 96 the DNR changed its organizational structure. A brief description of the new structure as it relates to groundwater management is at the end of this section.

Amendments to ch. NR 140, Wis. Adm. Code, became effective August 1, 1995. The amendments added groundwater standards for 13 substances, revised the standards for 10 others and provided language to allow the Department to grant a temporary exemption for injection or infiltration of substances or remedial material as part of a remedial response. NR 140 now includes groundwater standards for 109 substances of public health or welfare concern. The Department intends to begin the rule-making process to add more groundwater standards to NR 140 this fall based on recommendations from the Department of Health and Family Services.

GMS staff reviewed recommendations from the NR 141 *Ad Hoc* External Advisory Committee regarding groundwater monitoring well requirements. The recommended changes to the code (NR 141, Wis. Adm. Code) include: flush mount manhole wall thickness of 1/4 inch, refined language, modified depths for the use of bentonite chips, and the inclusion of remediation wells in the code. Other recommendations by the advisory committee include developing tables for determining the amount of water to be purged during well development, educational efforts to enhance compliance with NR 141, and a strategy for labeling wells with a unique well number to allow tracking. Several additional changes have been suggested and will be considered for adoption when the code revisions proceed.

Work has begun on methods for automating report submittals. Wisconsin Unique Well Number (WUWN) labels have been received and a system for distribution is being developed.

GMS staff performed 20 inspections of drilling operations in FY 96. These inspections are designed to educate drillers and environmental consultants about NR 141 and to enhance compliance with the code. Training relating to NR 141 and drilling was given to DNR district and central office staff to assist them in field inspections. Training sessions were also given at Wisconsin Groundwater Association state and area meetings.

An effort was made to develop and educate operators and consultants on the proper techniques for geoprobe abandonment.

During FY 96 GMS staff nearly completed revisions to DNR Groundwater Sampling Guidance. Both the Desk Reference and the Field Manual were revised for the first time since 1987 due to numerous advances in groundwater sampling and monitoring technology in recent years. The new documents will go into much greater detail on how to consistently collect high quality, representative groundwater samples and measurements. The review process for the documents included extensive comments from 5 environmental consulting firms, 1 private laboratory, and DNR and DATCP staff. Both documents should be published in the summer of 1996.

The DNR continued its groundwater monitoring program which includes problem assessment monitoring, at-risk well monitoring, management practice monitoring and regulatory monitoring. During FY 96, \$248,568 was awarded to 10 projects for the management practice monitoring program (see Table 1). The 10 projects were selected during the joint solicitation process described under "Groundwater Monitoring and Research" in this report. During FY 97, approximately \$184,384 will be awarded to 9 projects for the management practice monitoring program (see Table 2). Five projects are new studies selected during this year's joint solicitation process.

Under direction of the GCC, GMS staff coordinated efforts to distribute the findings of groundwater monitoring and research funded through the joint solicitation process. Over the last 2 years DNR and UW Water Resources Center (WRC) staff and principal investigators wrote summaries of 72 final reports. These summaries were published together in the "Wisconsin Groundwater Research and Monitoring Project Summaries" (WDNR PUBL-WR-423-95) in September 1995. See the Appendix for a list of the titles of the published summaries. The DNR and WRC eliminated the backlog of final reports for which summaries had not been prepared. Copies of all final reports and summaries are being distributed by the WRC and DNR.

The DNR is the lead state agency for developing and implementing the Wisconsin Wellhead Protection (WHP) Plan. The specific goal of Wisconsin's plan is to achieve localized groundwater pollution prevention measures in public water supply wellhead areas consistent with the state's overall goal for groundwater protection. To achieve this goal the DNR, working with other state and federal agencies, and extensive citizen input, developed a two-part state WHP Program. The first part is mandatory. Wisconsin Administrative Code ch. NR 811 requires that a WHP plan be developed for any new municipal water supply well constructed since May 1, 1992. The plan must be submitted to the DNR Public Water Supply Section for approval. The second part of the WHP Plan is a voluntary program which encourages a WHP plan for any public water supply well approved prior to May 1, 1992.

In 1993, the DNR initiated a statewide public information campaign aimed at encouraging water purveyors to proactively protect their water supplies from potential sources of contamination. This public education campaign continues with state-wide media releases, direct mailings of groundwater protection materials, bi-annual newsletters to water supply operators, city and village mayors, tribal chairs and town chairs. The DNR is also committed to providing technical assistance to water supplier systems that want help developing WHP plans for their water systems.

The DNR works with the Wisconsin Rural Water Association to develop community plans and provide technical assistance through conferences and training sessions for community officials and water system operators. The DNR has provided funding for a pilot project to develop WHP areas for all of the municipal water supply wells in Dane county. This project is near completion and the DNR is working to disseminate the information to the municipalities in the county.

In FY 96 GMS staff completed delineation of WHP areas for all municipalities in the state using the EPA-approved calculated fixed radius method. This simple method results in a circular WHP area around each well. The size of the area depends on the pumping rate of the well and the general hydraulic properties of the aquifer. In addition to the calculated fixed radius delineations GMS staff began using groundwater flow modeling to delineate more sophisticated WHP areas. WHP areas for 5 wells in Merrill were delineated using the modeling technique.

The DNR has been actively evaluating the proposed copper, lead and zinc mine near Crandon in southwestern Forest County. The Crandon formation is a sulfide deposit of volcanic origin. It is approximately 100 feet wide, 4900 feet long, and extends to a depth of 2800 feet. Total projected ore production is estimated at 55 million tons. The mine would be in operation for about 30 years.

The operation of the Crandon mine would necessitate groundwater pumping. Effects of this pumping on nearby lakes and wetlands is being investigated using MODFLOW, a code developed by the USGS. A second model will be developed from the regional model to assess the possible release of contaminants from the Tailings Management Area. GMS staff assisted BSHWM staff and Department consultants in the evaluation of the model, geologic interpretations in the model and monitoring well construction. GMS staff also assisted in field work, sampling and drilling investigations of groundwater inflow to several lakes in the project area.

In FY 95, GMS staff, with the help of a Groundwater Quantity Technical Advisory Committee, began preparing a report on the groundwater quantity issue (see "Condition of the Resource: Groundwater Quantity.") The GCC had identified the need for a report summarizing the status of the groundwater quantity issue for the Natural Resources Board. During FY 96 GMS staff completed a draft report. A final version is expected to be finished in Fall, 1996.

During FY 96, the Bureau of Water Supply continued several groundwater monitoring projects aimed at determining the impact of surface activities on groundwater and determining the extent of naturally occurring contaminants in drinking water wells. These included: 1) sampling for naturally occurring arsenic in the Lake Michigan, North Central, Southern and Southeast Districts; 2) radon sampling in private wells in the Lake Michigan District; 3) an investigation of boron and selenium contamination at a flyash disposal site in Southeast District; 4) an investigation of bacteriological and nitrate contamination in Waukesha County in Southeast District; and 5) an investigation of triazine herbicides in private wells in the vicinity of public wells where triazine was detected. More details on the DNR's monitoring activities are contained in the FY 96 Groundwater Quality Monitoring Plan.

During FY 96, Bureau of Water Resources Management staff increased efforts to address groundwater in the water quality management planning process. Water Quality Management (WQM) plans are mandated by Section 208 of the Clean Water Act. The plans provide water resources information along river basin and watershed boundaries.

The GMS provides guidance on availability of, and direct access to, groundwater documents germane to the planning basin, as well as insight concerning ongoing research in the planning area. GMS staff obtain data from the Groundwater Retrieval Network to identify areas with nitrate and/or pesticide contamination for use in WQM Plan maps. By providing information to water quality planners during development of WQM Plans, the accuracy and thoroughness of each WQM Plan will be enhanced. Most WQM Plans contain a groundwater report. Groundwater reports were prepared for the Upper Rock, Wolf, Upper Wisconsin, and Lower Chippewa basins. Work is progressing on reports for the Manitowoc, Lower Rock and Black River basins. In addition, the GMS provided groundwater training for basin planners.

A new method for ranking watersheds in WQM Plans for funding by the DNR Nonpoint Source Pollution Abatement Program has been developed. This method takes into account land use and water quality sampling

results. A key concern during the ranking criteria revision process was groundwater and surface water interactions.

During FY 96, private wells in eight existing watersheds were sampled for nitrate and seven new priority watersheds and three priority lake projects were sampled for nitrate and atrazine using the triazine screen as part of the joint DNR-DATCP nonpoint source program. The existing priority watersheds are: Duck Creek, Apple/Ashwaubenon Creeks, Dell Creek, Pensaukee River, Spring Brook, Sugar/Honey Creek, St Croix Lakes, Upper St. Croix Lake/Flowage and Osceola Creek. The new priority Watershed projects include: Pigeon River, Middle Peshtigo/Thunder River, Fond du Lac River, Lower Rib River, Kinnckinnic River, Lower Little Wolf, and the Pine and Willow Rivers. Lake projects sampled included: Big Wood Lake, Rock Lake and Horse Creek Lake. Sampling was offered to well owners free of charge and on a voluntary basis. All wells sampled were assigned a Wisconsin unique well number and inventoried. A total of 463 nitrate analyses were performed in FY 96 showing that nitrate + nitrite exceeded the preventive action limit (PAL) of 2 milligrams/liter (mg/l) in 65.8% and the enforcement standard (ES) of 10 mg/l in 27.4% of the samples analyzed.

Bureau of Solid and Hazardous Waste Management (now Remediation and Redevelopment), GMS, and Legal Services staff worked together to develop revisions to chapters NR 140 (Groundwater Standards), NR 722 (Remedy Selection), NR 724 (Remedial Action Implementation), and NR 726 (Case Closure) to allow greater flexibility in closing cases where groundwater contamination exceeds the NR 140 Preventive Action Limits (PALs) or Enforcement Standards (ES). Revisions to NR140 list natural attenuation as one of many potential options to cleanup contaminated groundwater. Revisions to ch. NR 726 would allow DNR staff to close out a case using natural attenuation as a final remediation response when groundwater standards are exceeded, provided specific criteria are met. These criteria are: the contamination has not migrated beyond the property boundary, the source of contamination has been adequately addressed, monitoring confirms natural attenuation is addressing the contamination and a restriction is placed on the property's deed that limits groundwater use. In public hearings on the proposed rule many comments supported the key concepts of the rule but raised concerns regarding applicability of the rule to landfills, rule implementation and guidance. Related guidance documents are being developed to provide a better understanding of the closure flexibility rule proposal, site specific soil standards, and overall approaches to clean-up actions. The rule revisions were passed by the Natural Resources Board on June 26, 1996 and will go before the Legislature in FY 97.

Progress continues to be made on the NR 706 rule package addressing hazardous substance spill reporting. The key features of the rule are: the provision establishing *de minimis* reporting quantities for petroleum and agrichemicals; and recognition of the federal reportable quantities provided the specific situation does not pose a threat to public health, safety or the environment.

In FY 95 the Emergency and Remedial Response (ERR) section of the BSHWM, with the help of an external advisory committee and a focus group, completed a series of administrative codes (NR 700-736) covering remedial responses to environmental contamination including soil contamination. Since then, the program has been seeking the US EPA Hazardous Waste Program's formal acknowledgment of the NR 700 Rule series to address RCRA-C hazardous waste sites. The final goal is to amend the state's authorization Memorandum of Understanding (MOU) to recognize the application of the NR 700 Rule Series to hazardous waste corrective action and generator closures. The MOU is expected to be finalized by early 1997. This effort should provide for more streamlined environmentally sound approaches to this category of contamination sites.

The ERR Section, as part of its responsibility to administer the State's Environmental Fund to cleanup severe contamination problems, initiated, or continued action at locations where groundwater contamination is known or suspected. Approximately \$3.5 was spent during FY 96 to address groundwater contamination at existing project sites. An additional \$1.5 million in bonding funds was committed for construction projects associated with prevention of groundwater contamination and groundwater remediation.

The Municipal Wastewater Section (MWWS) continued to issue permits to communities utilizing land application for disposal of treated domestic wastewater. New municipal wastewater Wisconsin Pollution Discharge Elimination System (WPDES) permits reflect the more stringent effluent limits for total nitrogen and chloride contained in ch. NR 206, Wis. Adm. Code. Groundwater monitoring is required at municipal land application facilities to confirm compliance with ch. NR 140. A concerted effort is being made to evaluate and require upgrading of groundwater monitoring systems at existing permitted facilities.

The MWWS continues to work with unsewered communities, served by individual on-site treatment systems, in their efforts to construct centralized wastewater treatment facilities. The MWWS is working with DILHR on its proposed on-site system regulations. DNR staff have assisted DILHR in defining the scope and content of the environmental impact statement (EIS) which DILHR (COMM) will prepare on the proposed regulations. Among the issues to be addressed in the EIS are jurisdiction and the nitrate standard compliance exemption.

The Industrial Wastewater Section (IWWS) continued to issue WPDES permits to facilities which use land application of industrial waste waters, sludges, and/or food processing by-products, which may ultimately impact groundwater. Groundwater monitoring is required at all large land application and wastewater storage sites. Groundwater quality sample data are reviewed for compliance with ch. NR 140 as submitted. The IWWS requires the evaluation of all industrial wastewater storage lagoons and large vegetable by-product storage structures. Per ch. NR 213, Wis. Adm. Code, 183 facilities were required to conduct such evaluations and most were initiated in 1991-92. The majority of studies are now complete, resulting in closure and/or upgrade of 34% and continued groundwater monitoring at 16% of the sites. The remaining 50% were found to have adequate integrity or were improperly identified as storage lagoons.

An investigation into elevated iron and manganese concentrations in groundwater at industrial wastewater land application sites is currently being conducted by the Mid-West Food Producer's Association, a trade organization representing the vegetable producing industry. This investigation will be conducted over the next three years.

The Animal Waste Advisory Committee completed their report in January 1995. The report recommended appropriate management activities for livestock owners to protect water quality and was accepted by the Natural Resources Board in February 1995. Since then, DNR staff have worked closely with interested legislators to draft legislation needed to implement the recommendations.

The DNR is currently undergoing internal reorganization. Bureau designations are changing over and were not fully implemented at the end of FY 96. Four new bureaus with groundwater responsibilities are:

1. Bureau of Drinking Water and Groundwater - Regulation of public water systems and private drinking water supply wells. In addition, the Groundwater Section (GS) assists in coordinating groundwater activities of the DNR, as well as other state agencies. Formerly the Bureau of Water Supply and GMS of the BWRM.
2. Bureau of Waste Management - Regulation and groundwater monitoring of proposed, active, and inactive solid waste sites. Formerly the Solid Waste Section of the BSHWM.
3. Bureau of Remediation and Redevelopment - Oversees clean-up actions at spills, abandoned containers, state funded responses, closed wastewater and solid waste facilities, hazardous waste corrective action and generator closures and sediment clean-up actions. Formerly the ERR and Hazardous Waste Sections of the BSHWM.
4. Bureau of Watershed Management - Regulates Wisconsin Pollutant Discharge Elimination System (WPDES) permittees at wastewater land disposal sites. The Bureau of Watershed Management cooperates with the Bureau of Remediation and Redevelopment at leaking underground storage tank (LUST),

Environmental Response and Repair, and Superfund Cleanup sites, by issuing WPDES permits for the discharge of contaminated groundwater.

During most of FY 96, the pre-reorganization bureaus were still in use. The DNR reorganization will be completed in FY 97.

For more information, contact Mr. Mike Lemcke, DNR, P.O. Box 7921, Madison, WI 53707-7921; phone 608-266-2104.

DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION

Protecting Wisconsin's groundwater is of the highest priority for the DATCP. DATCP's major activities in this area include management of pesticides, research, and funding of local soil and water resource management projects.

Under the Wisconsin Groundwater Law, DATCP manages pesticides and pesticide practices to assure that established groundwater standards for contaminants are not exceeded. This may include prohibition of certain activities including pesticide use. The agency also manages practices to "minimize" groundwater contamination to the extent "technically and economically feasible." DATCP regulates storage, handling, use, and disposal of pesticides and the storage of bulk quantities of fertilizer.

DATCP is also responsible for coordinating the development of Wisconsin's "generic" and "pesticide-specific" state management plans (SMPs) for protecting groundwater from pesticides. In FY 96, DATCP, in cooperation with DNR and other agencies, submitted Wisconsin's "Generic SMP for Protection of Groundwater from Pesticides" to the EPA for concurrence. EPA region V concurred with the Generic SMP in June, 1996 and submitted the plan to EPA Headquarters for their concurrence. According to the EPA document, "Pesticides in Groundwater Strategy" (1991), when EPA determines that a pesticide presents a significant risk of leaching to groundwater in a state, it may either cancel the registration of that compound or allow the state to prepare an SMP describing how the state will manage the pesticide to protect groundwater. The generic SMP presents a comprehensive review of Wisconsin's regulatory and nonregulatory efforts to prevent groundwater contamination due to pesticides. This generic plan will serve as a framework for pesticide-specific SMPs that will be required by the EPA for five commonly used herbicides.

Enforcement standards have been established in Wisconsin for many known and potential groundwater contaminants, including over 30 pesticides. Standards for additional pesticides have been proposed. DATCP applies these standards and the Groundwater Law when addressing nonpoint and point sources of pesticide contamination in groundwater.

DATCP's primary effort related to nonpoint contamination (i.e., due to general use) of groundwater continues to involve the herbicide atrazine. In response to concerns about atrazine contamination, DATCP amended administrative rule ch. ATCP 30 in 1992 to manage the use of atrazine in an effort to reduce or eliminate the potential for further groundwater impacts. Rule revisions have been made annually in response to additional detections of atrazine in groundwater. Rule revisions for the 1996 growing season increased the number of atrazine use prohibition areas, based on groundwater sample results available as of September 1995. Information suggests that atrazine use has declined as a result of the atrazine management rule and concern about groundwater contamination.

Since the late 1980s, DATCP has also initiated a number of surveys to investigate pesticides in groundwater resulting from nonpoint sources. In FY 96, DATCP completed a resampling of 122 Wisconsin wells that previously exceeded a pesticide enforcement standard. This Exceedence Survey was funded by DATCP. Most of the wells in the survey had exceeded standards for atrazine. Most were also within an atrazine prohibition area. Of wells exceeding standards for atrazine, 84% declined in concentration and 16% increased. Forty-three

percent of the wells tested above the atrazine enforcement standard and 57% tested below the standard. About 50% of well owners continue to use their contaminated well and about 25% have installed new wells at an average cost of \$6,300.

In FY 96, DATCP initiated the Phase 2 of a survey designed to evaluate the effectiveness of the Atrazine Rule (ch. ATCP 30, Wis. Adm. Code). This evaluation is required in ATCP 30 and will attempt to determine if a "statistically significant change" has occurred in groundwater concentrations of atrazine and its three chlorinated metabolites between Phases 1 and 2 of the survey. The focus of this evaluation is groundwater exploitable by private water supply wells. In Phase 1, DATCP sampled 289 wells that were selected using a stratified-random process. Results indicated that atrazine is present in about 12% of private wells and alachlor ethane sulfonic acid (ESA) is present in about 7% of wells. Nitrate contamination above 10 ppm can be expected in approximately 10% of state wells. Phase 1 samples will establish a statistically reliable basis for comparison with samples that will be collected in 1996 for Phase 2. Further discussion of pesticide sampling survey results is contained under Condition of the Resource - Groundwater Quality.

Previous DATCP and DNR surveys have identified significant point sources of contamination of groundwater quality at pesticide storage and handling facilities. These surveys indicated that activities at these sites have and continue to result in groundwater contamination, putting nearby private and, in some cases, municipal wells at risk. Surface water run-off from contaminated areas can also result in direct human and livestock exposure, property damage and/or surface water contamination.

In August 1993, section 94.73 of the Wis. Stats. was created and established the Agricultural Chemical Cleanup Program (ACCP) to address these point sources of contamination. The ACCP reimburses responsible parties for cleanup costs related to pesticide and fertilizer contamination at facilities and in nearby wells. Point source contamination on farms may also be handled by the program. To date, over 250 cases involving soil and/or groundwater remediation related to spills, misuse, and improper storage, mixing or loading have been initiated at pesticide and fertilizer handling facilities and on farms.

The ACCP also funds DATCP oversight of pesticide and fertilizer cleanup activities. Program staff investigate pesticide and fertilizer contaminated sites throughout the state. Investigations at these sites are prioritized based on suspected contamination levels, with higher levels investigated first. Investigations include discussions with facility staff or farmers to determine the most likely locations of contamination at the site. Other oversight activities include, but are not limited to, sample collection, laboratory analysis, and financial auditing.

DATCP solely funded four pesticide research projects during FY 96 (see Table 1). DATCP's research fund, which is based on fees paid by pesticide manufacturers, provides approximately \$135,000 annually to meet pesticide related research needs of the Department.

DATCP, through its soil and water resource management program, provides funding primarily to counties to assist in the protection of these resources. A portion of this funding is dedicated to the development and implementation of improved nutrient and pesticide management practices. In FY 96 approximately \$120,000 was provided to develop and demonstrate better management practices for nutrients and pesticides.

In FY 96 DATCP provided \$365,000 to fund Clean Sweep projects in 22 counties for collection and disposal of waste pesticides and containers. Approximately 164,000 pounds of waste were collected from farm sites, thereby reducing the potential for inadvertent environmental damage. DATCP is requesting additional proposals from counties for the 1997 fiscal year. Approximately \$560,400 will be available during FY 97 for these projects.

For further information, contact Mr. Nicholas Neher, DATCP, 2811 Agriculture Drive, Madison, Wisconsin, 53708-8911; phone 608-224-4567.

DEPARTMENT OF INDUSTRY, LABOR AND HUMAN RELATIONS/ COMMERCE

As of July 1, 1996 the Division of Safety & Buildings has been transferred from the DILHR to the newly created Department of Commerce. In moving to the new agency, the Division was split into two sections. All private sewage system related functions continue to be part of the Division of Safety & Buildings program. However, all functions related to the petroleum storage tanks and the Petroleum Environmental Clean-up Fund (PECFA) are in the newly created Division of Environmental Regulatory Services.

Private Sewage Systems - The draft of chapter ILHR 83 that revises private sewage system regulations from a prescription to performance based format continues to generate interest from local regulators, designers and property owners. There are also many inquiries from other states and consulting firms that recognize the value this code represents. The Department is preparing an environmental impact study (EIS) before proceeding with adoption of the code. COMM has consulted with the DNR to determine the scope of the EIS and is developing a timeline for completion. The tentative adoption date for the revised code is January, 1998.

COMM continues its involvement with the Washington Island decentralized wastewater management system. A local management board, (Sanitary District), is taking on the responsibility of overseeing the project and the individual private sewage systems that have been installed. Modifications to some of the systems continue to be made in an effort to remove as much complexity from the operation and maintenance of these systems as practical while maintaining the goal of providing effective treatment and dispersal of the wastewater. Monitoring will continue to insure that groundwater protection standards can be met. A report by UW-Green Bay researchers is due to be published this summer.

UW-Madison researchers are studying the use of highly pre-treated effluent from aeration type units that discharges into modified mound systems and/or smaller sized soil absorption fields. They are also beginning to evaluate the effectiveness of packaged sand filter designs that are currently being used successfully in other parts of the nation. The Department is assisting in this effort by reviewing and approving similar designs to help develop a representative statewide population of these types of systems to allow for additional sampling and evaluation under the wide range of soil, site and climate conditions that are typical in the state.

Education of regulators, system designers and installers continues to be a top priority of the Department. Seminars focus on advances in wastewater systems and processes. A new rule, COMM 5, includes a provision for mandatory continuing education for Certified Soil Testers. This rule addresses a long standing goal of providing the soil testers with the same educational opportunities available to those individuals that use their reports to design, install and inspect private sewage systems.

Petroleum Storage Tanks - Flammable and combustible liquids which have a flash point of less than 200°F. are regulated by the state Administrative Code Chapter ILHR 10. The creation of the Department of Commerce (COMM) through the merger of the Safety and Buildings Division of the Department of Industry, Labor and Human Relations with the Department of Development has transferred the storage tank program to COMM. The magnitude and significance of the storage tank program has resulted in the creation of the Division of Environmental and Regulatory Services (ERS). The division has three bureaus: Bureau of Storage Tank Regulation, Bureau of Petroleum, and PECFA Bureau.

The ERS Division continues to focus on the Federal EPA December 22, 1998 compliance deadline. Educational outreach and enforcement strategies by the Department are structured to emphasize the requirements which

must be met prior to December 1998. The Department is also exploring entering into a project with the Federal EPA to investigate groundwater protection compliance of non-petroleum hazardous substance tanks.

Since 1991 the database inventory of petroleum product tanks regulated under ILHR 10 has increased from 143,681 to 161,237 tanks as previously unregistered tanks have become registered. In 1991 the database included 68,056 tanks classified as federally regulated with 51,088 of those tanks in use. Today the database reflects 73,395 federally regulated tanks with only 18,784 tanks in use. In order to maintain a federally regulated tank in use the tank must have a valid use permit, which is complimented by an annual inspection. Annual inspections involve verification of leak detection and record keeping.

Program initiatives have resulted in identifying a larger population of underground tanks, reducing the population of underground tanks in use, and upgrading those in use to meet the 1998 federal technical requirements. The closure of federally regulated tanks will continue, but at a slower pace than experienced over the past few years. Closure of out-of-service residential heating fuel tanks is continuing at a strong pace as realtors and lenders recognize the potential problems and liability.

The closure of underground tanks is being supplanted by private fueling moving to retail fueling and some operators moving the storage tank to above ground. Residential heating fuel has not been significantly impacted as the closures are generally associated with the conversion to natural gas or LPG.

Educational outreach efforts and annual inspections by the department and its agents should result in high level of regulatory compliance, and a reduction of system failures and environmental contamination. Wisconsin's progress continues to reflect very favorably with the Federal EPA and has resulted in additional grant moneys to assist program initiatives.

For more information, contact Mr. John Alberts, Department of Commerce, P. O. Box 7970, Madison, Wisconsin 53707-7969, phone: 608-264-6152, fax: 608-266-3447.

DEPARTMENT OF HEALTH AND SOCIAL SERVICES/HEALTH AND FAMILY SERVICES

Chapter 160, Wis. Stats., directs the DHSS to recommend health-based enforcement standards for substances found in groundwater and specifies the protocol for developing the recommended standards. DHSS prepares recommended standards for the substances at the top of a prioritized list identified by the DNR. DHSS sends the recommendations to the DNR which proceeds through the rule-making process to amend ch. NR 140, Wis. Adm. Code. In June 1996, DHSS sent recommendations for 21 new groundwater standards. Authorization to subject these recommendations to public hearings will be considered by the DNR board during the fall of 1996.

The DHSS is responsible for investigating suspected cases of water-related illness and has conducted several studies into the health impacts of contaminated drinking water. Recent studies include a study of the health effects of consuming arsenic-contaminated water and several studies linking the occurrence of gastrointestinal upsets with the consumption of copper-contaminated water. During FY 97 DHSS will work with the University of Wisconsin Department of Preventive Medicine to investigate the financial and human health impacts of nitrate-contaminated groundwater. This research is being funded by the DNR through the GCC's joint solicitation process.

DHSS staff review copies of advisory letters sent to well owners by DNR representatives. The agency often provides additional advice and information to owners of wells which are seriously contaminated with toxic substances such as benzene. Followup letters sent by DHSS explain the health effects of the specific contaminant and advise the homeowner regarding continued use of the water for bathing, laundry, etc.

DHSS staff are listed on literature distributed by other agencies as resources for health risk information and handle several telephone calls each week answering questions about the health risks associated with consumption and household use of contaminated water. Toxicologists, public health educators, and epidemiologists employed by DHSS frequently present health-risk information at public meetings. They also prepare and distribute a wide variety of informational materials. The DHSS was renamed the Department of Health and Family Services as of July 1, 1996.

For more information, contact Dr. Henry Anderson, 1414 E. Washington Ave., Rm.96, Madison, Wisconsin, 53703-3044; phone: 608-266-1253.

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

The Wisconsin Geological and Natural History Survey (WGNHS) performs basic and applied groundwater research and provides technical assistance, maps, and other information and education to aid in the management of groundwater resources. The WGNHS groundwater program is complemented by geology, soils, and climate programs that provide maps and research-based information essential to the understanding of groundwater recharge occurrence, quality, and movement. WGNHS personnel are currently preparing groundwater-related maps (such as water-table or aquifer maps) at a scale of 1:100,000 for Racine, Kenosha, Waukesha, Dane, Ozaukee, Price, Washington, Fond du Lac, La Crosse, Buffalo, Milwaukee, Trempealeau, Eau Claire, Walworth, Polk, Burnett, Oconto, and Lincoln Counties.

In FY 96, the WGNHS continued to respond to requests for information and assistance from other local, state, and federal agencies, consultants, students, and the public. These requests ranged from the simple, "What will I find underground if I dig or drill here?", to the more complex, such as questions about groundwater flow and contaminant transport in areas of agricultural chemical use or wellhead protection.

Public information, records, and research results that the WGNHS stores and disseminates save the considerable expense of gathering the same geologic or groundwater information several times for different purposes, or "re-discovering" the same information over time. To help this service, the WGNHS continues to review, sort and catalog about 18,000 well construction reports per year (in cooperation with the DNR), measure monthly groundwater levels in a monitoring network of 167 wells (in cooperation with the U. S. Geological Survey), collect, and describe geologic samples from 300 wells per year, and collect and analyze approximately 600 groundwater samples per year for nitrate, chloride, and several other basic parameters.

Research projects completed this year or in progress include:

1. Groundwater flow and quality in fractured dolomite in Door County.
2. Hydrogeologic and engineering properties of glacial materials.
3. Age, origin, and movement of groundwater in low-permeability materials.
4. Hydrogeology of Dane County, including development of a computerized groundwater flow model for the county.
5. Hydrogeology of Southeast Wisconsin.
6. Delineation of hydrogeologic units throughout Wisconsin.
7. Extent of atrazine contamination in the Lower Wisconsin River valley.
8. Delineation of the groundwater divided between the Fox and Wolf River basins in Outagamie and Brown Counties.
9. Distribution of radionuclides in Wisconsin groundwater.

10. Hydrogeology and groundwater use, and quality of the Fox Cities area.
11. Delineation of wellhead protection areas for the City of Sturgeon Bay.
12. Delineation of wellhead protection areas for municipal water supply wells in Dane County.

For more information, contact Ken Bradbury or Ron Hennings, WGNHS, 3817 Mineral Point Road, Madison, Wisconsin, 53705-5100; phone: 608-262-1705.

DEPARTMENT OF TRANSPORTATION

The DOT regulates the storage of highway salt under ss. 85.17 and 85.18, Wis. Stats., to protect the waters of the state from harm due to contamination by dissolved chloride. Additional groundwater management and protection related activities performed by DOT as part of the design, construction, and maintenance process of state and federal highways include: road salt research; hazardous materials (petroleum) and hazardous waste investigation and remediation; wetland compensation; and erosion control and storm water management. DOT is also responsible for potable well sampling at 140 rest areas and waysides. The responsibility for the management of these activities is divided among several groups in DOT:

- * Salt Storage - Bureau of Highway Operations
- * Salt Research - Bureau of Highway Construction (Geotechnical Section)
- * Hazardous Materials (petroleum) - Bureau of Environment and District Environmental Coordinators
- * Hazardous Waste - Division of Business Management (Risk & Safety Management Section)
- * Wetlands - Bureau of Environment and District Environmental Coordinators
- * Erosion Control and Storm Water Management - Bureau of Environment and District Environmental Coordinators.
- * Potable Well Sampling - Bureau of Highway Operations

Salt Storage and Road Application - Highway salt is stored statewide by suppliers, counties, cities, villages, and private companies. Annual inspections and reports are made of salt storage sites to insure that storage practices are in accordance with ch. Trans 277, Wis. Adm. Code (Highway Salt Storage Requirements). The intent of the Code is to help prevent entry of highway salts into waters of the state from storage facilities. All salt must be stored on an impermeable base. The base is required to function as a holding basin and to prevent runoff. All salt piles must be covered by impermeable materials or structures to prevent contact with precipitation. State-owned facilities are being added to the salt storage program so that covered facilities are as close to the actual use area as possible.

Current policy in the State Highway Maintenance Manual restricts the spreading of deicer salts to a maximum of 300 pounds per lane mile per application. Electronic controls for salt spreader trucks are continually being tested to record and verify application rates and coverage effectiveness. New technology equipment (zero-velocity spreaders and liquid, onboard prewetting units) has been installed on county highway patrol trucks to help keep a greater percent of the salt applied to the roadway on the pavement surface. Additional efforts to minimize and conserve salt applications are being pursued by use of an *in situ* weather monitoring system consisting of temperature sensors and remote processing units which determine and record temperatures of road pavements at 51 separate statewide locations along major highway routes. The pavement temperature information determines the optimal sand to salt ratio applications. Also, annual training for proper snowplowing and salt spreading techniques is provided for county snow-plow operators, and the counties provide weekly reports of salt usage.

Salt Research - Since 1970, DOT has investigated potential road salt impacts on the environment adjacent to highways. Early investigations (1970s to early 80s) were focused on evaluating road salt impacts to surface water runoff, vegetation, and soils. In the last several years DOT has conducted limited investigations

evaluating road salt impacts to groundwater (1 or 2 shallow monitoring wells per site). To date approximately 20 sites throughout the state have been studied. In general, each site is monitored quarterly for a period of 5 years. The monitoring consists of analyzing soil, water, or vegetation samples for calcium, sodium, chloride, and electrical conductivity. Approximately 5 sites are currently monitored, and future groundwater monitoring plans are being evaluated (i.e., longer monitoring periods and multiple well arrangements per site). Results from the studies are discussed in 5 separate DOT progress reports entitled: Investigation of Road Salt Content of Soil, Water and Vegetation Adjacent to Highways in Wisconsin (1972, 1975, 1979, 1989 and 1996).

Hazardous Materials (Petroleum) and Hazardous Waste - As part of the road construction program, DOT performs an estimated 100 to 200 environmental assessments annually along right-of-way where potential sources of petroleum or hazardous waste contamination may occur. Assessments consist of standard environmental audits of properties adjacent to highways, and environmental drilling and sampling to identify or delineate the extent of soil or groundwater contamination. Numerous contaminated sites are identified as part of the environmental assessment process. This information is shared with DNR so appropriate enforcement and remedial action is taken to protect groundwater resources. In addition, DOT works with DNR and DILHR on 10 to 20 sites per year where underground storage tank removal or other remedial actions are necessary to accomplish highway improvement (e.g., managing the removal, treatment, and disposal of contaminated soils or groundwater).

Wetlands - During the past 6 years, DOT has engaged in a cooperative study with the U. S. Geological Survey to investigate groundwater relationships with respect to wetland creation and restoration projects. The projects are required as compensatory mitigation under section 404 of the Clean Water Act. The groundwater studies are intended to increase the certainty of establishing wetland hydrology. In addition, DOT has several ongoing wetland monitoring projects which evaluate wetland hydrology and water quality.

Since July 1993, DOT has had an interagency approved wetland mitigation banking program. Currently wetland loss due to highway, bridge and airport projects are being compensated for at 20 constructed wetland bank sites. The estimated total restored wetland for these sites is 1917 acres. Eleven new bank sites are under development. Depending on the nature of the site, some component of groundwater, water chemistry, and vegetational monitoring is conducted at various DOT wetland bank sites.

Erosion Control and Storm Water Management - DOT has established erosion control standards for airport, railroad, and highway construction projects as well as maintenance projects administered by DOT. These standards were created to minimize on-site erosion damage and to minimize adverse impacts to waters of the state resulting from sediment or pollutant accumulation. Construction projects must adhere to best management practices, performance standards, and erosion control implementation as stated in ch. Trans. 401 Wis. Adm. Code. Best management practices, given in Chapter 10 of DOT's Facilities Development Manual, include devices and procedures employed to minimize erosion. Best management practices were developed in consultation with the DNR, Federal Highway Administration (FHWA) and the road building industry.

Chapter 10 of the Facilities Development Manual is being revised to include management of storm water runoff from transportation facilities. The revised Manual is scheduled to be completed in 1997 and will contain interim storm water management policy. Currently, storm water best management practices are being incorporated into projects on a case-by-case basis.

Other Groundwater-Related Research and Projects - DOT is currently participating in a FHWA study investigating methods for treatment of highway runoff which flows directly into karst sinkholes for the purpose of protecting groundwater resources in karstic hydrogeologic settings (e.g., Door County or SW Wisconsin). In another effort to improve water quality from highway runoff, DOT has approved a pilot study to evaluate various pavement sweeping processes and technologies. Finally, DOT is proactively monitoring several sites to

evaluate the effectiveness of natural attenuation as a remedial option for petroleum contaminated groundwater. This information will be shared with the DNR.

For more information, contact Ms. Carol Cutshall, Director, Bureau of Environment, Room 451B, P. O. Box 7965, Madison, Wisconsin 53707-7965; phone: 608-266-9626.

UNIVERSITY OF WISCONSIN SYSTEM

The UWS has research, teaching and information/education responsibilities. These three missions are integrated through cooperation and joint appointments of teaching, research, and extension personnel who work on groundwater issues.

Research - During FY 96 the UWS directed a wide-ranging program of priority groundwater research consisting of 14 projects (Table 1). The projects include short-term and long-term studies, and may be either of a fundamental or an applied nature. They provide a balanced program of laboratory, field, and computer-modeling studies and applications aimed at preserving or improving groundwater quality. Among the categories of groundwater problems investigated are:

1. Contaminant interactions between groundwater and wetlands.
2. Hydrogeologic controls and new technologies for wellhead protection.
3. Hydrogeologic field measurements and computer modeling
4. New and improved technologies for remediation of contaminated waters.
5. New and improved technologies for waste management.
6. Biological effects of pollutants and more cost-effective bioassays for pesticides.
7. Improvements in on-site disposal systems.

The 14 projects funded provided training in several disciplines for postdoctoral research associates, graduate student research assistants, and undergraduate students at UW-Madison, UW-Milwaukee, and UW-Green Bay. In addition to these projects, UWS completed the first phase of a major project aimed at publication, distribution, and computerized dissemination of research findings resulting from its groundwater research program. Final technical reports, and 2-page executive and technical summaries of all completed UWS groundwater research projects back to FY 91 have been published for distribution to researchers, field specialists, state agency and academic libraries, environmental consulting firms, legislative personnel, and citizens groups. This exercise is part of an effort coordinated by the GCC being undertaken in conjunction with DNR, DILHR, and DATCP. The purpose is to enhance the utility of research findings resulting from studies funded through the Wisconsin Joint Solicitation process with advice from the UWS Groundwater Research Advisory Council (GRAC) and program planning from the GCC. This effort is now well underway and up to date with current incoming final project reports due by the end of calendar year 1996.

The UWS selected 10 new groundwater research projects for support during the FY 97 joint solicitation (see Table 2). One project will be co-funded with the DNR.

Teaching - The UWS institutions continue to offer courses and programs at the undergraduate and graduate level focusing on groundwater resources. In addition, several campuses offer credit, field-oriented water curriculum courses for middle school and high school teachers during summer sessions.

Information Transfer - Discussion of the UWS's new Water Resources Center Library home page (http://www.library.wisc.edu/libraries/water_resources/wrrs.htm) will soon provide electronic access to the 73 recently published Wisconsin Groundwater Research and Monitoring Project Summaries (WDNR PUBL-WR-423-95). Approximately 146 pages (8.5"x 11") of text, graphics, and tables will be reformatted with and HTML

editor beginning September 3, 1996. The editing process and links will require about 200 hours to complete and the summaries are likely to be electronically accessible from the "List of Project Summaries" home page link by mid to late November, 1996. The recently updated WRC Library home page also has an extensive list of links and pointers to Wisconsin and national water information on the World Wide Web.

Information/Education - The UWS institutions and county-based staff continue involvement in groundwater education activities. In cooperation with other state and federal agencies, groups and individuals, innovative problem-solving educational programs on groundwater resources are provided to the State's citizens through publications, meetings, teleconferences, satellite programs, water testing, and other forms of assistance. Activities of several specific programs follow.

The UWS farm assessment system (Farm*A*Syst) and home assessment system (Home*A*Syst) programs help farmers and rural non-farm residents assess water pollution risks related to their structures, management practices, and site characteristics. The system has been made available statewide and is a part of Extension programming in 23 counties. It has been integrated into at least five Wisconsin Priority Watershed projects and is under consideration as a major part of the educational plan for other projects. A pollution prevention delivery system based on Farm*A*Syst is being developed in cooperation with farm supply groups and other businesses. Project evaluation shows Farm*A*Syst to be an effective, voluntary program which increases knowledge and, most importantly, leads to changes in practices. The expanded, national project is working with all 50 states and several Canadian provinces in adopting this system. This is a cooperative project funded by the U.S. Department of Agriculture (USDA) Cooperative State Research Education Extension Service, the NRCS, and the EPA. Recent materials available through the national program are listed under publications.

The USDA Water Quality Demonstration Project in the East River Watershed (Green Bay) came to a close in 1995. The project encouraged farmers to adopt research-based practices for cost-effective water quality protection. This project's education emphasized manure handling, private well protection, milkhouse waste reduction, integrated crop management, and safe fuel and pesticide storage. Use of specific crediting of nutrients from applied manure has resulted in a reduction in use of phosphorus and nitrogen on corn fields. Resulting economic savings of \$10 to \$20 per corn acre has impressed farmers.

The USDA Hydrologic Unit (Stevens Point, Whiting, and Plover Wellhead Protection) project in Portage county applies innovative, research-based practices to maintain or improve the communities' well-water supply. Agricultural practices, such as irrigation water management and reducing fertilizer and pesticide use complement an urban groundwater protection component in the project's educational and technical assistance efforts. This special project, which will run through 1998, aims to comprehensively manage crop nutrients and pests, resulting in reduction of fertilizer and pesticide applications. Farmers in the project reduced inputs of nitrogen fertilizers, a source of nitrate contamination.

Give Water a Hand is a national youth watershed education program developed and coordinated at the UW Environmental Resources Center. *Give Water A Hand* seeks to engage youths, ages 9 - 14, in local natural resource service projects, including those related to groundwater. Program goals are to protect and improve local water quality by encouraging youth to investigate local issues, and plan and complete a service project with assistance from a local natural resource expert to address a problem they identify. Program materials, available through UW Extension Publications, consist of an *Action Guide* for youth, with step by step instructions for addressing local watershed concerns, and a *Leader Guidebook* to assist teachers and youth leaders in facilitating youth projects.

The UW Nutrient and Pest Management (NPM) program is engaged in 39 on-farm demonstration and field day activities to disseminate information on agricultural best management practices (BMPs) around the state. The program helps landowners understand how their farm practices may influence groundwater quality. Another incentive is farm profitability. Over the past six growing seasons, NPM regional specialists established 215

demonstrations on 95 farms statewide. Overall, 83% of the improved management practice demonstrations were more profitable than the standard practices to which they were compared.

The UWS cooperates with other state agencies involved in the Non-point Source Water Pollution Abatement program (Priority Watershed Program). This program improves water quality by providing education, technical assistance, and financial assistance through cost-sharing for BMPs in over 57 watersheds. Several projects incorporate groundwater education strategies into their overall information and education programs. Five Area Water Quality Education Specialists and three publication/editorial staff work with County Extension Agents and Land Conservation staff in educating rural and urban residents. A common element in these projects is well water testing and groundwater education. Additionally, this educational programming includes drinking water fact sheets, newsletter articles about groundwater and, in some instances, specific watershed studies that address unique water quality problems (e.g., elevated levels of arsenic in drinking water samples from Door County).

To address issues related to water resources, the Water Issues Team - a nine member committee, has been entrusted with developing an four year plan of work for Cooperative Extension's water programs. The Team has written a "blue print" for UW-Extension water-related programs that serves as a general guidance tool for local agents and state specialists as they implement existing, and develop new educational initiatives. The four year plan, or blue print, addresses multiple resource issues from groundwater, drinking water and surface water and is built upon a philosophy of:

1. Focusing on the eco-system/watershed;
2. Working in cooperation with other agencies, as well as interested groups, on educational program planning and delivery, technology transfer and informed public policy making;
3. Fostering internal and cross organizational coordination and cooperation with personnel and funds.
4. Empowering youth and volunteers by developing community roles for youth; and
5. Emphasizing a "process" model of educational programming that involves conflict resolution, negotiation, partnership and collaboration in building educational approaches that mobilize citizens and groups to action.

The Extension Water Resource Coordinating Council publishes a monthly newsletter Keeping Current, which brings information about water-related issues to more than 1,400 agency personnel throughout Wisconsin.

The Central Wisconsin Groundwater Center's (CWGC) mission is to provide groundwater education and technical assistance to the citizens and governments of Wisconsin. Programs range in breadth from answering citizen questions (e.g., Is my water safe? How deep should I drill my well? Where is this nitrate coming from?) to helping communities with wellhead protection planning and describing the extent and causes of groundwater nonpoint pollution in Wisconsin. The Center frequently works through county Extension faculty in program delivery.

Last year, the Center assisted 2,741 households in having their water tested in conjunction with county Extension offices and the UW-Stevens Point Environmental Task Force Laboratory. Of these, 10% exceeded the drinking water standard for nitrate-nitrogen. Twelve percent were unsafe because of coliform bacteria. Twenty-eight percent had moderate to severe corrosivity indexes. Education programs helped many families understand potential remedies for these problems and the relationship of land use practices to groundwater quality.

Other projects include studying agrichemical loading in the Central Sands; basin-scale modeling of contaminant loading and migration to the Stevens Point, Whiting, and Plover municipal wells; grant-funded workshops which provided sand-tank groundwater flow models to 11 Central Wisconsin schools; and completion and distribution of Home Water Safety educational materials.

For more information on research or information transfer contact Dr. George Blondin, UW-Madison Water Resources Center, Madison, WI 53706; phone (608) 262-3470, Fax (608) 262-0591, email gblondin@facstaff.wisc.edu. For teaching and information/education, contact Jim Peterson, UW Environmental Resources Center, 1450 Linden Drive, Madison, WI 53706-1562, phone (608) 262-3799, fax (608) 262-2031, email jopeters@facstaff.wisc.edu.

GROUNDWATER-RELATED PUBLICATIONS (most were published in FY 96, others were published earlier but were not included in previous years' reports)

UWEX Information and Education Program Planner for Priority Watershed Projects (1st Edition) 1996. Environmental Resources Center, University of Wisconsin Extension - Madison.

Evaluation and Meeting Project Objectives. A workshop notebook. (1st Edition), 1995. Environmental Resources Center, University of Wisconsin Extension.

Shepard, R.L. and C. Finlayson. Nonpoint Source Pollution Control: A Voluntary-Education-Based Response. Proceedings of the Sixth International Symposium on Society and Resource Management. May 18-23, 1996. The Pennsylvania State University, University Park, Pennsylvania. pp 215-216.

Nowak, P.J. G. O'Keefe and R.L. Shepard. The ASTE Model: Applying Social Science to the Implementation of Agricultural Natural Resource Programs. Proceedings from the Sixth International symposium on society and Resource Management. May 18-23, 1996. The Pennsylvania State University, University Park, Pennsylvania. p. 222.

Shepard, R.L. and C. Finlayson. The National Water Quality Initiative: Lessons Learned from the Water Quality Demonstration Project-East River. Proceedings from Watershed 96. Baltimore, Maryland. June 8-12, pp 600-602.

Keeping Current A newsletter published by UWEX to provide a monthly update on Wisconsin water resource programs and issues.

Give Water A Hand Leader Guidebook, 2nd Edition. 1996. University of Wisconsin, Board of Regents. 40 pp. Available through UW Extension Publications, Publication #4H-850.

Give Water A Hand Action Guide, 2nd Edition. 1996. University of Wisconsin, Board of Regents. 72pp. Available through UW Extension Publications, Publication #4H-855.

Field Notes - Newsletter published by NPM, eight times a year.

Guidelines for Applying Manure to Cropland and Pasture in Wisconsin (A3392), Available from UW-Extension Publications, 630 W. Mifflin St. Madison, WI 53703-2636

Whole Farm Nutrient Management Planning Workbook.

1994 NPM On-Farm Demonstration Updates.

Nitrogen Credits More Important than Ever

Manage Manure to Everyone's Advantage - Protect Water Quality.

Manage to Your Advantage - A Quick and Dirty Guide to Using Manure as a Fertilizer.

Publications and Reports by the Central Wisconsin Groundwater Center:

Kraft, G.J., W. Stites, D.J. Mechenich, and J. Balma. 1995, Port Edwards Groundwater Priority Watershed - Groundwater Resource and Agricultural Practice Evaluation. Report of Wisconsin Department of Natural Resources. Available from the Groundwater Center.

Mechenich, D.J. and G.J. Kraft. 1996. Contaminant Source Assessment and Management Using Groundwater Flow and Contaminant Models in the Stevens Point - Whiting - Plover Wellhead Protection Area. Report to USEPA and Portage County. Available from the Groundwater Center.

Mechenich, C. and B. Shaw. 1996. Do Deeper Wells Mean Better Water? Extension Bulletin G3652.

Publications, Software, AV and Training Materials From the Farm/Home Assessment System Program

Farm*A*Syst / Home*A*Syst Brochure - General program description

Farm*A*Syst Brochure for Rural Landowners

Protecting Rural America's Water: Farm*A*Syst - Basic information on Farm*A*Syst Generic Model "Farm and Home Assessment" draft version. Basic model addresses surface and ground water issues.

Farm and Home Pollution Prevention Update Newsletter Subscription

National Farm*A*Syst Directory - Updated annually

Wisconsin Farm*A*Syst Packet in Pagemaker 4.0 - 14 disks

Wisconsin Farm*A*Syst Factsheets in IBM WordPerfect 5.1 - 1 disk with 10 factsheets

Generic Model "Farm and Home Assessment" DRAFT VERSION in Pagemaker 5.0 - 8 disks, addresses both surface and groundwater issues

Farm*A*Syst Decision Support System, Version 3.0 Software - 2 disks and instructions, computerized worksheets and factsheets which simplify action plan preparation and improves data collection for documenting program impacts.

Videoconference: Using the Farm*A*Syst Decision Support System - 60 minute tape

Farm*A*Syst Overview Slide Show - 11 minute taped narrative and 43 slides

Drinking Water Well Training Manual - 23 minute script, 59 slides and handouts, disk with WordPerfect 5.2 text

Household Wastewater Treatment Training Manual - 25 minute script, 60 slides and handouts

Liability in the Field Training Manual 18-20 - minute script, 48 slides and handouts

Confidentiality Training Supplement to Liability Training Manual - 7 minute script, 14 slides and references

Pesticide & Fertilizer Storage & Handling Training Manual - 25 minute script, 56 slides and handouts

Petroleum Storage Training Manual

Groundwater-Related Publications of UW Faculty in FY 96

Allmaras, R. R., S. A. Clay, D. F. Hughes, R. Kanwar, R. E. Knighton, J. A. Lamb, B. Lowery, and S. E. Workman. 1995. Ridge tillage systems and water quality in MSEA studies. pp. 5-7. *In: Clean water - clean environment. Vol. III: Practices, systems, and adoption. Team Agriculture Working to Protect Water Resources, March 5-9, 1995, Kansas City, Missouri. American Society of Agricultural Engineers, St. Joseph, Michigan.*

Anderson, N., and D. M. Mickelson. 1996. Variation of hydraulic conductivity in supraglacial sediment. WRC GRR 96-04. Water Resources Center, University of Wisconsin-Madison. 43 pp.

Bahr, J. M., and E. H. Keating. 1995. Redox geochemistry of shallow groundwater discharging to Allequash Creek in northern Wisconsin. WRC GRR 95-08. Water Resources Center, University of Wisconsin-Madison. 41 pp.

Blondin, G., K. Sherman, and G. Chesters. 1995. Report to the Wisconsin Groundwater Coordinating Council -- research and monitoring project reports and summaries. Water Resources Center, University of Wisconsin-Madison. 30 pp.

Bundy, L. G., and P. C. Widen. 1996. Management of sweet corn processing wastes to protect groundwater quality. WRC GRR 96-02. Water Resources Center, University of Wisconsin-Madison. 35 pp.

Chesters, G., M. A. Anderson, H. W. Read, and S. Esplugas. 1995. A jacketed annular membrane photocatalytic reactor for wastewater treatment: Degradation of formic acid and atrazine. *J. Photochem. Photobiol.* 71:291-297.

Cherkauer, D. S. 1996. Impact of tunnel dewatering on surface water bodies in Milwaukee County: Determination of hydrogeologic controls and the efficiency of monitoring arrays. WRC GRR 96-03. Water Resources Center, University of Wisconsin-Madison. 68 pp.

Chesters, G., J. A. Cotruvo, and J. Detjen. 1995. Proposed guidelines and principles for science/environmental journalists. Presented in Rovereto, Italy to be distributed to science and environmental journalists in Countries of the European Community.

Dolan, P. W. 1995. Assessment of agricultural management practices to reduce Nitrate-N leaching. M.S. Thesis. Department of Soil Science, University of Wisconsin-Madison.

Edil, T. B., W. S. Wambold, and J. K. Park. 1995. Partitioning of VOCs in clay liner materials. *Proc. Of the Geoenvironment 2000. February 24-26, 1995. American Society of Civil Engineers Conference and Exhibition, New Orleans, LA.* 16 pp.

Fausey, N., R. Dowdy, T. Steinheimer, R. Spalding, P. Blanchard, B. Lowery, W. Albus, and S. Clay. 1995. Where's the atrazine? - A regional groundwater synopsis. Pp. 69-72. *In: Clean water clean environment. Vol. 1.*

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- Foose, G. J., C. H. Benson, and T. B. Edil. 1995. Evaluating the effectiveness of landfill liners. Environ. Geotech. Rept. No. 95-4. Department of Civil and Environmental Engineering, University of Wisconsin-Madison. 86 pp.
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- Fu, X., L. A. Clark, Q. Yang, and M. A. Anderson. 1995. The enhanced photocatalytic performance of titania-based binary metal oxides: $\text{TiO}_2/\text{SiO}_2$, $\text{TiO}_2/\text{ZrO}_2$. Environ. Sci. Technol. (In review).
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- Fu, X., W. A. Zeltner, and M. A. Anderson. 1995. The gas phase photocatalytic mineralization of benzene on porous titania-based catalysts. *Appl. Catal. B: Environ.* (In press).
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- Harris, M. T., and K. R. Waldhuetter. 1995. Facies-controlled porosity distribution in the Silurian dolomite aquifer of the Door Peninsula, northeastern Wisconsin. *Abstract Volume and Program, American Association of Petroleum Geologists*. p. 39A.
- Hoopes, J. A., S. M. Rashad, and T.-S. Tsay. Near source transport of contaminants in heterogeneous media. WRC GRR 95-09. Water Resources Center, University of Wisconsin-Madison. 19 pp.
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- Levy, J., and G. Chesters. 1995. Simulation of atrazine and metabolite transport and fate in a sandy till aquifer. *J. Contam. Hydrol.* (In review).
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Also see the Appendix for a list of the summaries published in "Wisconsin Groundwater Research and Monitoring Project Summaries".

Groundwater-Related Publications by the WGNHS

Wisconsin Private Well Water Quality - Data Summary Report. M. Brideson, and M. Bohn in cooperation with the Department of Health and Social Services, April 1995, 70 p.

Wisconsin Private Well Water Quality Survey. In cooperation between the DNR, SLOH, and DHSS, Summer 1994 26 p.

Variability of Hydraulic Conductivity in Uniform Sandy Till, Dane County, Wisconsin, 1996. Todd W. Rayne, K. R. Bradbury, and D. M. Mickelson, 19 p.

Regional Groundwater Flow System Between the Wolf and Fox Rivers Near Green Bay, Wisconsin, 1996. W. G. Batten and K. R. Bradbury, 28 p.

Precipitation Summary for 1995. Pamela Naber Knox, State Climatology Office, 1996. 5p.
Groundwater Levels in Wisconsin, Annual Summary 1995, A. Zaporozec, 6 p.

Wisconsin Groundwater Observation Well Network, 1995, A. Zaporozec, 15 p.

GROUNDWATER MONITORING AND RESEARCH

CONDITION OF THE RESOURCE - GROUNDWATER QUALITY

As part of 1983 Wisconsin Act 410, the Groundwater Account of the Environmental Fund was created to support groundwater monitoring by state agencies to determine the extent of groundwater contamination in Wisconsin and identify the sources of contamination. Groundwater monitoring has found that the primary contaminants of concern are volatile organic compounds (VOCs), pesticides and nitrates. Each is discussed below.

Volatile Organic Chemicals

VOCs volatilize under normal temperatures and pressures. Examples of VOCs include gasoline and industrial solvents, paints, paint thinners, drain cleaners, air fresheners, and household products (such as spot and stain removers). Many VOCs are suspected carcinogens when exposure is long term. In the short term, high concentrations of VOCs can cause nausea, dizziness, tremors, or other health problems.

Sources of VOCs include landfills, underground storage tanks, and hazardous substance spills. The DNR requires monitoring at state Environmental Repair Fund sites, abandoned facilities, Comprehensive Environmental Response Compensation Liability Act (CERCLA- superfund), LUST, and spill sites. Thousands of wells have been sampled for VOCs. Fifty-nine different VOCs have been found in Wisconsin groundwater. Trichloroethylene is the VOC found most often in Wisconsin's groundwater.

The DNR currently tracks more than 13,000 LUST sites, approximately 4,000 waste disposal facilities, and approximately 700 high priority Environmental Repair sites. Many of these sites have been identified as sources of VOCs. Facilities include: gas stations, bulk petroleum and pipeline facilities, plating, dry cleaning, industrial facilities, and abandoned non-approved unlicensed landfills.

Wisconsin has 101 active, licensed solid waste landfills of which 99 are required to monitor groundwater. Two studies conducted over four years revealed that out of 51 landfills - both industrial and municipal, engineered and unengineered -- 27 (53%) had VOC contamination in groundwater. VOCs contaminated groundwater at 21 (81%) of the 26 unengineered municipal solid waste landfills included in the two studies. While 20 different VOCs were detected overall, 1,1-Dichloroethane was the most commonly occurring VOC at all solid waste landfills. The two DNR publications: "Volatile Organic Compounds in Groundwater and Leachate at Wisconsin Landfills," dated February 1988, and "VOC Contamination at Selected Landfills - Sampling Results and Policy Implications" dated June 1989, further describe the research results. In a follow-up VOC study conducted from July 1992 through June 1994, the DNR reviewed historical data and sampled groundwater at 11 closed, unengineered landfills and at six older, engineered landfills. VOC levels have decreased after closure at all but two of the unengineered landfills, though at many sites VOC levels do not show continued decline. Also, the level of contamination remains high at many closed sites. No VOC contamination was attributable to leachate migration at any of the six older, engineered landfills.

Wisconsin requires underground storage tanks with a capacity of 60 gallons or greater to be registered with DILHR. This registration program has identified a total of 161,237 tanks as of April 1, 1996, of which 73,395 tanks are regulated by the federal underground storage tank program. Only 18,784 regulated tanks are currently in use, and 44,552 tanks have been removed. A federally regulated tank is any tank, excluding exempt tanks, that is over 110 gallons in size, has at least 10 percent of its volume underground, and is used to store a regulated substance. Exempt tanks include: farm or residential tanks of 1,100 gallons or less; tanks storing

heating oil for consumptive use on the premises where stored; septic tanks; and storage tanks situated on or above the floor of underground areas, such as basements and cellars.

Underground storage tanks over 110 gallons have been federally regulated since 1988. As of March 21, 1996, DNR records indicate there are 7,945 active underground storage tank contamination cleanups and approximately 4,826 inactive sites. The contaminants most commonly associated with leaks from petroleum underground storage tanks are benzene, toluene, ethyl benzene, and xylene (BTEX compounds). More than 3,000 LUST sites have BTEX groundwater standards exceedances. Drinking water at more than 285 households has been contaminated by leaks from underground storage tanks.

Other tanks not under the federally regulated classification have recently become eligible for PECFA funding, and the number of reported releases may increase as a result.

Hazardous waste treatment storage and disposal facilities are another VOC source. The new WDNR Bureau of Waste Management, Technical Resources Section is investigating or remediating contamination at 28 sites. Approximately 140 sites statewide are subject to corrective action authorities. Not all 140 sites will be put into the corrective action process because of minimal contamination at the site or jurisdiction under other regulatory authorities.

Generators improperly managing hazardous waste are another source of VOC contamination. Approximately 100 generator remediation cases statewide are to be addressed in accordance with the NR 700 series.

The Hazardous Substance Spill Law, section 144.76, Wis. Stats, requires immediate notification when hazardous substances are discharged, as well as taking actions necessary to restore the environment to the extent practicable. Approximately 1400 discharges are reported annually to the DNR, and of those, approximately 65% are petroleum related, with another 15% being agrichemicals. The NR 700 series contains the requirements for notification and for taking immediate and/or interim actions when releases occur. Groundwater monitoring is performed when necessary to delineate the extent of contamination.

Pesticides

Pesticide contamination of groundwater results from field applications (i.e., nonpoint sources), pesticide spills, misuse, or improper storage and disposal (i.e., point sources). Serious concerns about nonpoint sources of pesticide contamination in Wisconsin were first raised in 1980 when aldicarb was detected in groundwater near Stevens Point. The DNR, DATCP, and other agencies responded to these concerns by implementing monitoring programs and conducting groundwater surveys.

DNR expanded its sampling programs in 1983 to include analysis of pesticides commonly used in Wisconsin. Federal and state groundwater quality standards for many of these compounds were also adopted, and, to date, standards for over 30 pesticides are included in ch. NR 140, Wis. Adm. Code.

Pesticide and Groundwater Impacts Study - DATCP began a study in 1985 to determine if normal field application and use of pesticides and fertilizer was causing groundwater contamination problems. Data from 150 monitoring wells at 50 farm field sites across the state is being collected quarterly. So far atrazine has been found at 29 of 40 monitoring sites and has exceeded the ES at 12 sites. Alachlor (trade name Lasso) was detected at 10 of 27 sites.

Groundwater Survey for Alachlor in Southern Wisconsin- Since the late 1980s, DATCP has also initiated a number of surveys to investigate pesticides in groundwater resulting from nonpoint sources. A study completed in 1994, sought to determine the extent of alachlor and ESA (a breakdown product of alachlor) contamination in Southern Wisconsin private wells. The study was conducted in 11 counties where alachlor

sales and use have been concentrated. Test kits were sent to approximately 1300 homeowners whose wells had either a previous detection of a triazine-based compound or a previous detection of nitrate over 10 ppm. 669 samples were returned for immunoassay analysis (triazine screen) at DATCP's Bureau of Laboratory Services. Triazine-based compounds were detected in approximately 45% of these samples. Well owners with a detection were offered free follow-up sampling and more comprehensive laboratory analysis for alachlor, ESA, other commonly used pesticides, and nitrate. Two hundred ninety-three follow-up samples were analyzed. Follow-up analysis indicated that approximately 4.1% of the 293 follow-up samples had detections of alachlor and that 70.3% had detections of ESA. Alachlor was detected above the ES of 2.0 parts per billion (ppb) in six follow-up samples. ESA was detected above the Interim Health Advisory of 20 ppb in two follow-up samples.

DATCP plans to conduct site investigations around wells with alachlor exceedances of the ES or ESA exceedances of the Interim Health Advisory to identify the source(s) of groundwater contamination. Information from the investigations will be used to determine what actions DATCP will take in response to alachlor and ESA contamination in groundwater.

A Survey of Atrazine in Wisconsin Groundwater Phase One Report - In 1994, DATCP also completed Phase 1 of a survey designed to evaluate the effectiveness of the atrazine rule (ch. ATCP 30, Wis. Adm. Code). This evaluation, required in ATCP 30, will attempt to determine if a significant change has occurred in groundwater concentrations of atrazine and its three chlorinated metabolites between Phases 1 and 2 of the survey. Private wells were chosen using a stratified-random selection process. Samples were collected from 289 private water supply wells for comparison with samples that will be collected in 1996 for Phase 2. Samples were analyzed for atrazine, its breakdown products and a number of other pesticides. 25% of the samples contained a detectable concentration of one or more herbicide or a herbicide metabolite. 59 of 289 samples contain detectable levels of atrazine and/or its metabolites, with 10 samples exceeding the ES of 3.0 micrograms per liter ($\mu\text{g/L}$). 39 of 289 samples had detections of alachlor's ESA metabolite. 198 of 289 samples contain a nitrate-nitrogen detect, with 53 samples exceeding the ES of 10 ppm.

The Paired Well Survey - This study is currently underway to determine whether prohibiting the use of atrazine has reduced atrazine concentrations in groundwater. About 19 pairs of wells are being sampled every three months for one year. Each pair consists of one well within the prohibition area and one well outside the prohibition area. The first round of samples was collected in the last quarter of 1995.

Exceedence Survey: Resampling Wells that Previously Exceeded a Pesticide Enforcement Standard - DATCP completed this study in 1995 to measure changes in pesticide concentrations in wells that had previously exceeded an ES. 122 wells were resampled in this program for atrazine, deethylatrazine, deisopropylatrazine, diaminoatrazine, alachlor, alachlor ESA, cyanazine, metolachlor, metribuzin, and nitrate-nitrogen. Most wells are in Atrazine Prohibition Areas. 84% of the wells have decreased in atrazine concentration and 16% have increased. 43% of the wells sampled are still above the atrazine ES and 57% are now below. 50% of the well owners who had a well with an ES exceedance still use their well for drinking water. This report is available by contacting the DATCP.

Triazine Screen - Beginning in January of 1991, the Wisconsin State Laboratory of Hygiene (SLOH) initiated a testing program for the public based on the immunoassay screening test for triazine-based compounds. The triazine immunoassay screen is a test that uses specific antibodies (proteins produced by an immune system in response to the presence of a foreign substance) designed to selectively bind to target compounds present at low concentrations. Tests continue to be available to the public via a toll free 800 telephone number and a small fee. The DNR is funding a part time staff position at the SLOH to assist in the quality control process for data collection from triazine screening samples.

Since the start of this program, DNR groundwater databases have amassed more than 9,000 results from the triazine screen analysis. Data received from the SLOH indicates that approximately 42.5% of the samples

indicated a detection for a triazine based compound. Approximately 17.6% of the samples have a result which exceeds the PAL for atrazine of 0.3 ppb, and approximately 1.8% have exceeded the ES of 3.0 ppb. Comparison to the ES and PAL is used only for reference since the immunoassay triazine analysis screens for ten compounds other than atrazine specifically, and does not detect two of the three atrazine metabolites included in the groundwater standard. Comparison to the ES and PAL for atrazine has some reference value because atrazine has been so heavily used in Wisconsin, and there have been few detects of the other triazine-based compounds in groundwater.

The SLOH can now screen for many other pesticides and has expanded the immunoassay screening program to include other pesticides as requested.

Nitrate

Nitrate-nitrogen is the most commonly found groundwater contaminant, and frequently exceeds the state drinking water standard and ES of 10 milligrams/liter (mg/l). Consumption of water containing high concentrations of nitrate by infants under 6 months of age can induce methemoglobinemia or "blue baby syndrome." This condition occurs when hemoglobin is oxidized to a form that is unable to carry oxygen to the body's tissues. All infants are at risk of nitrate poisoning, but those suffering from gastrointestinal illnesses appear to be more sensitive than healthy infants. Serious poisonings in infants have occurred following ingestion of water containing nitrate concentrations as low as 50 mg/l, just 5 times the current ES. Most infant deaths have involved rural well water that contained nitrate levels above 100 mg/l. The developmental effects of low-level exposure are not known, but some experts believe this could cause a chronic oxygen shortage which could injure an infant's nervous system. Some scientific studies have found evidence suggesting that women who drank nitrate contaminated water during pregnancy were more likely to have miscarriages or give birth to babies with birth defects. Nitrate is not known to be harmful to adults or older children. However, since scientists are unsure about the chronic health effects of nitrate, long term ingestion of water that contains high nitrate levels is not recommended.

The DHSS and the DNR have recommended that all newly constructed private wells and wells that have not been tested during the past 5 years, be tested for nitrate. Due to the concern over nitrate, the GCC endorsed a resolution in 1989 recommending that newly constructed water supply wells be sampled for nitrate in addition to coliform bacteria. Testing is recommended for wells used by pregnant women and is essential for wells that serve infants under 6 months of age.

Nitrate can enter groundwater from many sources, including nitrogen based fertilizers, animal waste storage and feedlots, municipal and industrial wastewater and sludge disposal, refuse disposal areas, and private sewage systems. A U.S. Centers for Disease Control (CDC) and Prevention sampling project indicated that approximately 6.5 % of private wells in the state contain nitrate above the ES. This number can be highly variable between counties, but if true, 53,625 of Wisconsin's 825,000 wells exceed the standard of 10 mg/l of nitrate.

A data summary project was initiated to compare or validate the data from the CDC sampling project. The Wisconsin Private Well Water Quality Data Summary Report completed by the WGNHS and the DHSS uses data from existing databases at the CWGWC, the USGS, the DATCP, the WGNHS, and the DNR. This summary work indicated that nitrate exceedance rate of the ES from each of these existing agency databases ranges from 9% to 14%, depending on the dataset being used.

In response to widespread flooding in the summer of 1993 the CDC sponsored a private well sampling program across the 9 Midwestern flood affected states. DNR Water Supply staff took 636 private well samples with at least eight samples taken in each county. Each well was analyzed for nitrates, coliform bacteria, E. coli bacteria,

atrazine, radon and some for sulfates and arsenic. A GIS coverage consisting of point locations for each private well sampled was created by the DNR Water Resources Management Program.

The CDC study showed that concentrations of nitrate in groundwater are not uniform across the state. Some undeveloped areas have low nitrate levels, whereas up to 50% of rural wells in some agricultural areas of southern Wisconsin exceed the ES for nitrate. County groundwater assessments conducted by the WGNHS have found private well nitrate results above the ES ranging from 2% in Burnett County to 16% in Pepin County. Data compiled for the "Nitrate in Wisconsin's Groundwater: Strategies and Challenges" conference in 1994 shows a range of 0% for Forest County to 27% in Rock County above the ES. Most of the differences across the state can be related to variations in nitrogen loading and to differences in soil, geology and groundwater conditions.

DILHR continues evaluating state-of-the-art septic system designs for nitrate removal. In addition, DATCP has been evaluating the need for regulation of nitrogen-based fertilizers. DATCP proposed regulatory authority for fertilizer use in the FY 96-97 budget but the proposal was not approved. The DNR and DHSS produced a joint "Nitrate in Drinking Water" brochure to address nitrate education concerns.

Biological Hazards

The DNR is aware of several areas in Wisconsin where biological contamination of the aquifer is common. Biological agents include bacteria, viruses, and parasites. These agents can cause acute illness and result in life-threatening conditions for some population groups. Approximately 23% of well water samples test positive for total coliform bacteria, an indicator species of other biological agents. Approximately 3% of well water samples test positive for E. Coli, an indicator of water borne disease that originates in the mammalian intestinal tract. The DNR recommends that well owners test for biological quality annually or when there is a change in taste, color, or odor of the water.

Natural Groundwater Quality

Natural groundwater quality varies greatly throughout Wisconsin. Undesirable constituents commonly found in Wisconsin groundwater include iron, manganese, sulfate, arsenic, and radioactive materials. High levels of iron have been detected throughout the state. High levels of manganese, arsenic and sulfates are less commonly found and are more localized in extent.

Naturally occurring radioactivity in groundwater, including uranium, radium and radon, have become a concern in Wisconsin in recent years. The state has initiated programs to test groundwater for radioactivity. Recent sampling has identified radionuclides in groundwater in north-central Wisconsin. High levels of radium have also been found in water supplies in eastern Wisconsin. Studies have been initiated to examine the occurrence and extent of these naturally occurring contaminants.

A radon study currently underway is being conducted by DHSS, the Wisconsin Environmental Health Association, and the WGNHS. The goal of this study is to correlate groundwater radon concentrations with the major aquifers of the state, rather than with political subdivisions. The DNR Drinking Water Program's Well Log Database was used to select sample locations from wells with known geologic information. This electronic database has been growing rapidly since 1988, and now contains more than 100,000 well logs, covering the entire state.

Wells were selected to be representative of major aquifers. These aquifers are identified in a new mapping effort by the WGNHS. The "Primary Bedrock Aquifer" map has been created in a GIS layer. This GIS layer can be related to the Well Log Database which contains locational information, in addition to geologic information.

It is the intent of the project to take advantage of the State's growing electronic databases. This radon study may serve as a pilot study for relating existing naturally occurring water quality information to aquifer characteristics. Historically, associations were drawn between well results and county or minor civil division boundaries which rarely follow the boundaries of the water quality conditions. This tool, coupled with the WGNHS's growing knowledge of the State's major aquifer systems, will ultimately help well drillers, home owners, groundwater professionals, and others. A better awareness of groundwater quality conditions by aquifers at the local level will indicate the appropriate well construction, and/or water treatment needs in advance.

CONDITION OF THE RESOURCE - GROUNDWATER QUANTITY

Approximately 70% of Wisconsin's residents and 97% of Wisconsin's communities rely on groundwater to meet their water supply needs. Groundwater is also the primary source of water for irrigated agriculture, and is very important for industry. Streams, lakes, and wetlands are fed by groundwater baseflow, thus fish, other aquatic life, and wildlife are as dependent on abundant, clean groundwater as humans are.

About two million billion (2,000,000,000,000,000) gallons of water is estimated to be stored underground in Wisconsin. That is enough water to cover the state to a depth of 30 feet. Approximately 14 billion gallons of water are recharged to groundwater every day. The 1990 estimated daily use of groundwater in Wisconsin was about 600 million gallons.

Despite this abundance of groundwater, there has been a growing concern over the last several years about the quantity of good quality groundwater available for municipal, industrial, agricultural and domestic use and for adequate baseflow to our lakes, streams and wetlands. Groundwater quantity problems may occur naturally or from human activities. There may be a natural shortage of groundwater due to weather conditions (e. g., drought), geologic setting (e. g., crystalline bedrock aquifer with low yields), or the presence of naturally-occurring substances in groundwater which are of concern to public health or welfare.

Generally, groundwater levels vary seasonally. Groundwater levels in shallow aquifers tend to fluctuate at a greater frequency and to a greater extent than do groundwater levels (or hydraulic head) in deeper aquifers and confined aquifers. In the spring, groundwater levels rise rapidly due to recharge from snow melt and rain. In the summer, groundwater levels gradually decline; groundwater levels often rise in the fall and decline during the winter. Prolonged periods of below normal rainfall can result in lowered water levels which may dry up private wells or reduce baseflow to streams, lakes or wetlands. This was the case in 1977 and 1988.

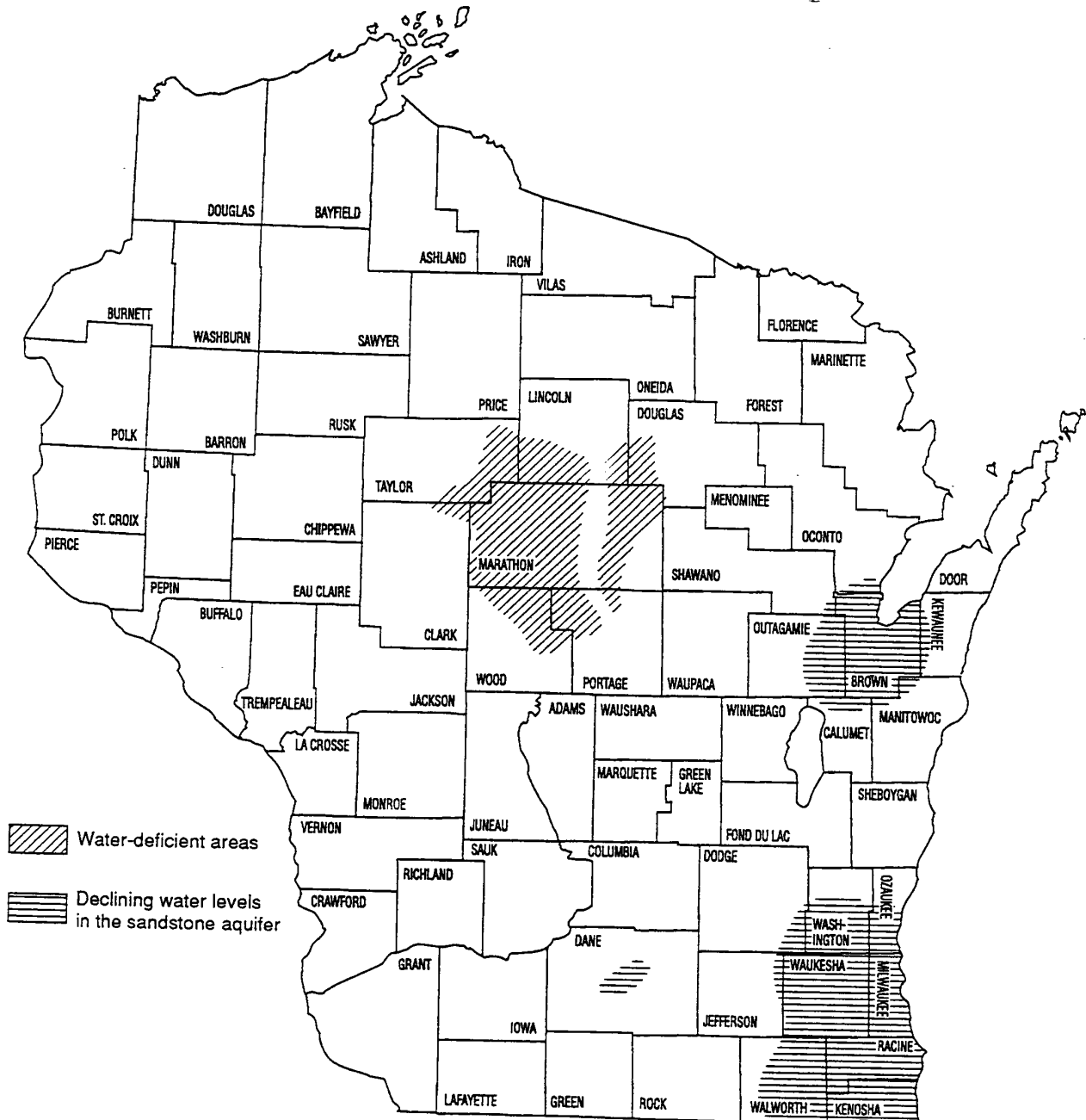
Geologic conditions may also limit the availability of groundwater. For example, a portion of north-central Wisconsin is underlain by poorly productive, fractured crystalline rocks (Figure 1) where the sand and gravel aquifer is thin or absent. In this area, yields of groundwater during dry seasons are too low in most places to sustain large water supplies, but there is generally enough water for domestic wells.

The availability of good quality groundwater may also be limited by naturally-occurring substances in groundwater which are of concern for public health or welfare. This is particularly true for bedrock aquifers where groundwater has been in contact with the rock formations for hundreds or thousands of years and high concentrations of minerals have dissolved into the groundwater. Naturally-occurring substances which have been found in groundwater at concentrations of public health or welfare concern include sulfates, arsenic, fluoride, radon, radium, chlorides, iron and manganese.

Groundwater quantity problems may also occur because of human activities such as groundwater withdrawal, land use activities, and the contamination of groundwater. When groundwater is pumped by a well or set of wells, one or more effects will occur. One effect is that groundwater levels, either water table or potentiometric levels, will decline near the well. This decline (typically referred to as a "cone of depression" or "drawdown") is usually small when a domestic well is pumped; however, this decline may be quite large in areas where a single or multiple high-capacity wells (e.g., municipal, irrigation and industrial wells) pump large quantities of groundwater.

Other possible effects include: a decrease in the amount of groundwater stored in the aquifer; a decrease in groundwater flow to streams, springs, lakes, and wetlands; and conversion of groundwater discharge areas to groundwater recharge areas (e.g., lake or stream water flowing into an aquifer). The practical implications of groundwater pumping include: increased pumping costs due to the need to pump water from a greater depth,

dewatering or mining of an aquifer to the point that it may no longer meet water supply needs, and drying up of nearby shallow wells (e.g., domestic wells).



The most noticeable and best documented effects of groundwater withdrawals can be seen on a regional scale in the Lower Fox River Valley, southeastern Wisconsin, and Dane County. Pumping from closely spaced high-capacity wells in the Lower Fox River Valley in northeastern Wisconsin has resulted in a substantial drawdown in this area's aquifer. The Lower Fox River Valley includes two major areas of groundwater pumping - the Green Bay metropolitan area and the Fox Cities area near the north shore of Lake Winnebago. Recent groundwater level measurements indicate that the cones of depression from these pumping areas have merged so that pumping in one area affects the other.

Another area experiencing declining groundwater levels as a result of groundwater pumping is southeastern Wisconsin (Figure 1). Pumping from the sandstone aquifer in the Milwaukee-Waukesha area began in the late 1800s. The potentiometric surface was near the land surface and in some cases above the land surface. Since the 1880s, groundwater pumping in the Milwaukee-Waukesha area and northeast Illinois has reduced the potentiometric surface by as much as 350 feet in the Milwaukee-Waukesha area and 275 feet or more near the Wisconsin-Illinois state line. Originally, groundwater flowed east and discharged into Lake Michigan. Now, Lake Michigan recharges groundwater in the Milwaukee area.

Dane County has also experienced historical groundwater level declines resulting from groundwater pumping. Large withdrawals from the deep sandstone aquifer, beginning in 1882, have produced a significant groundwater level drawdown. The situation in Dane County is further complicated by the fact that most of the groundwater that is withdrawn from the aquifer in the Madison area is not returned to the drainage basin. Effluent from the Madison Wastewater Treatment Plant discharges into Badfish Creek which carries the effluent out of the Yahara River drainage system. This diversion has reduced the baseflow in the lower Yahara River and resulted in aquifer recharge from the Madison area lakes.

There have been more localized effects from groundwater withdrawals as well, although these effects are not as well studied or as well documented as the regional effects. Streamflow in the Little Plover River in the Central Sands has decreased due to groundwater withdrawals. There have been concerns about the effects on wetlands in southeastern Wisconsin due to withdrawals from nearby high capacity wells. There have been a number of cases around the state where wells have gone dry, lake levels have dropped, streamflow has been reduced, and wetlands or springs have gone dry. For most cases, there was a suspected cause but not enough information to prove a connection.

A major source of groundwater withdrawals are the more than 8,000 high capacity wells in the state; these are wells which pump over 100,000 gallons per day or 70 gallons per minute. These include some 1500 public water supply wells, 3800 irrigation wells, 800 industrial wells and others serving schools, wastewater treatment plants and commercial establishments.

A decrease in baseflow (i.e. natural groundwater discharge) to lakes, streams, and wetlands due to groundwater withdrawals can have a number of adverse effects, including a decline in fishery, more stringent discharge requirements for facilities which discharge to the river or stream, a loss of wildlife habitat, a change in stream classification, and greater susceptibility of groundwater to bacterial contamination from surface water, especially in fractured bedrock. Depressional wetlands, which receive little surface water runoff, and wetlands hydraulically connected to an aquifer are at greatest risk from aquifer dewatering practices. Baseflow may contribute up to 70% of a wetland's water budget.

When groundwater withdrawals reduce the amount of baseflow that discharges to a wetland, both the water level and the water chemistry of the wetland change. Decreased water levels in a wetland also affect the type of plants and animals that live in the wetland. Most of our game and non-game wildlife depend on wetlands for some stage in their life cycle. In general, decreased baseflow reduces the level of biodiversity a wetland can support.

There is an ongoing effort by state and federal agencies and university staff to gather data and information on groundwater quantity issues. Effective management of groundwater in Wisconsin requires up-to-date information on fluctuations and trends in groundwater levels throughout the state. In 1946, the WGNHS and the USGS initiated a statewide groundwater-level observation network to gather such information. The main purpose of this network is to evaluate short-term changes and long-term trends in groundwater levels due to variations in precipitation and groundwater pumping.

The USGS also maintains a network of streamflow gaging stations across the state to record surface water flow information. Historical streamflow data is valuable as we look at the relationship between surface water and groundwater. The earliest stations were installed prior to the turn of the century. Data are presently being collected from 96 continuous streamflow stations and 6 lake level stations.

Funding cuts for FY 97 will result in the loss of groundwater-level observation network wells and streamflow gaging stations. About 70 network wells and 20 gaging stations will be lost. These cuts represent a 30 percent loss in groundwater-level observation network wells and a 20 percent loss of stream gages. The ability to substantiate surface/ground water interactions and establish trends in groundwater levels and stream flows will be lost in many parts of the State because of the funding cuts.

Every five years, the USGS publishes a report called, "Water Use in Wisconsin", which contains a summary of water use, including trends in use and how surface water and groundwater are used. Water use has increased steadily from 1950 to 1990 for all use categories (Figure 2). Public water supply withdrawals doubled and industrial withdrawals grew from around 75 million gallons per day (mgpd) to 475 mgpd during this time. Groundwater withdrawals from all sources in 1990 was estimated to be 732 mgpd. Irrigation increased by 44 percent between 1980 and 1990. In Dane County, rates of groundwater withdrawal have increased faster than population growth. These trends of increased withdrawals have resulted in large cones of depression in several areas of the state as described earlier.

Historically in Wisconsin, little research has focused on groundwater quantity problems, issues and management. In the water-rich midwest, groundwater *quality* has been considered a much higher priority and has overshadowed groundwater *quantity* concerns. There have, however, been some studies of groundwater quantity problems.

A numerical groundwater flow model for Dane County to assess the effect of groundwater management options including different withdrawal scenarios has been developed. Groundwater quantity studies are also underway in the Little Plover River Basin, the Lower Fox River Valley, and the Driftless Area.

While there are a few well-documented studies and some information related to groundwater quantity and groundwater - surface water interactions, most incidents of groundwater quantity problems are not well documented or are anecdotal. We do not know how extensive groundwater quantity problems are throughout the state, especially at the local level. The cause of a particular problem is usually suspected, rather than confirmed. Because of the many factors involved, gathering definitive data on the effects of groundwater withdrawals is complex, time-consuming, and expensive.

Additional research is needed to increase our understanding of groundwater-surface water interactions and the impacts of groundwater withdrawals. Potential topics include identifying the environmental, economic, and land use implications for the current trends in groundwater use, determining the level of information needed to make informed decisions about groundwater withdrawals in Wisconsin, considering what management options are available for addressing this issue, quantifying the monetary, social, economic, and ecological costs associated with groundwater quantity problems and determining the effect of large numbers of private wells in a small area.

Figure 2 - Surface and Groundwater use in Wisconsin

Under Wisconsin's Environmental Protection Law, chapter NR 144, Wis. Stats., the DNR is instructed to serve as the "central unit of government to protect, maintain, and improve the quality and management of the waters of the state, ground and surface, public and private." The DNR carries out these responsibilities through its Drinking Water and Groundwater, Watershed Management and Fish and Surface Water Management programs. The DNR regulates high capacity wells and surface water diversions. Other agencies involved in groundwater quantity issues include the WGNHS, CWGC, Public Service Commission, the USGS, and local units of government or water utilities.

It is apparent that additional work is warranted by all parties to address groundwater quantity issues in Wisconsin. There needs to be further discussion to determine appropriate management options for addressing major groundwater withdrawal (i.e., Lower Fox River Valley, southeast Wisconsin and Dane County). There also needs to be additional data collection and research to provide information which can be used to address the groundwater quantity management issues. Funding to continue these efforts is important.

The GCC has encouraged research on groundwater quantity and groundwater-surface water issues. Each year groundwater research and monitoring funded through the joint solicitation process aids our understanding of the types and severity of such problems. A report on the topic is being prepared by the DNR's Groundwater Section. This report is near completion and will be brought to the Council at their November meeting.

COORDINATION OF GROUNDWATER MONITORING AND RESEARCH

Four state agencies have had approximately \$825,000 available each year for groundwater-related monitoring or research. The sources of money and purposes of monitoring or research include:

1. DNR Management Practice Monitoring - The DNR has had approximately \$350,000 available each year since FY 86 up through FY 95 to support groundwater monitoring studies evaluating existing design and/or management practices associated with potential sources of groundwater contamination. In FY 96 there was \$275,000 available for monitoring. Through FY 96, the DNR has spent approximately \$3.5 million on 137 monitoring projects. Seven projects have been co-funded with DATCP, three projects have been co-funded with the UW and one project has been funded by DNR, DATCP and UWS. The money has come from the Groundwater Account of the Environmental Fund (which is funded by various fees). The intent of these studies is to reduce the impacts of potential sources of contamination by changing the way land activities which may impact groundwater are conducted.
2. UWS Groundwater Research - The UWS has received funding since FY 90 for groundwater research. The money is part of the base UWS budget. They received \$200,000 in FY 90 and \$300,000 annually since then. Through FY 96, the UWS has spent \$2 million on 54 groundwater research projects. Three of the 54 projects have been co-funded with DATCP, three have been co-funded with the DNR and one project was jointly funded by DNR, DATCP and UWS.
3. DATCP Pesticide Research - Since 1989, DATCP has had approximately \$125,000 available annually as a result of the pesticide law to fund research on pesticide issues of regulatory importance. The money comes from fees paid by pesticide manufacturers to sell their products in Wisconsin. Through FY 96, DATCP has spent about \$875,000 on 17 pesticide projects. Three have been co-funded with the UWS, seven have been co-funded with the DNR and one project was jointly funded by DNR, DATCP and UWS.
4. DILHR Private Sewage System Research - DILHR received a special GPR appropriation of \$50,000 from 1990 to 1993 to fund research on alternatives to current private sewage system technology (s. 145.20(5), Stats.) In 1994, when the appropriation expired, \$75,000 generated through plan review and licensing fees became available each year for research on private sewage systems. Through FY 96, DILHR has spent approximately \$410,000 on three projects.

Approximately \$6.5 million has been spent through FY 96 on 194 different projects dealing with groundwater or related topics.

The GCC provides consistency and coordination among the four state agencies in funding groundwater monitoring and research to meet state agency needs. In 1988, the GCC requested that the UWS create a Groundwater Research Advisory Council to establish a long-range groundwater research plan and develop a groundwater research decision item narrative (DIN) for inclusion in the University's biennial budget. The GRAC consists of university, state agency, and public representatives.

Based on discussions with the GCC, the GRAC prepared a groundwater research DIN for inclusion in the University's 1989-1991 biennial budget request. The GCC endorsed the DIN in 1988. The DIN was included in the governor's budget and was approved by the Legislature at a level of \$500,000 for the 1989-1991 biennium for groundwater research. This amount was increased to \$600,000 for the 1991-1993 and subsequent biennial budgets. Statutory language requires that there be agreement between the UWS and the GCC on the use of the UWS research funds before the funds can be released by the Department of Administration.

To expedite this agreement, a MOU was signed in 1989 by representatives of the GCC, the GRAC, and the UWS on use of the UWS groundwater research funds. The MOU spells out the procedures for establishing priorities

and selection of projects for funding of UW groundwater research. The MOU recognizes that the GCC has a substantive role in establishing research priorities and an advisory role in project selection to minimize overlap and duplication.

The UWS funded 19 groundwater research proposals during FY 90 and FY 91 with concurrence from the GCC. The results of the first studies that were funded by the UWS were published in October 1991 by the UW Water Resources Center in a report titled, "UWS Groundwater Research Program, Summary of 21 Projects."

During the summer of 1990, the GRAC and GCC developed and endorsed a plan to coordinate the solicitation of projects for funding in FY 92 and subsequent years. The joint solicitation provides for only one submittal of project proposals, rather than four as had been the case. The intent of the plan is to determine the most appropriate funding source for a particular project.

FY 96 Monitoring Projects - Joint Solicitation

The joint solicitation for FY 96 was distributed in November, 1994. A total of 40 project proposals were submitted in response to the joint solicitation. To assist in the review process, a joint meeting of the Monitoring & Data Management and Research Subcommittees of the GCC was held in early March 1995 to review and rank the projects submitted for funding. As a result of that meeting and review of the proposals by DNR staff, 5 new projects were selected for funding in FY 96; one of those was co-funded with the UWS. Six on-going projects were carried over into FY 96.

In addition to the projects funded by the DNR, the UW System fully funded 13 projects and co-funded one project with the DNR. DATCP funded 4 projects and DILHR funded one project in FY 96. A total of 28 projects were funded through the joint solicitation at a cost of approximately \$718,000 (see Table 1 and Figure 3).

FY 97 Monitoring Projects - Joint Solicitation

A joint solicitation for project proposals by the UW System, DNR, DATCP and DILHR was distributed in November, 1995 for funding in FY 97. The deadline for proposals was January 12, 1996. The joint solicitation contains a listing of the priorities for each of the agencies (see Appendix). The priority needs for the DNR's management-practice monitoring program for FY 97 were identified by the Monitoring & Data Management and Research Subcommittees of the GCC. The two subcommittees met in early March to rank the 35 proposals submitted. Seventeen of the 35 proposals received will be funded in full or in part through the joint solicitation process. The projects to be funded in FY 97 are listed in Table 2.

A survey was distributed to investigators who submitted proposals in previous years to assess how the joint solicitation is working. The results of the survey were used in preparing the FY 97 joint solicitation package.

**Table 1 - Groundwater Projects Funded Through
the Joint Solicitation for FY 96**
(Map numbers are for locating projects on the State map in Figure 3)

DNR Projects

* An Evaluation of Long-term Trends and a Mineralogical Interpretation of Naturally Occurring Metals Contamination and Acidification of the St. Peter Sandstone Aquifer. Annette Weissbach. \$20,000. (Map # 1)

* Agrichemical Impacts to Groundwater Under Irrigated Vegetables in the Central Sand Plain. George Kraft and Larry Binning. \$51,243. (Map # 2)

* Collection of Hydraulic and Geologic Data to Improve the Quality of the Wisconsin Groundwater Monitoring Network. Alex Zaporozec. \$9,450.

* Pesticides and Groundwater Impacts. Jeffrey Postle. \$4,504. (Map # 3)

* Direct and Residual Effects of Land-Applied Sweet Corn Processing Wastes on Nitrate Loss to Groundwater. Larry Bundy. \$19,430. (Map # 4)

Application of a Discrete Fracture Flow Model for Wellhead Protection at Sturgeon Bay, Wisconsin. Kenneth Bradbury and Maureen Muldoon. \$33,823. (Map # 5)

Optimum Management of Ground-water Resources in the Lower Fox River Valley. James Krohelski. \$34,375. (Map # 6)

Variability of Nitrate Loading and Determination of Monitoring Frequency for a Shallow Sandy Aquifer, Arena, Wisconsin. Fred Madison. \$13,126. (Map # 7)

GIS as a Tool to Prioritize Environmental Releases, Integrate their Management, and Alleviate their Public Threat. Richard Stoll. \$27,940. (Map # 8)

Delineation of Capture Zones for Municipal Wells in Dane County, Wisconsin. Kenneth Bradbury. \$22,747. (Map # 9)

The total cost for projects funded by the DNR through the FY 96 joint solicitation process, including the co-funded project below, is \$248,568.

DNR/UWS Co-Funded Project

Evaluation of Shallow-Soil Absorption Fields Associated with Advanced On-site Disposal System. Ronald Stieglitz. \$11,930/\$11,930. (Map # 10)

UWS Projects

* Tracer Study for Characterization of Groundwater Movement and Contaminant Transport in Fractured Dolomite. Ken Bradbury. \$16,764. (Map # 11)

* Evaluating the Effectiveness of Landfill Liners. Craig Benson. \$24,480.

* Integration of Hydraulics and Geology into a Hydrostratigraphic Model for the Paleozoic Aquifer of Eastern Dane County, Wisconsin. Douglas Cherkauer. \$25,080. (Map # 12)

* Development and Demonstration of an Accurate Manure Spreading System to Protect Water Quality, Improve Waste Management and Farm Profitability. Kevin Shinnars. \$25,860. (Map # 13)

* Synergistic Effects of Endocrine Disrupters in Drinking Water. Warren Porter. \$24,703.

Responses of Biological Toxicity Tests to Mixtures of Pesticides and Metabolites. Gordon Chesters. \$29,970.

The Use of Azimuthal Resistivity & Self Potential Measurements to Delineate Groundwater Flow Direction in Fractured Media. Robert Taylor. \$21,678. (Map # 14)

Stratigraphic Controls on the Mobilization and Transport of Naturally Occurring Arsenic in Groundwater: Implication for Wellhead Protection in Northeastern Wisconsin. Juan Simo. \$24,980. (Map # 15)

Characterization of the Role of Evapotranspiration on Groundwater Movement and Solute Chemistry in Groundwater-fed Wetlands. Kenneth Potter. \$20,025. (Map # 16)

Bioremediation of Hydrocarbons Influenced by Air Sparging: A Multi-model Approach to Assess Contaminant Mass Removal. Jean Bahr. \$19,470. (Map # 17)

Biostimulation of Trichloroethylene Degradation in Contaminated Aquifers. William Hickey. \$20,320.

Evaluation of Well Seals Using an Ultrasonic Probe. Tuncer Edil. \$24,740. (Map # 18)

The total cost for projects funded by UWS through the FY 96 joint solicitation process, including the DNR/UWS co-funded project above is \$290,000.

DATCP Projects

An Integrated Approach to the Management of Insects in Sweet Corn Grown for Fresh Market. John Wedberg. \$16,000.

Land Use Effects on Groundwater and Streamwater Quality in the Little Plover River Watershed. Byron Shaw. \$33,930. (Map # 19)

Iron-based Abiotic Destruction of Chlorinated Solvents and Pesticides in Groundwater. Gerald Eykholt. \$24,950.

Ground-water Recharge and Contamination in Wisconsin's Driftless Area. Kenneth Potter. \$30,000. (Map # 20)

The total cost for projects funded by DATCP through the FY 96 joint solicitation process is \$104,880.

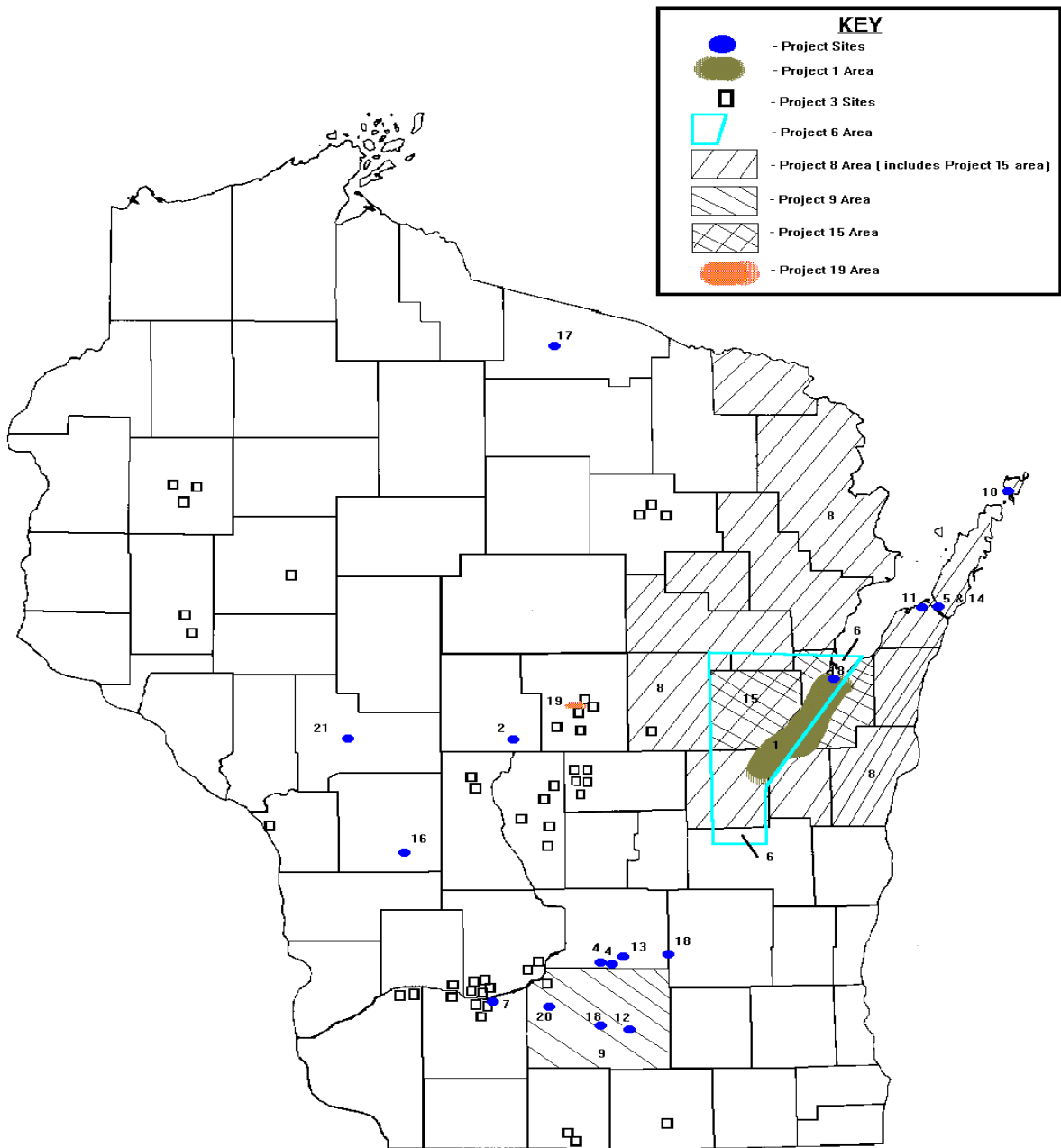
DILHR Projects

* Nitrogen Removal from Domestic Wastewater in Unsewered Areas. Ayres & Assoc. \$52,775. (Map # 21)

Use of Heavy Nitrogen to Study Nitrate Flux from Septic Systems. John Harkin. \$21,725.

The total cost for projects funded by DILHR through the FY 96 joint solicitation process is \$74,500.

* Projects preceded by an asterisk were also funded in FY 95.



**Table 2 - Groundwater Projects to be Funded Through
the Joint Solicitation for FY 97**

DNR Continuing Projects

GIS as a Tool to Prioritize Environmental Releases, Integrate their Management, and Alleviate their Public Threat. Richard Stoll. \$28,626

Optimum Management of Ground-water Resources in the Lower Fox River Valley. James Krohelski. \$34,375

Variability of Nitrate Loading and Determination of Monitoring Frequency for a Shallow Sandy Aquifer, Arena, Wisconsin. Fred Madison \$11,501

Pesticides and Groundwater Impacts. Jeffrey Postle \$4,154

DNR New projects

A Study of Well Construction Guidance for Arsenic Contamination in Northeast Wisconsin. Annette Weissbach \$15,380

Stratigraphic Controls on Distribution of Hydraulic Conductivity in Carbonate Aquifers. Tony Simo \$25,506

Evaluation of the Use of DUMPSTAT to Detect the Impact of Landfills on Groundwater Quality Ken Potter \$13,431

Nitrate-Contaminated Drinking Water Followback Study. Marty Kanarek \$21,261

The total cost for all projects funded by the DNR through the FY 97 joint solicitation process, including the DNR/UWS co-funded project below is \$184,384.

DNR/UWS Co-Funded Project

Improved Detection Limits for Ground Water Monitoring Bill Sonzogni. \$10,050/\$10,050

UWS Continuing Projects

Characterization of the Role of Evapotranspiration on Groundwater Movement and Solute Chemistry in Groundwater-fed Wetlands. Kenneth Potter. \$17,676

Responses of Biological Toxicity Tests to Mixtures of Pesticides and Metabolites. Gordon Chesters. \$33,100

UWS New Projects

Groundwater Protection by Application of Modern Portfolio Theory to Microbiotesting Strategies. George Blondin \$13,812

Development of a Variable Rate Nitrogen Application Approach for Corn. Larry Bundy \$11,580

Experimental Verification of Models Used to Evaluate Landfill Liner Effectiveness. Tuncer Edil \$23,000

Stratigraphy, sedimentology, and Porosity Distribution of the Silurian Aquifer of Ozaukee County, Wisconsin.

Mark Harris \$8,600

Improved Estimation of Groundwater Recharge Rates. Mary P. Anderson \$22,100

Hydrogeochemical and Microbiological Studies for Enhanced Ground Water Bioremediation. Jean Bahr \$31,630

Groundwater Bioremediation: Monitoring with MMO Probes. Mary Perille Collins \$27,807

Treatment of Groundwater Contaminated with Chlorinated Aliphatics Using a Silicone Tubing Supported Methanotrophic Biofilm Reactor. Jae K. Park \$29,610.

In situ Air Sparging: Air Plume Characterization and Removal Effectiveness. Craig H. Benson. \$25,163.

The total cost for all projects funded by the UWS through the FY 97 joint solicitation process, including the co-funded project above is \$254,128

DATCP Continuing Projects

An Integrated Approach to the Management of Insects in Sweet Corn Grown for Fresh Market. John Wedberg \$14,500

Land Use Effects on Groundwater and Streamwater Quality in the Little Plover River Watershed. Byron Shaw. \$33,930

DATCP New Projects

Fate of Nicosulfuron in Sparta Sand. Birl Lowery \$13,575

Determining Compatibility Between Herbicide Release and Habitat for Karner Blue Butterfly in Red Pine Plantations. Ed Sucoff \$10,059

The total cost for all projects funded by DATCP through the FY 97 joint solicitation process is \$72,064

DILHR Continuing Projects

Evaluation of Shallow-soil Absorption Fields Associated with Advanced On-site Disposal System. Ronald Stieglitz. \$17,781

DILHR New Projects

Molecular Techniques for Detection and Identification of Sewage-Borne Human Pathogens in Soils. William Hickey \$24,550.

Holding Tank Effluent and Fecal-Contaminated Groundwater: Sources of Infectious Diarrhea in Central Wisconsin. Mark Borchardt \$27,203

The total cost for all projects funded by DILHR through the joint solicitation process in FY 97 is \$69,534.

BENEFITS FROM MONITORING AND RESEARCH PROJECTS

Table 3 (see Appendix) is a list of groundwater-related monitoring and research projects funded by state agencies since enactment of Wisconsin's comprehensive groundwater protection legislation (1983 Wisconsin Act 410) in 1984. Those agencies which have funded projects are the DNR, DATCP, DILHR, and the UWS. There are 195 projects listed. One hundred of these projects have been funded through the joint solicitation process which began in FY 92. The remaining projects were funded by the above agencies through separate solicitation processes prior to 1992. The table includes the project title, principal investigator or investigators, the years the project was funded, and the funding agency or agencies.

Many projects have provided valuable information to evaluate existing regulatory programs and determine if there is a need for additional regulations. Numerous studies have increased the knowledge of the movement of contaminants in the subsurface. A number have provided valuable information regarding the state's groundwater resources. Others have developed new methods for groundwater evaluation and protection. The following discussion highlights some of the areas that have been the focus of research and monitoring projects and illustrates how agencies have used the project's results to improve the management of the state's groundwater resources.

The Atrazine Rule - The development of the Atrazine Rule (ATCP 30, Wis. Adm. Code) illustrates how the benefits of state-funded research and monitoring can build on one another. In the mid-1980s the corn herbicide atrazine began to be detected in monitoring wells and private drinking water wells in Wisconsin. The first systematic well sampling program to characterize atrazine contamination on a statewide basis was the 1988 DATCP Grade A Dairy Farm Well Water Quality Survey (LeMasters, 1989). This state-funded well survey estimated that atrazine was present in 12% of the Grade A Dairy Farm Wells in the State.

This study left many questions regarding the sources, groundwater susceptibility, and the presence of pesticides other than atrazine unanswered. Without better information on these and other questions, it was challenging for DATCP, the agency charged with groundwater protection related to agricultural chemicals, to develop a plan of action. It was obvious that a concerted information gathering program was needed. Over the next several years, before and during the development of the DATCP atrazine rule, the Wisconsin Groundwater and Pesticide Research program played an essential role in providing the needed information. Research and monitoring were conducted on several topics that played a direct role in the evolution of the atrazine rule.

The state research and monitoring program funded several key projects to better understand the sources of atrazine contamination. When atrazine was first found in groundwater, an argument had been made that this was the result of point sources such as spills and mishandling. One of the most important findings that allowed DATCP to begin developing the atrazine rule was that normal agricultural applications of atrazine could lead to groundwater contamination. The DATCP groundwater monitoring project (Postle, 1986-96) for pesticides used monitoring wells located next to agricultural fields to study groundwater contamination by atrazine and other pesticides. This study showed that atrazine from field use on sandy soils could cause contamination, often above the 3 µg/l ES. The UW Water Resources Center conducted a detailed hydrogeologic study (Chesters, 1990-91) at a farm in Dane County and showed conclusively that atrazine contamination could result from both field applications and mixing/loading practices. With the knowledge that nonpoint contamination of groundwater by atrazine was indeed occurring, DATCP could develop ways to reduce this contamination.

State-funded research was essential in showing that atrazine contamination did not follow simplistic notions of groundwater contamination susceptibility. One of the most important findings was that the Central Sands and the Lower Wisconsin River Valley (LWRV), two areas that appear similar in soils and agricultural practices, had significantly different susceptibility to contamination. These differences were pointed out in several research projects conducted by the UW Soil Science Department (Daniel, 1991; Lowery, 1991; McSweeney, 1991;

Lowery, 1992-3). This information had a direct influence on the atrazine rule in that there is now a use prohibition in the LWRV and managed use in the Central Sands.

Another key finding related to the susceptibility of groundwater to atrazine contamination was that many of the areas with high frequency of detections had medium textured (loamy) soils. It had previously been thought that these areas were less susceptible to leaching and groundwater contamination than areas with sandy soils. State-funded research and monitoring efforts, however, showed that the intensity of atrazine use, in addition to soil and geologic conditions, played an important role in the contamination. This finding helped to explain why many areas in south central Wisconsin, with medium textured soil and high corn production, had many wells contaminated with atrazine. This knowledge allowed DATCP to adopt management strategies for reducing atrazine contamination in these areas.

When atrazine was first discovered in Wisconsin's groundwater in the mid 1980s, DATCP was interested in managing its use based on predictive modeling of contamination processes. Modeling activities funded by the state research program, however, indicated that the behavior of atrazine and other contaminants in the environment was complex and could not be reliably predicted by modeling. In response to this finding, DATCP adopted a more empirical approach to identifying management areas. Actual well results were plotted on maps and, together with an analysis of soils and geology, management areas were delineated.

When monitoring and rule making efforts for atrazine first started, parent atrazine was the only compound that was considered. As more research was conducted, however, it was discovered that three metabolites (breakdown products) of atrazine were present in groundwater and were of health concern (Chesters, 1990-91; LeMasters, 1990; Cowell, 1990; Cates, 1991). State-funded sampling programs showed that due to the presence of atrazine metabolites, the groundwater problems were more serious than previously considered. This knowledge allowed DNR to strengthen the groundwater standard for atrazine in 1992 and allowed DATCP to strengthen the atrazine rule in 1993 and extend required use reductions to the entire state.

It is interesting to try to envision how DATCP's atrazine rule would look if it did not have the benefit of the intensive research and monitoring efforts. It is safe to say that it would not have been developed on as good an understanding of the behavior of atrazine in the environment or the geographic patterns of contamination. It is possible that without the intensive monitoring efforts, the full extent of the problem would not have been discovered and atrazine use would not have been reduced. On the other hand, it is possible that with inadequate knowledge a "broad brush" approach would have been taken. This could have resulted in unfair regulations that were not tailored to the different geographic areas of the state.

Two important aspects of environmental regulation that promote its acceptance are that it is based on science and that it is fair. Good research is necessary to achieve these two characteristics. The Atrazine Rule has experienced a relatively high degree of acceptance due to the effort that was put into its development.

Groundwater Monitoring at Solid Waste Disposal Sites - The BSHWM received project funding eight times from 1985 to 1995 through the joint solicitation process. These projects have benefited the DNR's Solid Waste Management program in many ways, primarily, impacting regulations and monitoring practices.

The first two studies (Friedman, 1985-87; Battista, 1988-89) revealed for the first time that groundwater around many Wisconsin landfills was contaminated by VOCs. The studies also showed that VOC contamination of groundwater was more common at unengineered municipal solid waste landfills than at other types of landfills. A follow-up VOC study (Connelly 1993-94) showed that VOC levels have decreased at most of the unengineered landfills, though at many of the sites VOC levels do not show continued decline. There was no VOC contamination definitely attributable to leachate migration at any of the older, engineered landfills which confirmed that these sites are performing as BSHWM staff had hoped. The results of the three VOC studies have been used to establish requirements for VOC sampling at new and existing landfills. These studies have also indicated that inorganic compounds could be useful in predicting VOC contamination at landfills.

Therefore, until recent EPA rules required VOC monitoring, the BSHWM allowed sites to sample for inorganic parameters as part of routine monitoring and not sample VOCs until inorganics were elevated. The VOC studies provided valuable data which was used to convince EPA to reduce the number of VOCs required for monitoring at municipal solid waste landfills in Wisconsin. This reduction in monitoring (the use of inorganics and the reduced number of VOCs when they are required) allowed landfill owners considerable savings while providing equivalent environmental protection. Additionally, the VOC data was used to require responsible parties to define the degree and extent of contamination and remediate groundwater contamination at their landfills.

Research on methods of assessing groundwater quality data and data quality control completed in the third VOC study has been helpful to BSHWM staff and consultants in interpreting groundwater quality data from landfills and other facilities. This study also showed the need to require laboratories to report data between the limit of detection and the limit of quantitation.

An assessment of Wisconsin's Groundwater Monitoring Plan program (Pugh, 1992) for active non-approved landfills provided the documentation of a set procedure for selecting monitoring sites. This information has been useful in recent meetings with municipalities held to convince municipalities that they have not been singled out for further evaluation of groundwater contamination and to demonstrate that the process used for selecting landfills for monitoring is objective.

Three studies from 1991 to 1994 on the potential groundwater impacts at deer pits, yard waste sites, and construction and demolition landfills (Pugh, 1992-3; Pugh, 1994) were conducted because little or no data existed on the potential impact to groundwater from these sites. Research has provided the information necessary to establish policy regarding monitoring and siting of demolition landfills, deer pits, and yard waste sites in Wisconsin. The groundwater study of deer pits showed that impacts were minimal and helped the BSHWM to decide not to require liners and to loosen some construction and reporting requirements. Similarly, the yard waste site study showed only minor groundwater impacts which led the BSHWM to encourage active management of these sites rather than stiffen regulations. The study of construction and demolition landfills showed some groundwater impacts at large sites but little or no impacts at smaller sites. These findings led to new proposed regulations allowing an intermediate size demolition landfill which would have the economic benefits of a large site without the potential negative impacts of very large sites. Since these studies have been conducted, many states and the EPA have contacted the BSHWM about the information collected.

A recent DNR-funded study undertaken by the BSHWM (Connelly, 1994) was a comparison of groundwater sampling methods for collecting metals samples at monitoring wells. The study was in response to EPA's October 1991 ban on field filtering of groundwater samples which became effective in October 1994. The BSHWM opposed this ban because many Wisconsin monitoring wells produce very turbid water which can lead to false positive results for metals if samples are not filtered. Additionally, the new EPA-recommended procedure, low-flow pumping, requires a significant amount of additional equipment. The study showed that the low-flow pumping method was appropriate in many circumstances but could not be used to sample slowly recovering wells. The results showed that turbidity was the best indicator that a well has been sufficiently purged. The results of the investigation are being used to revise groundwater sampling procedures required by the BSHWM. Additionally, the study helped establish Wisconsin as one of two leading states playing a major role in advising EPA on revisions to their groundwater sampling requirements at municipal solid waste landfills. A similar study comparing VOC sampling methods is in progress.

Monitoring for Naturally Occurring Compounds - Wisconsin is also a leader in groundwater monitoring for naturally occurring compounds. Two projects in the DNR Lake Michigan District (Stoll, 1992; 1994) identified the existence of lead and arsenic contamination in groundwater. Homeowners were alerted through direct mailings, public meetings and mass media news releases. Over 72,000 people were unaware of their exposure to the substances in their drinking water. The sources of metals in these drinking water supplies were either given priority for removal (Door County Lead Arsenate Mixing Sites) or well construction criteria were defined

to avoid arsenic associated with the St. Peters Sandstone. The DNR coordinated with the DHSS to conduct health surveys on individuals consuming locally contaminated water supplies and made appropriate health recommendations. Research is continuing in this area.

Groundwater Movement in Fractured Dolomite - Door County has been the site of three research projects by the WGNHS to develop a framework for studying the complex groundwater flow regime in fractured rock found in many parts of the state. The first project (Bradbury, 1986-90) started as a non-point source watershed project investigating the hydrogeology and groundwater geochemistry in the shallow fractured dolomite aquifer in Door County. Groundwater quality was found to vary widely over time with bacteriological contamination common. The second study (Bradbury, 1992) showed that modeling results obtained from a discrete fracture model varied considerably from results produced by a continuum model for groundwater movement. The discrete fracture model estimated capture zones, groundwater flow paths and groundwater travel times by using mathematical representations of fractures digitized from aerial photos. The third study (Bradbury, 1993-94) used a tracer for characterization of groundwater movement and contaminant transport. It revealed that hydraulic conductivity can vary widely in the same well depending on what depth interval is tested.

A fourth study applied the discrete fracture flow model above to wellhead protection at the City of Sturgeon Bay. The project, carried out by the WGNHS, was funded jointly by the City and by DNR Management Practice Monitoring monies. Municipal wells at Sturgeon Bay draw groundwater from a series of horizontal fracture planes in Door County's dolomite aquifer, and delineating wellhead protection areas in such environments is extremely challenging. This complex project has required hydrogeologic information and analytical tools developed through the three Door County groundwater research projects above which targeted processes and models for groundwater movement in fractured rocks. Without the knowledge and experience gained through these previous projects the Sturgeon Bay wellhead protection project could not have been accomplished.

Developing New Tools for Groundwater Protection - Applications of a wide variety of tools for gathering and working with hydrogeologic and groundwater quality data have been funded. Projects involving one of the most promising tools in environmental management, Geographic Information Systems (GIS) have been funded in the Lake Michigan District and in Dane County. The funding agencies hope to continue to develop improved methodologies to make groundwater quality and contaminant source data more readily available.

An environmental inventory utilizing GIS was created in the DNR's Lake Michigan District (Carlson, 1992-93; Stoll, 1994). Computerized maps were created which link all potential groundwater impact site locations with their respective data. This project has resulted in numerous map products showing potential groundwater contamination source/receptor relationships in a rapidly retrievable, highly summarized fashion. Many consultants, county agencies, state agencies and realtors have utilized this information for environmental management and land transactions. The chief benefits to the public have been the rapidly accessible information and greater purchasing confidence when buying property. Landowners also experience increased responsibility for the land they reside on as they become aware of how readily available this information is. In this way, use of GIS has heightened awareness of the importance of wise land use.

Previous support of county-wide groundwater inventory studies and of modeling methodologies has given WGNHS and USGS personnel the hydrogeologic databases and analytical tools needed for the construction of regional groundwater models such as the recently-completed Dane County groundwater model. This computer model, which covers all of Dane County, simulates current and future groundwater conditions and is being used to evaluate how current and future groundwater pumping affects regional water levels and also how groundwater use affects shallow lakes, streams, and wetlands. In addition, this model has been used to delineate groundwater capture zones for all municipal well in Dane County. Such models are critical tools in the planning process, and allow water managers to evaluate the impacts of various future water management and land use alternatives in order to make well-informed land-use decisions.

Prevention and Remediation of Groundwater Contamination - Thirteen research projects emphasizing new technologies for prevention or remediation of groundwater contamination have been supported by the State of Wisconsin through the UWS Water Resources Center. Several of these projects have been completed. Final technical reports are published or in press. The reports provide information or products which will be important for future efforts aimed at controlling or attenuating groundwater contamination in Wisconsin. The findings cover a wide range of technologies including:

- New and enhanced physicochemical or biological methods to renovate waters contaminated by pesticides and volatile organic carbon compounds (Hickey, 1996) (Bahr, 1996) (Anderson, 1994-95) (Chesters and Harkin, 1991) (Harris and Hickey, 1991-92);
- Enhancements in the ability to control, monitor, and predict the movement of landfill contaminants to groundwater (Edil and Park, 1992-93) (Benson, 1995-96);
- Improvements in the predictability of pump-and-treat remediation applications to contaminated aquifers (Bahr, 1994-95);
- Innovative agricultural practices designed to reduce groundwater contamination by pesticides and nitrate (Bundy, 1993-94) (Bahr, 1991-92) (Harrison, 1992-93) (Newenhouse, 1995); and
- Evaluation of a new ultrasonic probe device to analyze the integrity of water supply well seals (Edil, 1996).

Effects of Groundwater Contamination on Real Estate Values - G. William Page and Harvey Rabinowitz of the University of Wisconsin-Milwaukee School of Architecture and Urban Planning studied the effects of groundwater contamination on commercial and residential property values. Their report affirms that real estate value exists in the perception of prospective buyers and sellers and that groundwater contamination adversely affects the value of real estate. The value of such real estate is reduced to its "value in use" rather than its market value. Thus, it is frequently impossible to sell such real estate or even to use it as collateral for a loan because, in the case of a default, the lending institution would not be interested in taking the property through foreclosure for fear of liability. They find that the fear of groundwater contamination is so pervasive that even local governments are beginning to shy away from taking selected buildings *in lieu* of taxes owed. For example, the City and County of Milwaukee holds off for approximately 3 years, while charging interest, before initiating proceedings to take a property *in lieu* of those taxes. The City's recent experiences with several groundwater contaminated properties in which the clean-up costs exceeded the normal market value of the property by a factor of 10 to 20 has required a policy change. Many of these kinds of properties are now left abandoned across the United States and municipalities are reluctant to fence in or manage the properties because they may lead to liability as has been determined in several court cases in different states. Thus their "use value" is characterized by negative impacts on property tax bases which often extends to the neighborhoods where the contaminated properties are located. The report covers Federal and State and Local Government Regulations of contaminated properties and regulation by the marketplace which includes owners, lessees, financial institutions, secondary mortgage companies, appraisers, insurance companies (title, property, and liability), law firms, and real estate brokers.

Biological Effects of Groundwater Contaminants - At the urging of the GRAC, the UW-Water Resources Center has solicited research projects during the last 3 years that deal with biological aspects of groundwater contamination. Two of the 4 biological projects which have been selected for funding deal with cooperative biological effects among chemical contaminants. This is a subject of widespread current interest because synergistic interactions among chemical contaminants can often greatly enhance or diminish the toxicity of individual components of a mixture. Warren Porter of the UW-Madison Department of Zoology has completed an evaluation of interactions between endocrine disruptors (PCBs, phthalates, etc.) and a common groundwater contaminant (nitrate). Gordon Chesters and Harry Read of the UW-Madison Water Resources Center are in the second year of a project that focuses on biological interactions between different herbicides and the modulation of these interactions by common agricultural chemicals (e.g., nitrate). There is a great deal of current interest in these types of interactions because environmental toxicologists have heretofore focused

exclusively on evaluations of the biological effects of individual chemicals which does not effectively encompass the environment of these compounds in the real world.

Two new biological projects selected for funding during the FY 97 Solicitation will likely continue to provide new and exciting biological insights and practical applications for dealing with groundwater contaminants. Mary Lynne Perille Collins of the UW-Milwaukee Department of Biological Sciences will initiate a 2 year project aimed at providing a biological probe for methanotrophic bacteria. Methanotrophs are among the most promising of microbial mono-oxygenase bacteria with a capacity to facilitate remediation of groundwater contaminated with a variety of pervasive organic chemicals. The goal of the project is to design and produce molecular probes for methanotrophs by taking advantage of DNA sequence information that has recently become available. These probes can be used to rapidly and efficiently monitor specific methanotrophic growth and metabolic phenomena at treated sites and to relate these activities to diverse in situ environmental conditions that are likely to affect the success or failure of the remediation effort. George Blondin of the UW-Madison Water Resources Center will initiate a 1 year project aimed at providing a statistical model for assembling the most efficient suite of biological test regimes to monitor the biological activity of a complex water sample containing any number and kinds of suspected contaminants. The project addresses the proliferation of new, rapid, and cost effective microbiotests that have evolved as commercially available toxicity monitoring products over the past several years. Since all microbiotests have inherent biases in terms of their biological response to different classes of contaminants, test suites of a few different microbiotests are usually employed to provide the needed biological diversity to affectively accommodate a given array of suspected contaminants. Unfortunately, test suite components are usually assembled on the basis of intuition or familiarity. This project's goal is to provide a PC based statistical model that will enable the strict assembly of the most efficient test suite.

Evaluating nonpoint source pollution reduction strategies - Nonpoint pollution is the primary source of groundwater contaminants in Wisconsin. Several water quality projects have been undertaken to reduce groundwater nonpoint source pollution, but outcomes have been difficult to establish (Kraft, 1996). The CWGC has concluded monitoring and modeling studies in the Central Sands region which indicate current strategies may not be substantially improving groundwater quality. In the Port Edwards Groundwater Priority Watershed, nitrate loading was still large under agricultural Best Management Practices, in excess of 100 lb/acre as nitrate-N. Five pesticides were detected beneath BMP fields, sometimes in excess of the enforcement standard. For the area around Stevens point, Whiting, and Plover, agriculture contributes 90% of nitrate to groundwater. Even if 100% of farmers adopt BMPs, nitrate-N concentrations will continue to increase there. New and better strategies are needed to control groundwater pollution.

GROUNDWATER DATA MANAGEMENT

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

The collection and coordination of groundwater data exchange within the DNR and with outside agencies continues to be an important issue. The DNR places priority on coordinating the collection and retrieval of all groundwater data to meet inter-agency responsibilities and cooperative agreements.

The DNR groundwater data retrieval system, the Groundwater Retrieval Network (GRN), was completed in October 1993. The GRN currently has access to information on over 154,000 wells. These represent public and private water supply wells, piezometers, monitoring wells and non-potable wells. Enhancements to the system, suggested by District and Central office staff, are implemented annually, to improve system functionality and ease of use. The current GRN system has links to the Waste Management Groundwater and Environmental Monitoring System (GEMS), Public and Private Water Supply and Water Resources program data systems for retrieval. The Wastewater program data systems will be made accessible to the retrieval network when the redesign of this program system is completed; the redesign has not been scheduled.

A statewide GIS coverage of well locations is created through a maintenance link to . Through a new option recently added to the GRN download menu, users can extract well locations and other related information in ARCVIEW 2 format (a desktop GIS viewing software package produced by the makers of ARC/INFO). A customized ARCVIEW 2 application has also been developed that automatically loads the data selected through GRN, and creates a customized well GIS "layer" for viewing and querying purposes on the desktop personal computer. Data can also be provided in other GIS formats upon request through the use of ARC/INFO.

To provide access to the system for other state agencies, computer hardware and software was provided to DATCP, DILHR, and DHSS, WGNHS and the CWGC. Documentation and training was recently provided for using the new GRN system. The sharing and exchange of information between agencies dealing with groundwater is enhanced by the GRN system.

DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION

DATCP needs up-to-date, reliable data on pesticide contamination of groundwater. These data are used to develop substance specific rules on pesticide use, such as DATCP's "Atrazine Rule" (Chapter ATCP 30, Wis. Adm. Code), to respond to citizen requests on groundwater quality data for specific locations, and to initiate timely investigations of pesticide contamination of groundwater. DATCP ensures the quality of its database by carefully checking and cross-referencing manual (e.g., paper lab slips) and computerized data received from DNR and other sources. DATCP feels that this additional scrutiny is necessary because the data are used for regulatory purposes.

The DATCP groundwater database currently contains information for over 18,000 wells and over 51,000 pesticide and nitrate results. These data represent samples analyzed by DATCP, the SLOH, and other public and private laboratories. The groundwater database currently operates in a multiuser environment under Paradox 4.0. All members of the groundwater unit access the database via Pathworks operating on the DATCP's VAX computer. The application will be converted to Microsoft ACCESS in fiscal year 1997. Links between the groundwater sample database and DATCP's compliance tracking system are also being developed. This will allow staff to view results for specific compliance cases.

DATCP uses GIS tools to analyze groundwater data and prepare maps for public hearings and other uses. For example, an ARC/INFO data layer containing well locations and associated database information is being used to generate maps of atrazine and other pesticide detections statewide for the Atrazine Rule. Other GIS analyses

involve identifying groundwater wells that may be impacted by point sources of pesticide and nitrate contamination.

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

The University of Wisconsin-Extension Geological and Natural History Survey has responsibility for geologic mapping, collection and analysis of basic data, and survey and research on Wisconsin's groundwater resources. Products from the Survey geologic mapping program support land-use planning and groundwater quality management and protection. County-wide inventories of groundwater resources are supported through cooperative agreements with county governments. Through analysis and integration of data from subsurface records and water quality sampling programs, these studies develop water table elevation maps and other products, providing planners and educators with a good foundation of information for groundwater quality management and protection. Detailed research and monitoring of groundwater movement and quality are undertaken on a project basis. Maps, publications, and presentations are developed for groundwater education and outreach.

Computerized groundwater databases have generally been developed on a project basis to support on-going research and inventory efforts. Many of these data have been incorporated into the ARC/INFO geographic information system. The Survey is continuing initiatives to better integrate, standardize and document their data holdings, which are currently on a variety of personal computers, media and software systems. This effort will improve access and use of our existing and future groundwater and geologic data.

DEPARTMENT OF INDUSTRY, LABOR AND HUMAN RELATIONS/COMMERCE

DILHR has embarked on an information technology initiative, the purpose of which is data integration. With regard to groundwater protection, DILHR will, at the completion of this project, be able to identify sites that have underground petroleum storage tanks and private sewage systems. Sanitary permits, groundwater monitoring data, and underground storage tank information will be located in combined databases, the result will be groundwater quality data and information on activities that may affect groundwater quality.

DEPARTMENT OF HEALTH AND SOCIAL SERVICES/HEALTH AND FAMILY SERVICES

DHSS does not maintain a centralized database on groundwater data. The Department relies on other state agencies for computerized groundwater information. DHSS maintains lab slip samples data in project specific files.

UNIVERSITY OF WISCONSIN SYSTEM

The CWGC maintains a database of private well testing data from the Environmental Task Force Regional Laboratory at UW-Stevens Point, and Drinking Water Education Programs conducted through the Center. There are currently over 193,000 individual test results for approximately 31,700 samples covering the state. Chemistry data includes pH, conductivity, alkalinity, total hardness, nitrate-nitrite, chloride, saturation index, and coliform bacteria. The database primarily covers the period 1985 to the present. The database is PC-based and can be easily queried to be a significant source of information for local communities and groundwater managers. Thirty-three counties are represented by 100 or more samples in the databases, and 14 counties are represented by 500 or more samples.

DEPARTMENT OF TRANSPORTATION

The DOT maintains records of hazardous material (hazmat) investigations associated with highway projects. Records of hazardous materials encountered during these investigations, including any groundwater contamination, are on file in the Bureau of Environment.

Groundwater monitoring is conducted in association with several DOT wetland mitigation projects. The records of this monitoring effort contain information on groundwater elevation, and horizontal and vertical groundwater gradients as it relates to a wetland restoration or creation project.

The DOT is currently evaluating databases to incorporate information from wetland delineations, hazmat sites and groundwater monitoring sites into a GIS. GIS mapping is used for transportation planning, design, construction, and maintenance.

COORDINATION ACTIVITIES

GROUNDWATER COORDINATING COUNCIL

The Groundwater Law, 1983 Wisconsin Act 410, established the GCC to advise and assist state agencies in coordinating nonregulatory programs and exchanging groundwater information. The GCC consists of the heads of all state agencies with some responsibility for groundwater management plus a Governor's representative. The agency heads have appointed high-level administrators who have groundwater responsibilities to sit on the Council. The state agencies include the DNR, COMM (formerly part of DILHR), DHFS, DATCP, DOT, WGNHS, and the UWS. Additionally the DNR has one permanent position with half of its responsibilities related to coordination of the GCC. The GCC had four meetings during the past year and met once via teleconference. The meeting minutes are included in the Appendix.

The focus of the GCC's activities during the past year changed as past goals were attained and future goals were refined. Accomplishments came as a response to new opportunities for groundwater management.

- * The GCC and the UWS GRAC continued coordination of the annual solicitation for groundwater research and monitoring proposals among state agencies. Twenty-nine projects were funded in FY 96 by one or more of the following agencies: UWS, DATCP, DNR and DILHR. The projects funded are listed in Table 1. The GCC approved the 1997 fiscal year joint solicitation package for groundwater research and monitoring to meet state needs described in a previous section. The package was sent out in November 1995 and is contained in the Appendix. A total of 35 project proposals were received. A comprehensive review process ensued that resulted in the selection of 18 new projects for funding for FY 97. The 18 new projects selected by the UWS, DNR, DILHR, and/or DATCP for funding in FY 97 are in addition to 9 projects which carried over from FY 96. On April 22, 1996 the GCC met by teleconference and unanimously approved the proposed UWS groundwater research plan as required by s. 160.50(1m), Wis. Stats. The UWS will fund 2 continuing and 10 new projects in fiscal year 1997. The FY 97 groundwater monitoring and research projects are listed by funding agency in Table 2.
- * Region V of U.S. EPA concurred with Wisconsin's Generic SMP for the Protection of Groundwater from Pesticides on June 5th, 1996. Region V has determined that the SMP is consistent with EPA's "Pesticides and Ground-Water Strategy" and concurs that it contains sufficient scope and detail to satisfy the adequacy criteria for Generic State Management Plans contained in EPA's "Guidance for Pesticides and Ground Water State Management Plans". The Wisconsin Generic SMP is the first to receive Region V concurrence.
- * The GCC coordinated efforts to distribute the findings of groundwater monitoring and research funded through the joint solicitation process. Over the last 2 years DNR and UW-WRC staff and principal investigators wrote summaries of 72 final reports thus eliminating the backlog of final reports for which summaries had not been prepared. These summaries were published together in "Wisconsin Groundwater Research and Monitoring Project Summaries" in September 1995. See the Appendix for a list of titles of the published summaries. Copies of all final reports and summaries are being distributed by the WRC. The WRC also made progress making the summaries accessible by computer through the National Library System and WisInfo online services.
- * The GCC completed a detailed documentation of the reasons for its creation, its charge, makeup, activities, meeting records, meeting attendance, and other information for the Office of the Lieutenant Governor in a response to a survey designed to evaluate advisory councils. 1995 Wisconsin Act 27 required the Office of the Lieutenant Governor to evaluate designated councils, offices, boards, and commissions, and recommend continuation, termination or transfer of their functions to another state

body. The GCC is one of 144 organizations being evaluated. The GCC's response consisted of over 30 pages of detailed information. A decision is expected in late 1996.

- * The GCC sent a letter to the Wisconsin Land Information Board (WLIB), requesting that the WLIB encourage potential grantees to include geologic and hydrogeologic data needs in their grant proposals. The letter also asked the WLIB to consider making funds available for state agency groundwater initiatives with demonstrable benefit to local units of government. The letter came as a result of work done this past year by the Planning and Mapping Subcommittee (see the Planning and Mapping Subcommittee Activity Summary in the following section). The subcommittee began to identify additional statewide geologic and hydrogeologic data that are needed to better manage the Wisconsin's groundwater as well as potential sources of funding for collection and development of these data.

- * The GCC continued to promote communication, coordination, and cooperation between the state agencies through its quarterly meetings. The GCC received briefings on:
 - Subcommittee activities (see below)
 - Groundwater Quantity
 - Comprehensive State Groundwater Protection Plan
 - ILHR 83
 - DNR Reorganization
 - Pesticide State Management Plan
 - Research/Monitoring Project Summaries and Final Reports
 - The Use of Peat as an Absorptive Medium for Remediation of Pesticide Contaminated Groundwater
 - Washington Island Septic System Research
 - Joint Solicitation Survey Results
 - FY 1997 Joint Solicitation Package
 - Nitrate Information Document
 - Baltic State Wellhead Protection
 - Hydrogeologic Properties of Wisconsin Glacial Deposits
 - Status of Lieutenant Governor's evaluation of the GCC
 - Evaluation of Proposed Crandon Mine
 - Geologic Constraints on Arsenic in Groundwater in Carbonate Aquifers
 - Potential for increased lands in agriculture production
 - Alachlor metabolite (ESA) groundwater standard setting process
 - Private Well Water Quality Reports
 - Revisions to DNR Groundwater Sampling Guidance
 - Brownfields initiative

- * Work progressed on a report on groundwater quantity. The GCC directed the DNR to summarize available information on groundwater quantity and provide options for managing problems (see also "Condition of the Resource: Groundwater Quantity"). The report is near completion. One groundwater quantity-related monitoring project is being funded as a result of a groundwater quantity research priority added by the DNR to the 1996 joint solicitation package.

- * The GCC has continued to work with representatives of federal agencies to promote communication and coordination of federal and state groundwater activities. Representatives from the NRCS, ASCS, and the USGS attend GCC meetings and serve as *ex officio* subcommittee members. The Appendix contains a summary of USGS groundwater activities.

SUBCOMMITTEE ACTIVITY SUMMARIES

Research Subcommittee - The Research Subcommittee reviewed the priorities for the DNR's groundwater management practice monitoring program for FY 96. The revised priorities were included in the joint solicitation distributed by the UWS, DNR, DILHR, and DATCP in November, 1995.

The subcommittee met with the Monitoring and Data Management Subcommittee in early March to review the 35 proposals which had been received as a result of the joint solicitation. Subcommittee members made recommendations which were used by the three agencies and the UWS in deciding which groundwater-related proposals to fund for fiscal year 1997. The projects to be funded in FY 97 are listed in Table 2.

The subcommittee continued to address the accountability of the groundwater research and monitoring programs coordinated through the joint solicitation process by overseeing the preparation of a collection of summaries of projects. This document, "Wisconsin Groundwater Research and Monitoring Project Summaries" (WDNR Pub No. WR-423-95, 9/95) consists of summaries of 72 groundwater research/monitoring projects grouped by topic. See the Appendix for a list of titles of the published summaries. This publication puts a wealth of groundwater information within easy reach of scientists, policymakers, and the public.

Monitoring & Data Management Subcommittee (MDMS) - The MDMS and the Education Subcommittee have worked on the following efforts:

- Created a draft Wisconsin Unique Well Number (WUWN) labeling brochure. The brochure is general in nature and targets state, county, and local agency staff and various private industry staff to promote use of the WUWN.
- Completed several education efforts for Drinking Water Week. Activities included press releases, public radio discussions, school notifications and assistance, and displays.
- Promoting accurate WUWN assignment and well inventory data collection for all groundwater samples analyzed at state laboratories or funded or managed by state agencies. This effort includes identifying groups and exploring ways to reach professionals involved in the assignment process.
- GRN training for all interested agency staff.

The MDMS is exploring procedures to improve data transfer and reporting.

Planning and Mapping Subcommittee - The Planning and Mapping Subcommittee met twice during FY 96. The primary focus of the subcommittee continues to be the review and evaluation of groundwater mapping and analysis tools and practices. This past year the subcommittee began to focus on the importance of data standardization and integration. The group addressed the usefulness of existing databases and began to identify additional data that are needed to better manage Wisconsin's groundwater resource.

The subcommittee focused on identifying the types of geologic and hydrogeologic data that need to be collected and developed for statewide planning and mapping activities. Accurate geologic and groundwater information is necessary for a number of federal, state, and local applications, such as wellhead protection, groundwater remediation, private and public drinking supply planning, land use planning and routing, and construction of transportation and utility networks. Statewide data that would facilitate these activities include, but are not limited to aquifer depth, aquifer thickness, aquifer extents, aquifer properties, contaminant source locations, depth to water table, soils and potential point sources of contamination.

In addition to identifying needed data, the subcommittee began identifying potential sources of funding for collection and development of these data. Currently, geologic and hydrogeologic data are developed on a piecemeal basis through special projects, research projects, and county-based projects. The subcommittee began focusing on funding that could be used to produce statewide data layers. The subcommittee drafted a letter from the GCC to the Wisconsin Land Information Board (WLIB), requesting that the WLIB encourage potential grantees to include geologic and hydrogeologic data needs in their grant proposals. The letter also

asked the WLIB to consider making funds available for state agency groundwater initiatives with demonstrable benefit to local units of government.

The subcommittee will continue to identify data needs and potential funding sources in FY 96. Subcommittee members continue to promote the importance of groundwater planning and mapping activities within their agencies and to other interested groups through informal and formal presentations.

Education Subcommittee - The Education Subcommittee met four times during the past year. The subcommittee continued its focus on identifying education needs and coordinating production of consistent educational messages. In addition, the subcommittee better defined its own goals and operating procedures, and worked toward better coordinated groundwater education efforts at selected statewide events.

The subcommittee examined the language used in reporting coliform bacteria results to private well owners and communicated with the committee examining new language choices. The subcommittee also reviewed the need for revision or development of documents on iron, copper, arsenic, and infant health concerns.

The subcommittee produced a document better defining its own role in groundwater education. Four areas identified were information sharing, joint education efforts, conflict resolution, and groundwater education strategies development. They also developed guidelines for review and assistance with educational materials which might be presented to them for endorsement. Finally, the subcommittee developed a document on "Groundwater Education Goals and Principles" which was endorsed by the Council (see Appendix).

The subcommittee successfully enlisted the help of the UW-Extension News Service in producing press releases highlighting results of research performed through the Joint Solicitation. A release on results of atrazine use research appeared in several major Wisconsin agricultural newspapers. Future press releases are planned to increase awareness of groundwater research efforts and their usefulness to the public.

The subcommittee initiated efforts to examine agency participation in statewide educational efforts and the opportunities for coordinated messages. DNR, DPI, and UW - Extension coordinated and assisted each other with some National Drinking Water Week activities in May. In addition, the subcommittee agreed to examine opportunities for coordination at the annual Wisconsin Farm Progress Days.

Local Government Subcommittee - The Local Government Subcommittee was formed in 1993 to represent local units of government and organizations representing local units of government. In FY 95 the Local Government Subcommittee began discussing how to overcome the barriers which presently hinder implementation of wellhead protection programs at the county-wide level rather than focusing solely on community level projects. The subcommittee is presently focusing on innovative solutions to providing county-wide wellhead protection. The subcommittee will continue to discuss issues of concern to local units of government and develop recommendations to be presented to the GCC for future action. The subcommittee members' interests sometimes differs from the subcommittee's mission in that members are often concerned with regulatory issues that affect their communities while the GCC is a non-regulatory body that is limited to making recommendations to the appropriate regulatory agencies regarding groundwater issues. The subcommittee will continue to communicate interests of local governments to the GCC regardless of their regulatory status.

DIRECTIONS FOR FUTURE GROUNDWATER PROTECTION

PRIORITY ISSUES THAT NEED TO BE ADDRESSED

- * **Promote consistency between the agencies on data management issues:** Through publication of the Directory of Groundwater Databases and redesign of the DNR's groundwater computer system, state and local government agencies now have more convenient access to groundwater data. Consistency has been promoted by use of translatable geolocational coordinate systems and consistent data elements for use in a GIS environment. The next step is to evaluate possible common data elements to facilitate data sharing between agencies. The GCC will continue to provide leadership and communication through its Monitoring and Data Management and Planning and Mapping Subcommittees. This continued effort displays the GCC's commitment to management of the resource through sound scientific methods.
- * **Research on land use management and its impact on the groundwater resource:** Additional research is needed on the effect of various land uses (e.g. urbanization) on groundwater quality and quantity. This issue crosses agency lines and promises to be an important issue for years to come.
- * **To act as a coordinating and facilitating mechanism for the publication and distribution of information and educational materials on groundwater related issues:** The public has benefitted from the consistent educational messages which have been endorsed by the Education Subcommittee. The Education Subcommittee will continue to provide its leadership and assistance to state agencies providing educational materials to the public.
- * **Distribution of findings from groundwater research or monitoring projects:** There has been considerable progress in preparing summaries of the results of groundwater-related monitoring and research projects funded through the joint solicitation process. In FY 96 the DNR and UW WRC published a document of these summaries. It is important that these summaries and the final reports are distributed widely. The Education Subcommittee has taken the summaries to the UW-Extension for preparation of farm-related articles on groundwater research/monitoring results. More work needs to be done to target interested audiences and distribute summaries and final reports more widely.
- * **Identify tools that can be used to better predict Wisconsin's groundwater susceptibility to contamination:** In FY 95, the Planning and Mapping Subcommittee reviewed and evaluated groundwater vulnerability mapping and analysis practices. The subcommittee found that the assessment systems were not good predictors of groundwater susceptibility but that mapping aquifers and thin layers of low-permeability materials such as clay and shale may be valuable for evaluating groundwater susceptibility. The studies demonstrated the need for developing statewide data layers that would facilitate better groundwater vulnerability assessments. These data layers include land use, soils, regional groundwater flow, hydrogeologic characteristics such as aquifer materials, and potential point sources of contamination such as underground storage tanks and pesticide spills. The studies also illustrate the importance of locational data for contaminant sources. In FY 96, the Planning and Mapping Subcommittee began to prioritize, promote, and help facilitate the development of data layers. The task is large and overlaps with the Monitoring and Data Management Subcommittees data integration work. This work should continue and may result in adding improved predictive capabilities as new research/monitoring priorities for the next joint solicitation.
- * **Continued evaluation of alternatives to on-site septic systems:** Although the DNR and DILHR have recently funded monitoring projects in this area, additional work is needed to find state-of-the-art solutions to the problem.

- * **Investigation of the causes and effects of nitrate in groundwater:** The GCC will support the agencies and the UWS in obtaining information pertinent to the health implications of consuming nitrate contaminated groundwater. In addition, it will continue to facilitate consistent education to provide a clear message on the many causes and effects of nitrate in groundwater for urban and rural citizens.
- * **Investigation of groundwater nonpoint pollution:** A survey by DATCP revealed that 10% of Wisconsin's wells exceed the nitrate standard and at least 12% contain one or more pesticides. These rates are substantially higher in agricultural areas. Agriculture is the major source of these pollutants. More work is needed to determine how far Wisconsin groundwater will deteriorate without a substantial change in farming practices, and what practices will sustain both agriculture and groundwater quality.
- * **Improved communication between local and state government:** The Local Government Subcommittee to the GCC was created in February 1993 to provide a line of communication between local and state governmental entities. In recent years there has been a lack of interest among the Local Government Subcommittee members in utilizing this line of communication. The members are often concerned with regulatory issues that affect their communities while the GCC is a non-regulatory body limited to making recommendations to the appropriate regulatory agencies regarding groundwater issues. To increase the responsiveness of state agencies to local government needs, local government needs must be communicated to the GCC and relayed to the appropriate agencies. An effort must be made by the GCC to increase interest in the GCC by local governments, and to offer opportunities to communicate concerns to regulatory agencies.
- * **Investigation of adverse impacts from groundwater withdrawals:** In FY 96, DNR staff with help from the Groundwater Quantity Technical Advisory Committee completed much of a report on the groundwater quantity issue (see "Condition of the Resource - Groundwater Quantity"). In the report, localized areas with groundwater quantity problems are identified and the effects of groundwater withdrawals on surface waters and long-term groundwater availability are discussed. There is a need to further quantify hydrographic relationships of surface and groundwater. The GCC should continue to encourage research efforts that will provide information useful in addressing this issue.

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Wisconsin Groundwater Coordinating Council
Meeting Minutes - August 25, 1995

Members Present: Susan Sylvester (DNR), Ned Zuelsdorff for Nick Neher (DATCP), Jack Metcalf (Governor's Rep.), James Robertson (WGNHS), Henry Anderson (DHSS), Bennette Burks (DILHR), Al Beaver (UWS), Carol Cutshall (DOT).

Others Present: Mike Lemcke, Jill Jonas and Jeff Helmuth (DNR); Ron Hennings (WGNHS); Earl Peace, George Blondin and Jim Wiersma (UWS); Jim Vanden Brook, and Jeff Postle (DATCP); Chuck Warzecha (DHSS); Jim Kaap (NRCS).

The meeting was held in the Room 611B of the GEF 2 building in Madison, beginning at noon.

1. **Introductions** - Introductions were made.
2. **Agenda Review** - No changes were made to the agenda.
3. **Approval of Minutes** - The minutes of the May 12 meeting were approved with the following two changes:
1) Under item 4, after the second sentence the following sentence was added "There was strong consensus that the GCC should be continued from the members." 2) Under item 7, second paragraph, item 3 was changed to "... in Wisconsin in the near future."
4. **Continuation of GCC** - Susan Sylvester summarized what was known about the review of the GCC. As of mid-August, the Office of the Lieutenant Governor was working on a questionnaire to evaluate advisory councils. There would be at least 4 weeks to complete the questionnaire, which will require a response by 10/1/95. The questionnaire will ask about each council's reasons for creation, history, meeting records, meeting attendance, and other specifics. It will allow customized responses and will be an opportunity to make changes of membership and responsibilities. The DOA will be involved in the evaluation and decision process. The Lieutenant Governor wants some public input into the process also. A bill will be required to terminate councils. Jeff Helmuth was asked to prepare the draft document and distribute it to GCC members before submittal to the Lieutenant Governor.
5. **Status Reports**

DNR Reorganization - Susan Sylvester gave a summary of changes planned for the DNR in the Department reorganization. Divisions will be media-based (i.e. Land, Water, Air and Waste). The biggest change will be the creation of an external Bureau of Customer Assistance and External Relations which will coordinate multi-media permitting. Districts will be managed by water basins, landscapes or ecoregions. Approximately 300 positions will be transferred from the central office and district offices to local service centers. Teams have been established to implement the reorganization in each new division. Mike Lemcke is representing groundwater concerns on the Air and Waste Division team. Implementation teams will report by mid-October with their recommendations. The central office and one region will implement the reorganization starting in January 1996. The reorganization should be completed by the end of 1997.

DATCP Atrazine Survey/Pesticide State Management Plan - Jim Vanden Brook gave an update on Phase I of the Atrazine Survey which has been completed. The estimated 95% confidence interval for the true statewide proportions of groundwater exploitable for private water supplies that is contaminated with atrazine and/or one or more of its chlorinated metabolites is 8.0 to 16.4%. The 95% confidence interval for the true statewide average concentration of atrazine and its three chlorinated metabolites in groundwater exploitable for private water supplies containing a detectable concentration of atrazine and/or one or

more of its chlorinated metabolites is 0.98 to 1.36 µg/l. These estimates will be compared with estimates of the same population parameters to be conducted in 1996.

Jim also gave an update on the Generic Pesticide State Management Plan (SMP) which the DATCP and DNR have prepared for the U.S. EPA. The EPA has encouraged each state to prepare a generic SMP stating how it will generally manage all chemical pesticides to assure groundwater protection. If the EPA determines that a pesticide presents a significant risk of leaching to groundwater in a state, it will either cancel the registration of that compound or allow the state to prepare a pesticide specific SMP describing how the state will manage the pesticide to protect groundwater. Pesticide specific SMPs will be based on the generic document which the EPA will already understand and will have approved. So far the EPA has tentatively identified alachlor, atrazine, cyanazine, metolachlor, and simazine as requiring pesticide specific SMPs. Wisconsin's Generic SMP was submitted to EPA Region V in May. EPA review was scheduled to be completed by October 15, 1995. The EPA is expected to propose the SMP rule this winter, possibly by February.

ILHR 83 - Bennette Burks gave an update on how the rule-drafting process was proceeding for the private sewage system code. Bennette said DILHR was in the process of responding to the Governors budget which had been influenced by over 6000 letters opposing DILHR's proposed rule. The letters resulted in septic systems being exempted from state groundwater standards. Bennette reported that the Environmental Assessment of the rule would soon be completed. A 30-day public comment period will follow. DILHR will identify an alternative standard based on best available technology and will then decide whether to submit the rule to the legislature or revise. If the rule goes into effect, it will be phased in.

Bennette also mentioned that the Division of Safety and Buildings would be transferred from DILHR to the new Department of Commerce in July, 1996. The Division would consist of three bureaus with the functions of plan review, inspection, and policy development.

Research Subcommittee - Jeff Helmuth reported that the Research Subcommittee had met on May 23rd to address the accountability of the Research/Monitoring programs coordinated through the joint solicitation process. At the meeting, Steve Born suggested several ways to increase the utility of the research and monitoring results. Steve had emphasized that project results must be translated into outcomes. The subcommittee agreed that making the results more widely known would be a good first step towards that goal. A table listing project status, report availability and summary availability will be distributed widely.

The subcommittee made suggestions for: 1) questions to be included in a survey of investigators responding to the joint solicitation in the past several years; and 2) improvements to the joint solicitation process for fiscal year 1997. The subcommittee also reviewed and discussed the draft document containing project summaries. The summaries will be published by the DNR this fall.

Susan Sylvester thanked Jeff from the GCC for putting together the summary document. Summaries will also be available on WISCINFO soon. Al Beaver said the GCC should ask for an inflationary funding increase for research and monitoring for the next biennium. Threats to the funding were discussed with Mike Lemcke noting that the DOA had looked at the funding to see if it could be reduced.

Education Subcommittee - Ron Hennings said that the Education Subcommittee was appreciative of the GCC's permission to be more proactive. The subcommittee is developing a list of goals and specific activities which will be circulated to the GCC for suggestions. At its July 26th meeting the subcommittee also discussed the use of the words "safe" and "unsafe" in drinking water test result reporting. The subcommittee would like water test results to encourage people to think of drinking water quality as more

complicated than "safe" or "unsafe".

Planning and Mapping Subcommittee - Mike Bohn presented a draft letter that Lisa Morrison and he had prepared for Susan Sylvester's signature addressed to the Chair of the Wisconsin Land Information Board (WLIB) requesting that the WLIB: 1) encourage local governments to include geologic and hydrogeologic data needs in their land information plans and grant requests; and 2) consider state agency groundwater initiatives with demonstrable benefits to local governments eligible for WLIB grants. The letter was sent to GCC members prior to the meeting. There was some discussion about the timing of the letter and the specific requests made in it. It was agreed that the final paragraph, containing request 2), above, should be deleted and that the letter, as amended, should be sent.

Monitoring and Data Management - Jill Jonas reported that the Monitoring and Data Management Subcommittee had met on August 24th to address two issues: 1) improving and expanding use of Wisconsin Unique Well Numbers (WUWN) and 2) making corrections and data transfers to Groundwater Retrieval Network data. The subcommittee is currently focusing on identifying areas where WUWN use can be expanded. The subcommittee plans to address the confidentiality of regulatory and nonregulatory well sampling information soon.

6. **Research/Monitoring Project Final Reports and Summaries** - Jeff Helmuth handed out a table summarizing the status of final reports and summaries for projects funded through the joint solicitation process. George Blondin reported that he had talked to investigators responsible for problem reports and that there were only two remaining delinquencies. Bennette Burks said he would locate two final reports listed as missing.

There was discussion on the draft document of summaries which Jeff had sent to members prior to the meeting. The document included 66 summaries prepared by principal investigators, Jeff Helmuth and George Blondin. Six more summaries had been completed since the draft was sent out and will be included in the final document. Jeff asked for comments on the layout and explanatory section at the beginning to be sent to him by September 8th. There was consensus that there should be: 1) a discussion of the history of the joint solicitation process in the introduction; and 2) a short introduction to each topic area. With those two additions the GCC agreed that the document should be published without further GCC review.

8. **1995 GCC Report to the Legislature** - Jeff Helmuth asked for comments on the second draft GCC Report to the Legislature which had been previously sent to all GCC members and handed out a list of proposed changes to the report. There was discussion of the proposed changes including a submittal from Kevin Keith summarizing the groundwater activities of the Department of Public Instruction during FY 95. The Council decided that although the DPI is not a GCC member agency, the summary should be included in the report's Appendix. Susan Sylvester asked that Kevin Keith be invited to attend future GCC meetings. As amended, the report was approved by the GCC.
9. **Meeting with Lieutenant Governor** - Jack Metcalf suggested that a group from the GCC meet with the Lieutenant Governor regarding the evaluation of the GCC. Susan Sylvester, Nick Neher, Jamie Robertson and Al Beaver said they would be interested in attending the meeting. Jack said he would schedule the meeting.
10. **Update on Washington Island Septic System Research** Jim Wiersma talked about the work he had done on onsite wastewater treatment systems on Washington Island where a centralized wastewater treatment system is not feasible due to shallow dolomite bedrock. Jim had evaluated the effectiveness of a denitrification system and found a good reduction in suspended solids, coliform bacteria, and ammonia

and improved organic nitrogen and total nitrogen removal. BOD reduction was good for all but one site. Nitrate concentrations in effluent averaged somewhat above 10 mg/l, not including absorption field reduction. Jim said that he will be looking at absorption field reduction in the second year of the project. He will also be looking at mound systems in Brown County.

11. **The Use of Peat as an Absorptive Medium for Remediation of Pesticide Contaminated Groundwater** -

Jim Wiersma gave a summary of research he had done with Ron Stieglitz using peat to remediate pesticide contaminated groundwater. Jim showed the group samples of some of the different types of peat he used. His work with atrazine showed 80-85% adsorption in one hour and equilibrium in about 24 hours. Jim discussed the effect of pH and hardness on absorption as well as some of the difficulties he had in setting up the column experiments. Jim suggested that further work be done on peat regeneration with methanol although he commented that used peat can be disposed by landspreading. The findings indicated that peat is not as effective as activated carbon for remediating pesticide contaminated groundwater. One interesting implication is that pesticides in groundwater seeping into a marsh are likely to be filtered out at the marsh's edge.

10. **Adjournment & Next Meeting**

The meeting adjourned at 3:00 pm. The next meeting of the Groundwater Coordinating Council will be at noon on November 10th in the Board Room of the DATCP building at 2811 Agriculture Drive in Madison.

Respectfully submitted,

Jeff Helmuth
Water Resources Management Specialist
Department of Natural Resources

Wisconsin Groundwater Coordinating Council
Meeting Minutes - November 10, 1995

Members Present: Susan Sylvester (DNR), Nick Neher (DATCP), Maureen Muldoon for James Robertson (WGNHS), Henry Anderson (DHSS), Roman Kaminski for Bennette Burks (DILHR), Al Beaver (UWS), Bob Pearson for Carol Cutshall (DOT).

Others Present: George Blondin, Jim Peterson, Steve Born (UWS); Gary LeMasters, Jeff Postle (DATCP); Chuck Warzecha (DHSS); Gary Lueck (WRWA); Mike Lemcke, Jill Jonas, Jeff Helmuth (DNR).

The meeting was held in the Board Room of the Department of Agriculture, Trade and Consumer Protection building in Madison, beginning at noon.

1. **Introductions** - Introductions were made.
2. **Approval of Minutes** - The minutes of the August 25 meeting were approved without changes.
3. **DNR Reorganization** - Susan Sylvester summarized some of the changes that were planned for restructuring the DNR. The 5 bureaus that now manage water related functions will be rearranged into 3 bureaus in a single division. The Groundwater Management Section will be moved to the proposed Bureau of Drinking Water and Groundwater which will also include much of what is now in the Bureau of Water Supply. Positive effects of this move will include: 1) focusing water supply activities on managing groundwater as a resource; and 2) having a more coordinated effort in the field. Other relevant changes in the Water Division will include: 1) Combining Fisheries and Surface Waters into a single bureau; and 2) the creation of a Water Division Integration Team to coordinate inter-program work. Susan asked for comments on the DNR reorganization by November 20th.
4. **Continuation of GCC** - Susan Sylvester said that a meeting that she, Jack Metcalf, Al Beaver and Nick Neher had with the Lieutenant Governor to discuss the continuation of the GCC had gone well. The meeting followed the submittal of a response to the Wisconsin Evaluation Survey to the Lieutenant Governor's Office. The Office of the Lieutenant Governor, with input from the Department of Administration, will determine, by mid-January, whether the GCC will be continued. There was a strong consensus that there is a need for the GCC to continue to meet.

5. **Status Reports**

Education Subcommittee - Jim Peterson reported that the Subcommittee had prepared and discussed a second draft of goals. The subcommittee has also worked on clarifying water test result reporting language used by the State Lab of Hygiene (SLOH). For example, the subcommittee would like to see the absence of total coliform in private wells not called "safe" and the recognition of other factors. Other changes would include more details about other water quality parameters. So far the subcommittee has been unable to influence the SLOH to make any changes. The subcommittee will explore ways of popularizing the findings from the research and monitoring projects. Jim said subcommittee members were looking at publishing news releases through the DNR Digest and the UWEX news service. The subcommittee will begin formulating specific plans for National Drinking Water Week at the next meeting.

Nick Neher commented that he was interested in the subcommittee's work on popularizing the research/monitoring project findings. Some responses to the DATCP Atrazine Survey Report illustrated difficulties in communicating monitoring findings.

Monitoring and Data Management Subcommittee - Jill Jonas reported that the subcommittee was working with Jane Larson of the Education Subcommittee to improve the Wisconsin Unique Well Number (WUWN) assignment process. The Monitoring and Data Management Subcommittee has been working to identify groups who could improve the WUWN assigning process. County health departments and state agency staff have been identified as target groups. A non-point source priority watershed training session was held in April to instruct county staff in sampling procedures and how to fill out the WUWN forms. The subcommittee agreed that a brochure on WUWN assignment would be helpful.

Research/Monitoring project reports/summaries - Jeff Helmuth reported that over 200 copies of the Groundwater Research and Monitoring Project Summaries document had been distributed. A total of 300 copies were printed. Jeff also reported that Bennette Burks had located the two final reports previously listed as missing. George Blondin said he had sent the summary from each UW-funded project to that project's principal investigator. George also reported that all of the summaries would be listed in the Water Resources Reference Services Recent Acquisitions publication. George encouraged the Education Subcommittee in its efforts to popularize the research/monitoring findings.

Joint Solicitation Survey Results and FY 1997 Joint Solicitation Package - Jeff Helmuth summarized comments made in 31 responses received to a survey sent to previous joint solicitation proposal authors. Most respondents thought the instructions and priorities were clear. Only six respondents thought that the rating criteria were not clear. Additional language describing rating criteria was included in the FY 97 joint solicitation package. Thirteen respondents thought the package should be sent out earlier. Jeff reported that this year's package had been sent out approximately two weeks earlier than last year, and that next year's package could be distributed even earlier, possibly in September after approval at the August GCC meeting. Twenty-two responses indicated a preference for earlier notification. All but three would be satisfied if notified by March 15th. George Blondin said that the entire review process would have to be moved one month earlier to have funding decisions by March 15. There was consensus that March 15th, 1997 should be the target date for funding decisions for the fiscal year 1998 joint solicitation.

Eleven responses requested more specific feedback regarding the weaknesses of their proposals. The UW annually compiles a summary sheet of ratings and anonymous reviewer's comments for each proposal. In the future, the summary sheet will be distributed to proposal authors. Only two responses indicated dissatisfaction with project management. Other comments regarding ways the joint solicitation process could be improved included: 1) lessen "Madison focus" (GCC discussion indicated that if there is a perceived bias towards Madison, it results from the rejection of irregular quality non-Madison proposals. Considerable time has been invested in clarifying proposal guidelines for this year.); 2) set funding limit (The GCC does not support setting a funding cap but would like to encourage proposals for smaller amounts. The FY 97 package states that the DNR will give greater consideration to projects costing < \$25,000.); and 3) prioritize priorities (The DNR has done this, but only to a small extent because the relative importance of priorities may change between the time they are set and the time that proposals are evaluated). Jeff concluded that almost all of the concerns raised by the survey have been addressed in the FY 97 joint solicitation package.

Bob Pearson suggested the possibility of including a portion of the funding from the DOT Council on Research grant program in the joint solicitation. Bob noted the similarity of some of the DOT research goals with the other state-funded groundwater research and monitoring programs. Some of the areas of mutual interest include wetlands evaluation, data management using geographic information systems (GIS), storm water management, groundwater remediation, and land use planning. Susan Sylvester said that the GCC will explore this possibility.

ILHR 83 - Roman Kaminski gave an update on how the rule-making process was proceeding for the private sewage system code. Roman reported that intense work on the rule's Environmental Assessment (EA)

included negotiations between DILHR and DNR. The 30-day comment period was to be extended, after which the draft EA may be adjusted. An additional public hearing may be held. Roman added that the rule was to be sent to the Legislature in three rule packages. Implementation of the rule will be delayed until January 1997.

Nitrate Information Document - Jill Jonas reported that an informal group of state agency staff was examining the need for a comprehensive document on nitrate in groundwater.

6. **Baltic State Wellhead Protection** - Jill Jonas gave a slide presentation on an EPA-sponsored trip to Latvia and Lithuania that she and Bob Krill had recently taken. The EPA program is part of an effort funded by the U.S. Agency for International Development. The purposes of the trip were to: 1) participate as speakers at the International Conference, "Underground Water Protection and Water Supply Problems in Daugavpils, Latvia"; 2) assist in determining follow-up activities to be taken by the Latvian Ministry concerning wellhead protection activities in Latvia; and 3) meet with local, national, and regional representatives in Siaulia, Lithuania to discuss development and implementation of a wellhead protection plan for the municipal water system. This trip was a follow-up to previous work completed in the Baltic countries.
7. **Approval of Meeting Schedule for 1996** - The proposed GCC meeting dates for 1996 were changed. The dates that were approved are: February 16 at WGNHS; May 17 at Dodgeville; August 23 at DNR; November 15 at DATCP. All meetings are on Fridays, starting at noon.
8. **Hydrogeologic Properties of Wisconsin Glacial Deposits** - Dave Mickelson discussed his research which has focused on identifying characteristics that can be generalized for the glacial deposits that cover most of the state. His presentation covered several projects funded through the joint solicitation. He began by noting that an understanding of glacial deposits is critical to managing groundwater in Wisconsin.

In "Variation in Hydraulic Conductivity in Sandy Glacial Till: Site Variation Versus Methodology", the research focused on the Horicon Formation, a till found in much of East-central Wisconsin which appears to be lithologically and texturally homogeneous, but hydrogeologically heterogeneous. The study also evaluated different methods for determining hydraulic conductivity. This information is important for the DNR and other regulatory agencies that require that hydraulic conductivity tests be made as part of a site investigation to allow these agencies to establish realistic and consistent requirements for initial site reports and feasibility studies. The results showed that hydraulic conductivity measurements of the formation vary over nearly two orders of magnitude. In general, larger-scale tests yielded larger values of hydraulic conductivity. Textural analyses of samples showed little variability, and there was no correlation between textural characteristics and hydraulic conductivity. Dave concluded that most of the reported variability (from DNR files) of field-measured values of hydraulic conductivity in till of the Horicon Formation is due to different testing methods (e.g. slug tests versus pumping tests), different scales of the same testing method (e.g. different slug sizes) that test different volumes of aquifer, or misidentification of the material.

A second project, "Three-dimensional Characterization of Hydraulic Properties of a Coarse Glacial Outwash", addressed the problem of preferential flow within heterogeneous outwash deposits. This is important because these deposits are easily contaminated and are commonly used for water supply sources. The heterogeneity of a gravelly outwash deposit in southern Wisconsin was mapped in detail. Groundwater flow in the deposit was then modeled with MODFLOW to determine preferential flow paths. Most of the deposit was found to be a matrix of high conductivity gravel with occasional discontinuous zones of even more conductive gravel and lenses of fine grained lower conductivity sand and silt. Modeling showed that the coarse-grained, gravel facies enhance contaminant movement because of their high conductivity relative to the matrix. The fine-grained, sand and silt facies act as a coating between gravel facies and give rise to high conductivity channels due to scouring.

A third project, "Evaluation of the Correlation between Glacial Landforms, Glacial Sediments and Hydraulic Conductivity in Dane County, Wisconsin", investigated the relationship between surface landforms and underlying glacial deposits in two distinctly different glacial landscapes in Dane County. It was hoped that glacial features mapped at the surface could be used as an indicator of the distribution of hydraulic conductivity values in unconsolidated glacial deposits. The results showed that the glacial map units may provide a reasonable estimate of the characteristics of the first unit of sediments beneath the ground surface. However, the lateral and vertical distribution of hydraulic conductivity values within the glacial map units cannot be reliably predicted based on the existing subsurface information. The main conclusion of this investigation was that the existing database of lithologic information needs improvement in order to support detailed mapping of the distribution of glacial sediments in the subsurface. Dave attributed this deficiency to the lack of distinctive, readily identifiable, laterally extensive glacial sedimentary units, and the lack of standardization of the sediment descriptions reported by the well drillers. Dave said that he hoped progress in the use of lithostratigraphic unit names as descriptors would continue. Correlation of these units would be useful both at the site level and the regional level. The many applications include contamination potential and recharge mapping, and land use planning. Some of the hydraulic conductivity information Dave has collected is available in a GIS format. Bob Pearson added that the information was invaluable as a resource for planning site investigations and remediation activities.

- 9) The meeting adjourned at 3:00. The next meeting will be at 12:00 on February 16, 1996 in the Conference Room of the Wisconsin Geological and Natural History Survey at 3817 Mineral Point Road in Madison.

Respectfully submitted,

Jeff Helmuth
Water Resources Management Specialist
Department of Natural Resources

Wisconsin Groundwater Coordinating Council
Meeting Minutes - February, 14 1996

Members Present: Susan Sylvester (DNR), Jack Metcalf (Gov. Rep.), Jim Vanden Brook for Nick Neher (DATCP), James Robertson (WGNHS), Henry Anderson (DHSS), Bennette Burks (DILHR), Al Beaver (UWS), Carol Cutshall (DOT).

Others Present: George Blondin, Chris Mechenich, Tony Simo (UWS); Ron Hennings (WGNHS); Bob Pearson (DOT) Lisa Morrison (DATCP); Chuck Warzecha (DHSS); Gary Lueck (WRWA); Barb Lensch (NRCS); Mike Lemcke, Bill Tans, Steve Karklins, Dave Johnson, Jeff Helmuth (DNR).

The meeting was held in the Conference Room of the Wisconsin Geologic and Natural History Survey building in Madison, beginning at noon.

1. **Introductions** - Introductions were made.
2. **Approval of Minutes** - The minutes of the November 10, 1995 meeting were approved with the following change suggested by Jim Peterson of the Education Subcommittee: p.1 item 5, 3rd sentence changed to "For example the subcommittee would like to see the absence of total coliform in private wells not called "safe" and the recognition of other factors."
3. **Continuation of GCC** - Jeff Helmuth reported that the Office of the Lieutenant Governor had delayed its decision on the continuation of the Groundwater Coordinating Council and other advisory councils. The Office, with input from the Department of Administration, will determine, by the end of the calendar year, whether the GCC will be continued. There was a strong consensus that there is a need for the GCC to continue to meet.
4. **DNR Reorganization** - Susan Sylvester detailed some of the changes that were planned for the DNR. She said that the Groundwater Section Chief would be a liaison to the Solid and Hazardous Waste program. The present Wastewater, Water Resources, Water Supply, Fisheries Management and Water Regulation and Zoning Bureaus will be integrated in the new Water Division. Fisheries Management will broaden its scope to include the Wetlands and Lakes programs. Basin teams will be formed and will include stakeholders in establishing priorities and will reduce conflicts between programs. By focusing resources geographically in water basin management units, funding will be more direct. In the service center implementation phase, consistency will be emphasized. Links to the Land Division will be facilitated by use of the same basin management units by both divisions. Bureau Directors and Regional Media Heads will be selected by the end of March. Section Chiefs will be selected in June. Susan also mentioned that Ron Semmann, who is retiring, will be replaced by Darrell Bazzell.
5. **Subcommittee Reports**

Education Subcommittee - Chris Mechenich reported that the Subcommittee had been working with Pam Seelman (UWEX) to produce news releases based on topics covered in the Groundwater Research/Monitoring Summary document. Atrazine contamination of groundwater and crop rotation are likely to be the first two topics. Chris added that researchers would see the news releases before publication. Jim Vanden Brook said that there was a great need to combat misinformation. Chris said the Subcommittee was making plans for National Drinking Water Week in May. By coordinating agency activities the Subcommittee will increase the value of agency efforts. The subcommittee is also working on a brochure on Drinking Water and Infant Health which will combine infant health concerns into one brochure.

Chris then outlined and asked for the GCC's endorsement of three materials the Subcommittee had prepared: 1) Groundwater Education Goals and Principles; 2) Guidelines for review of Educational Materials; and 3) Roles of the Education Subcommittee in Groundwater Education in Wisconsin. Some minor changes were made before the documents were endorsed. The endorsed documents are attached. Susan Sylvester thanked Chris for her efforts with the Subcommittee and said the documents were fundamental to the future progress of the Subcommittee.

Jack Metcalf said that there would be an increased need for groundwater education efforts due to many acres of farm land coming back into production. Jack said that with current crop and cattle prices there was a strong incentive to plant cash crops (mainly corn and soybeans) that would result in increased nitrogen and pesticide use. Furthermore, with fewer cattle there would be less incentive to rotate these crops with alfalfa. Susan asked that someone from DATCP make a presentation on the potential changes in acreage and groundwater impacts at the next meeting.

Monitoring and Data Management Subcommittee - Chuck Warzecha said that a draft brochure on Wisconsin Unique Well Number (WUWN) assignment was in draft form. The Subcommittee had targeted county health departments as a group who could be helped to improve their WUWN assigning process. Chuck summarized the results of several queries he had made of State Lab of Hygiene data. Chuck had sorted the data by account #, county, and Storet Code to show the percentage of samples from wells with a WUWN and so are entered into the Groundwater Retrieval Network (GRN). Chuck said that the Subcommittee can also help identify ways of improving GRN. Questions still remain about how to protect the confidentiality of the data. The Subcommittee had also discussed DATCP's Atrazine Exceedence Study. Jim Vanden Brook added that a full report of the study would be given to the ATCP board on March 12.

Planning and Mapping Subcommittee Lisa Morrison reported that the Subcommittee had been exploring the need for better data management for mapping purposes. At their Feb. 14th meeting the Subcommittee had discussed the availability of DNR site investigation/remediation data. There is a large amount of data but it is not easily available for mapping purposes. Making all of the data available electronically seems to be prohibitively expensive at this time. Electronic submittal by consultants is one possibility for the future. The Subcommittee agreed on two action items: 1) The Subcommittee will determine what data is most essential for good planning and mapping and will report its findings to the GCC at the May GCC meeting; and 2) The Subcommittee will investigate data management strategies and write a proposal for the FY 98 joint solicitation to fund a data management project to make the data more accessible.

6. Status Reports

FY 97 Joint Solicitation - George Blondin indicated that only 5 of the 35 proposals that had been received were in total conformance with proposal guidelines. George recommended two changes to the guidelines: 1) including a checklist for guidelines in the solicitation; and 2) setting the page limit to 16 plus 2 vitae pages per PI and Co-PI. George noted that 17 of the proposals have a biological emphasis which is new. George also noted that 4 proposals are reworked versions of unfunded proposals from last year. Reviewers comments had been provided to the authors and seem to have resulted in improved proposals. George reported that he had sent out 133 requests for outside reviews and had received 44 responses so far. Jeff Helmuth added that the 35 proposals request \$825,000 for FY 97, and that there is approximately \$390,000 available. Jeff also reported that the Research and Monitoring & Data Management Subcommittees would meet on Feb. 19th to discuss and rate the proposals. The GCC showed support for the efforts made to keep the proposals within the guidelines stated in the joint solicitation package.

Evaluation of Proposed Crandon Mine - Bill Tans reported that the review of the proposed Crandon Mine was approximately half-complete. Discussions with the Crandon Mining Company on developing the groundwater flow model and the contaminant transport model will continue for at least the next several months. The DNR has requested more information on the company's proposed tailings management area and waste characterization alternatives. The amount and source of groundwater discharge to Little Sand Lake is being determined. Bill anticipates that the Department's environmental impact statement will be released in late 1996 but that there may be a number of years of legal activities beyond that.

Contaminated Site Closure Flexibility/Revisions to DNR Groundwater Sampling Guidance In the interest of allowing enough time for the presentation by Dr. Simo, Steve Karklins was asked if he could make his updates at the May GCC meeting.

7. **Geologic Constraints on Arsenic in Groundwater in Carbonate Aquifers** - Tony Simo reported on the bedrock geology in Brown, Winnebago, and Outagamie Counties in response to high concentrations of arsenic found in wells in the Fox River Valley. The purposes of Tony's work were to describe and define the stratigraphic units of the Ancell and Sinnipee Groups, to establish hydrostatic units on which future groundwater flow or geochemical modeling could be based, and to determine any possible geologic controls on the occurrence of mineralization which could cause arsenic contamination of groundwater.

Tony described how he had correlated gamma probe data from outcrops and wells to predict carbonate bedrock lithologies. By constructing cross-sections and mapping arsenic concentrations a correlation with geology was established. Apparently, arsenic is most likely to be found in groundwater where the water table intersects a mineralized zone called the sulfide cement horizon. The chemical evolution of the arsenic contamination groundwater was studied using PHREEQE but is still poorly understood. An additional area requiring study is the dynamics of groundwater flow in fractured bedrock. Tony alluded to the complicated results of Maureen Muldoon's tracer tests in Door County as an indication of the importance of increasing our understanding in that field.

Tony's study was the first to investigate the stratigraphy of the area since the late 1800's. The findings have explained the geographic distribution of arsenic contaminated groundwater and will provide a basis for modeling hydrostratigraphic units in the area. Tony added that the stratigraphic information is useful beyond predicting and preventing groundwater contamination. By indicating the location of suitable high quality aggregate material, knowledge of carbonate bedrock stratigraphy can save the state millions of dollars in road construction costs.

8. The meeting adjourned at 3:10. The next meeting will be at 12:00 on May 17, 1996 in the Conference Room of the Department of Natural Resources Area Office in Dodgeville.

Respectfully submitted,

Jeff Helmuth, Groundwater Specialist
Department of Natural Resources

**Wisconsin Groundwater Coordinating Council
Teleconference Minutes - April 22, 1996**

Members Present: Susan Sylvester (DNR), Henry Anderson (DHSS), Carol Cutshall (DOT), Bennette Burks (DILHR), Ned Zuelsdorff for Nick Neher (DATCP), Jack Metcalf (Gov. Rep.)

Others Present: Gordon Chesters and George Blondin (UW-WRC); Jeff Helmuth (DNR).

The only agenda item for the teleconference was to review the proposed University of Wisconsin System (UWS) groundwater research plan for fiscal year (FY) 1997 which begins July 1, 1996. Gordon Chesters reported that the Groundwater Research Advisory Council (GRAC) meeting had gone well and that this year's research proposals were of better quality than preceding year's. The lowest ranked proposal to be funded scored 3.73 out of 5, whereas the average score was 3.53. Gordon also indicated that the Water Resources Center's funding from the Department of the Interior had been significantly reduced so he had been forced to take a small amount (about 2%) of the groundwater research funds for administrative costs. Gordon and George Blondin summarized the project selection process and explained how the rankings were adjusted by the GRAC.

The UWS will fund ten new projects at a cost of \$206,959 including one project co-funded by the DNR and \$6,600 in administrative costs. Two projects which are being funded by the UWS in FY 96 will carry over to FY 97. The total cost for those 2 projects in FY 97 will be \$58,053 including a reporting cost of \$8,053. Due to a new accounting system for fringe benefits an additional \$34,000 will be withheld by the UWS for payment of fringe benefits. Gordon Chesters indicated that the balance between new and continuing projects would be more even next year because several of the new projects are one-year projects. The GCC unanimously endorsed the recommended UWS groundwater research plan for FY 97 and the transmittal of that endorsement to the Department of Administration for release of funds. Letters of endorsement will be sent to the UWS and the Department of Administration.

Respectfully submitted,

Jeff Helmuth, Groundwater Specialist
Groundwater Management Section
Wisconsin Department of Natural Resources

**Wisconsin Groundwater Coordinating Council
Meeting Minutes - May 17, 1996**

Members Present: Susan Sylvester (DNR), Jack Metcalf (Gov. Rep.), Henry Anderson (DHSS), Bennette Burks (DILHR), Carol Cutshall (DOT), Ned Zuelsdorff for Nick Neher (DATCP), Ron Hennings for James Robertson (WGNHS), Evan Norris for Al Beaver (UWS).

Others Present: Lisa Morrison (DATCP); Chuck Warzecha (DHSS); Jon Cleveland (WRWA); Cara Norland, Jill Jonas and Jeff Helmuth (DNR).

The meeting was held in the Conference Room of the DNR Area Office in Dodgeville, beginning at noon.

1. **General Business** - Introductions were made. The minutes of the February 16 meeting and the April 22 teleconference were approved. Susan Sylvester noted that the UW Water Resources Center had requested funding from the DNR but that there may not be money available for the funding.
2. **Outline for 1996 GCC Report to the Legislature** - Jeff Helmuth proposed that the report be structured as it has in the past but with two changes: 1) expansion of the "Condition of the Resource: Groundwater Quantity" section to reflect progress on the groundwater quantity report now nearing completion; and 2) addition of a summary of USGS groundwater-related activities to the appendix.
3. **Subcommittee Reports**

Planning and Mapping Subcommittee Lisa Morrison reported that she and several others of the Subcommittee were following up on their February meeting discussion on the need for data standardization and multi-agency groundwater data integration. Lisa emphasized the importance of the issue and said that she planned to have a joint meeting of the Planning and Mapping and Monitoring and Data Management Subcommittees to develop a consistent approach to the problem. Lisa will outline a strategy for addressing the issue at the August GCC meeting.

Monitoring and Data Management Subcommittee - Jill Jonas reported that the Subcommittee had continued to work on improving the Wisconsin Unique Well Number (WUWN) assignment process. The Subcommittee had not needed to meet since January because individual members were working on various aspects of the WUWN assignment process. Jill added that members had also contributed to an educational effort focusing on Drinking Water Week and were looking forward to working with the Planning and Mapping Subcommittee on data integration issues.

Education Subcommittee - Ron Hennings reported for Chris Mechenich that he and Chris had worked with Pam Seelman (UWEX) to produce a news release on atrazine contamination of groundwater based on results from projects funded through the joint solicitation. The news release went mainly to county newspapers. Ron hoped to have the technical information consolidated into an article for farm journals. Jack Metcalf said that the farm journals and Extension columns in county papers are widely read among farmers. Susan Sylvester asked that the Subcommittee get Jack's input on how to best reach farmers with the research findings.

Ron also reported that the Subcommittee had coordinated agency education efforts for Drinking Water Week. Included in those efforts were mailings of DNR groundwater education materials to teachers, an appearance on Larry Meiller's radio show, and a radio spot for statewide broadcast on the importance of testing drinking water.

4. Status Reports

FY 97 Joint Solicitation - Jeff Helmuth reported that letters had been sent to James Klauser of the Department of Administration and Katherine Lyall of the University of Wisconsin System to release funds for the 1997 UWS groundwater research plan. Eighteen of the 35 proposals received in response to the joint solicitation will be funded. The UWS is funding 10 new projects, the DNR 5, DILHR 2, and DATCP 2. One project will be co-funded by the UWS and the DNR. Principal investigators have been informed of their funding status.

Evan Norris reported that George Blondin intends to summarize nine technical reports in the summer of 1996 and handed out a list of the nine reports.

Carol Cutshall reported that DOT was finalizing their research project selection. One project related to groundwater quality involves street sweeping. Susan Sylvester asked that the street sweeping project be included in the next summary publication.

Potential for increased lands in agricultural production - Ned Zuelsdorff reported that agricultural statistics showed a likely 5% increase in corn acreage, up 200,000 acres to 3.85 million acres in 1996. Of this total, 96% are treated with herbicides. Soybean intentions were up 8% or 70,000 acres. Ned said that out of the 700,000 acres in CRP 400,000 will be released if the Farm Bill is released as drafted. Ned noted that to address the need for education, Monsanto had produced a booklet and video titled "Solving the CRP Puzzle: A Guide for Growers" that discusses the use of Roundup, a Monsanto produced herbicide.

Alachlor metabolite (ESA) groundwater standard setting process - Henry Anderson noted that ESA was widely distributed in Wisconsin's groundwater but that it is not known how toxic ESA is to humans. Due to a lack of agreement on the available health effect data, a panel of unallied experts will be assembled for a review. The review will probably be completed this summer but may not be done in time to meet the July 8 deadline for the cycle 7 groundwater standard setting process. Henry said he hoped to have the issue resolved before the 1997 growing season.

Ned Zuelsdorff added that: 1) alachlor use was decreasing due to its replacement by other herbicides including acetochlor; 2) there were currently no requirements for testing groundwater for metabolites of new chemicals; and 3) during hearings on the 1996 atrazine rule changes he had heard many objections to the groundwater standards from people who believed that the standards are too low. Jon Cleveland said that he often heard this objection and that it shows that there is an educational need. Jack Metcalf said that he believed the standards were not strict enough and that we must think of our children's and grandchildren's welfare. Jack said it was time to question whether farmers need to produce 200 bushels per acre at the expense of groundwater quality.

Private Well Water Quality Reports - Chuck Warzecha summarized the findings of the Center for Disease Control (CDC) Private Well Water Quality Survey. The survey consisted of sampling private wells on a grid pattern throughout 9 Midwestern states and testing the samples for a variety of water quality parameters. Wisconsin's report on the study, prepared by the DNR, State Lab of Hygiene (SLH), and DHSS was distributed to the GCC at the November 1995 meeting. Recently the CDC distributed a draft report on the entire 9-state study for review by the states involved. The report clearly identifies an association between well age, well construction type, well depth and rates of bacterial contamination. Wisconsin's comparatively low rate of bacterial contamination is assumed to be, in part, a result of a strong well code. The CDC draft report fails to emphasize the need for strong well construction codes at the state level.

Rather, it appears to be declaring a need for federal regulation of private water supplies. The report does not recognize that the difference between bacterial contamination rates is generally a well-specific issue. DHSS, DNR and SLH each submitted comments on the draft report and have been promised another review opportunity. However, at this time, the next draft of the report had not yet been received.

Groundwater Quantity - Jeff Helmuth reported that the Groundwater Management Section had met to discuss the Groundwater Quantity report and decided it could be completed for the August GCC meeting. Comments from the technical advisory committee have been incorporated into the report. The final draft of the report is now being finalized and will be reviewed internally. Council members should receive a copy a few weeks before the August meeting.

Revisions to DNR Groundwater Sampling Guidance - Jill Jonas reported for Steve Karklins that both the Desk Reference and the Field Manual were being revised for the first time since 1987. Numerous advances in groundwater sampling and monitoring technology in recent years made the revisions necessary. The new documents will go into much greater detail on how to consistently collect high quality, representative groundwater samples and measurements. They will include listings and descriptions of the newest groundwater monitoring and sampling equipment as well as a list of options on how to collect samples and measurements. The review process for the documents included extensive comments from 5 environmental consulting firms, 1 private laboratory, and DNR and DATCP staff. The documents are currently being edited and should be published this summer. Lisa Morrison suggested attaching the Wisconsin Unique Well Number brochure to the documents for distribution.

5. **Brownfields initiative** - Cara Norland, the Public Outreach Specialist from the DNR's Land Recycling program gave a presentation on contaminated lands recycling in Wisconsin. The goal of the program is to encourage the redevelopment of urban, contaminated properties to return them to productive use. 1993 Wisconsin Act 453 was enacted to do this. Act 453 provides incentives for purchasers to acquire property, clean it up and put it back into use by providing that a purchaser is not liable for further cleanup action on the property under the state's Spills Law. The potential for completing cleanups in "real time" was illustrated by a site where a cleanup was completed only 4 months after entering the Land Recycling Program. Cara mentioned several other success stories to show the effectiveness of the program.

Cara emphasized that education must play a key role in the success of the land recycling program. Cara gave out fact sheets on: 1) Implementing the Brownfields Cleanup Initiative in Wisconsin; 2) Limited Liability for Purchasers of Contaminated Property; 3) Conducting a Thorough Environmental Investigation; 4) WDNR's Superior Lien Authority; 5) Environmental Liability Exemption for Lenders and Representatives; and 6) Fees for Assistance in the Purchaser Liability Exemption Program. Several other information sheets on the program are also available. There is significant interest in the program. A 1-800 line for information on the program is receiving more than 500 calls per month.

6. The meeting adjourned at 3:00. The next meeting is scheduled for 12:00, August 23rd at the Wisconsin Department of Natural Resources GEF II building in room 611A.

Respectfully submitted,

Jeff Helmuth, Groundwater Specialist
Department of Natural Resources

Joint Solicitation of Groundwater and Related Research/Monitoring Proposals

November 1995

The University of Wisconsin System (UWS) and the Wisconsin Departments of Natural Resources (DNR); Agriculture, Trade and Consumer Protection (DATCP); and Industry, Labor and Human Relations (DILHR) are participating in a joint solicitation of research/monitoring proposals dealing with groundwater and pesticides. The four state agencies have approximately \$635,000 available for groundwater-related monitoring or research. The four monitoring/research programs are summarized as follows:

1. UWS Groundwater Research - The UWS, through its UW-Madison Water Resources Center (WRC), has received funding since fiscal year 1990 (FY 90) for groundwater research. They will have \$300,000 to fund research in FY 97. Through FY 95, the UWS has spent \$1.7 million on 46 groundwater research projects. Three of the 46 projects have been co-funded with DATCP and one co-funded with DNR. Eight of the 46 projects were supported for one year and 38 for two years for a total of 84 project-years which gives rise to an average of about \$20,000/project/year.
2. DNR Management Practice Monitoring - The DNR has been funding groundwater management practice monitoring projects since FY 86. The DNR has approximately \$125,000 available for FY 1997 to support groundwater monitoring studies evaluating existing design and/or management practices associated with potential sources of groundwater contamination. The money comes from the Groundwater Account of the Environmental Fund (which is funded by various fees). Through FY 95, the DNR has spent approximately \$3.1 million on 120 monitoring projects. Two projects have been co-funded with the DATCP and one with the UWS.
3. DATCP Pesticide Research - Since 1989, the DATCP has had approximately \$135,000 available annually to fund research on pesticide issues of regulatory importance. The money comes from fees paid by pesticide manufacturers to sell their products in Wisconsin. Through FY 95, the DATCP has spent about \$750,000 on 13 pesticide projects. Three were co-funded with the UWS and 2 were co-funded with the DNR.
4. DILHR Private Sewage System Research - DILHR received an annual appropriation of \$50,000 from 1990 to 1993 to fund research on alternatives to current private sewage system technology. In 1994, when the appropriation expired, \$75,000 generated through plan review and licensing fees became available each year for research on private sewage systems. Through FY 95, the DILHR has spent \$337,600 on three projects.

The Wisconsin Groundwater Coordinating Council provides consistency and coordination among the four state agencies in funding groundwater monitoring and research to meet state agency needs. The reasons for this solicitation to be made jointly are to:

- Facilitate proposal writing
- Streamline the review process.
- Curtail duplication
- Improve coordination among agencies and researchers.
- Enhance communication between the agencies and between principal investigators.

Joint-funding of some projects may be appropriate, but joint funding is not the purpose of this solicitation because each agency has its own designated mission and priorities. Contributors to this solicitation and their roles are:

- The UWS, through its Water Resources Center (WRC), with oversight from the UWS Groundwater Research Advisory Committee, has approximately \$200,000 available in FY to fund new projects. The remainder of the UWS groundwater research funds have been committed to ongoing projects for FY 97. The funds are restricted for use by UWS faculty within the UWS. Projects of fundamental and applied research will be supported on all matters relating to groundwater including natural science, engineering, social science and law. Projects will be considered for one or a MAXIMUM of two years during a solicitation cycle.
- The DNR has approximately \$50,000 available in FY 97 to fund new groundwater monitoring projects. About \$75,000 has been allocated for ongoing monitoring or related projects. The DNR is also helping DILHR fund projects that focus on the performance of currently-approved onsite wastewater treatment (private sewage) systems. The monitoring will establish and improve management practices which will allow the state to meet the groundwater quality standards enumerated in NR 140, Wisconsin Administrative Code. Although no restrictions are placed on who may apply for these funds, preference will be given to UWS and state agency contractors. Contracts will be approved on an annual basis, and no out-of state submittals will be accepted.
- The DATCP has approximately \$86,000 available for FY 97 to fund new projects. Investigators should note that the focus of the DATCP program is on pesticide research which includes but is not limited to groundwater issues. Proposals may be submitted by any college or university, research foundation or individual having a demonstrated capacity in pesticide or other applicable research.
- The DILHR will administer \$75,000 for FY 97 to support research on performance of onsite wastewater treatment systems. Approximately \$57,000 of the funds will be available for new projects.

Please read the solicitation carefully; it contains a description of the priorities for each agency program and other pertinent information, much of which has changed since last year. Capital items may not be purchased with these funds, and faculty salaries plus fringe benefits will be limited to a maximum of 10% of an individual grant (e.g., for a \$20,000 grant, a maximum of \$2,000 can be allotted to faculty salaries and fringe benefits).

A cover page and proposal format have been agreed upon and are contained in this package. Although all proposals received will be distributed to each agency, each investigator is asked to identify the agency whose mission and priorities best match their project.

Attached is the description of each agency's guidelines, the outline for a cover page, and a detailed format for the proposal. **Proposals should be no longer than 20 pages.** The project summary and narrative should start on a new page, be double-spaced (except for Figure and Table legends), and use no smaller than 11-point font. All margins should be no less than 0.75 inches and all except the cover page must be paginated. Include literature citations in the proposal where appropriate (single spaced within, double spaced between). Any section of a proposal which exceeds the maximum page limits specified in the table below will be grounds for returning the proposal to the author.

<u>Section</u>	<u>Maximum pages</u>
Cover Page	1
Project Summary	2
Narrative and supplements	10
Curriculum vitae	4
Budget	3

Compliance with proposal guidelines will be a rigid criteria used in acceptance of proposals. Proposals not in compliance will be returned to investigators to allow redrafting and resubmittal if time before the deadline permits. Examples of successful proposals will be made available to investigators upon request.

The deadline for submittal of proposals is January 12, 1996. **No proposals will be accepted after the close of WDNR business at 4:45 PM on January 12, 1996 unless they are postmarked on January 11, 1996 or earlier.** No facsimiles of proposals and no hand-written proposals will be accepted. A minimum of one in-State and two out-of-State written reviews will be solicited from an international list of experts in the field of each proposal. Proposals are also evaluated by the Research & Monitoring and Data Management Subcommittees of the Wisconsin Groundwater Coordinating Council, by the Groundwater Research Advisory Council, and by targeted State Agency personnel. Funding decisions will be made in April, 1996.

A principal investigator with unfinished Joint-Solicitation-funded final reports that are significantly overdue (in the case of UWS by more than one year) with respect to initially specified or understood completion dates will not be eligible for new funding. Extenuating circumstances may be considered by the Groundwater Coordinating Council on a case-by-case basis.

If you have questions please call the following appropriate agency contacts.

George Blondin, University of Wisconsin-Madison (608) 262-3470

Jeff Helmuth, Wisconsin Department of Natural Resources (608) 266-5234

Jeff Postle, Wisconsin Department of Agriculture, Trade and Consumer Protection (608) 224-4503

Harold Stanlick, Wisconsin Department of Industry, Labor and Human Relations (414) 548-8604

Please submit the original and three copies of each separate proposal to:

Jeff Helmuth, WR/2
Wisconsin Department of Natural Resources
101 S. Webster St.
P.O. Box 7921
Madison, WI 53707

PROPOSAL FORMAT (Original and three copies)

Deadline for Submission: January 12, 1996

A. Cover Page--Sample copy is appended.

B. Project Summary (begin on **new page, not to exceed 2 double-spaced pages**)

1. Specific groundwater or related problem addressed by research/monitoring proposal.
2. What will findings contribute to problem solution or understanding?
3. Project objectives.
4. Project approach to achieve objectives including methods and procedures.
5. Users of project findings.

C. Proposal Narrative (begin on **new page, not to exceed 10 double-spaced pages**)

1. Objectives.
2. Background information describing prior research/monitoring relevant to objectives; references to ongoing projects and how they relate to proposed investigation; information gaps which will be filled by the proposed project.
3. Project plan outlining experimental design and schedule.
4. Methods detailed enough to convince the reviewer that the investigators are up-to-date on modern techniques; a general statement alluding to techniques is not acceptable.
5. Relevance to groundwater and related problems.
6. Citations
7. Training support (if any) provided by the project.

D. Principal Investigators

Include a curriculum vitae (including recent publications) of each investigator and state the time each will spend on the project. A recent reprint or offprint of a key publication should be submitted if appropriate and available.

E. Budget using order shown in sample form

1. Salaries and wages, including percentage of grant to be used for faculty salaries.
2. Fringe benefits, including percentage of grant to be used for faculty benefits.
3. Supplies--list office, laboratory, computer and field supplies separately. Fabrication of equipment

should be listed as a separate item.

4. Travel to support field operations only. Travel to meetings is excluded because of the limited funding.
5. Publication costs.
6. Total direct costs.

SAMPLE COVER PAGE

Project Title

(Maximum of 100 characters)

PRINCIPAL INVESTIGATOR:

Name

Title, Affiliation, and complete mailing address including ZIP

Telephone

FAX

CO-PRINCIPAL INVESTIGATOR(S):

Name

Title, Affiliation, and complete mailing address including ZIP

Telephone

FAX

Location of Research

Desired Start-up Date and Duration of Project:

Amounts Requested:

<u>FIRST YEAR</u>	<u>SECOND YEAR</u>	<u>TOTAL</u>
\$\$\$\$\$\$\$\$	\$\$\$\$\$\$\$\$	\$\$\$\$\$\$\$\$

Check agency(ies) to which this proposal is targeted:

[If appropriate for more than one agency rank highest (1) to lowest (4)]

UWS () DNR () DATCP () DILHR ()

Date of Submittal:

SAMPLE BUDGET PAGE

Budget Period from July 1, 1996 to June 30, 1997

(Make a separate page for each year of support)

1. Salaries and Wages Time, % Cost, \$

 Name and title if known

 a.

 b.

 c.

 d.

% of grant to be used for faculty salaries and fringe benefits = _____

2. Fringe Benefits

 % of which salaries

 % of grant to be used for faculty salaries and fringe benefits

3. Supplies

 a. Office

 b. Laboratory

 c. Field

 d. Computer

 e. Fabrication of equipment

4. Travel only for support of field operations. Detail transport, meals, hotels and number of persons involved.

5. Publication Costs.

6. Total Direct Costs

7. On a separate sheet, indicate the level of current or pending support. See attached example.

**UNIVERSITY OF WISCONSIN SYSTEM (UWS) PROJECTS FUNDED
THROUGH THE GROUNDWATER RESEARCH ADVISORY COUNCIL**

As part of the joint solicitation for groundwater research proposals, the UWS seeks projects of a fundamental or applied nature on any aspect of groundwater research in the natural sciences, engineering, social sciences or law.

Application Requirements: Most often the principal investigator will be a faculty member on any campus in the UWS. However, academic staff who have achieved nomination to PI status by endorsement of the relevant academic dean may serve in this capacity.

Budgetary Considerations: About \$200,000 will be available for new grants in FY 97. Projects will not be approved in any one budget cycle for a period of more than 2 years and then contingent on satisfactory progress. No capital equipment (more than \$1,000/item) will be purchased. Travel for attendance at scientific meetings will not be accepted. Faculty salaries and fringe benefits to be paid from any project will not exceed 10% of the total individual grant.

Priorities: (Presented in no particular order of importance.)

- Chemical and biological degradation of pollutants in surface soils, subsoils and groundwater, including identification of degradation products.
- Transport of pollutants in soil and groundwater, including elucidation of soil and hydrologic factors controlling movement, and development of predictive models.
- Impact of waste, agricultural, industrial, and municipal management practices on groundwater contamination.
- Characterization of geologic factors affecting groundwater movement, contamination, and recharge.
- Interaction of groundwater with wetlands and impacts of wetland development.
- Examination of the social and economic impacts of groundwater contamination.
- Comparative analysis of policy alternatives for controlling groundwater contamination.
- Biological, chemical and physico-chemical technologies for remediation of contaminated soils and groundwater.
- Biological, ecosystem, and human health effects of common groundwater pollutants.

Proposal Format: The proposal format is fully outlined on pages 2 through 8 of this joint solicitation package. Most recent literature citations are absolutely required for all proposals seeking support from the UWS.

Review: Each project will receive at least two reviews one of which will be from out-of-state.

DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION (DATCP)

PESTICIDE RESEARCH PROGRAM

RESEARCH GRANT PROGRAM FOR FY 1997
SOLICITATION OF APPLICATIONS

Applications are invited for grant awards focusing on regulatory issues associated with pesticide use and control. This program is administered by the Agricultural Resource Management Division of DATCP. Under this program, the Department may award grants not to exceed three years for research projects on the program priorities outlined below. Proposals may be submitted by any college or university, research foundation or individual having a demonstrated capacity in pesticide or other applicable research.

DATCP RESEARCH PRIORITIES FOR FY 1997

1) **Evaluation of the Environmental Fate Investigation Strategies and Remediation Alternatives for Contaminated Soil and Water at Pesticide Spill Sites.**

This Project should study the degradation and movement of pesticides at spill sites, develop criteria on the need for and appropriate extent of remedial actions, and evaluate various methods for investigation and remediation of contaminated soil and water.

2) **Refinement of Application Methods for Pesticides with High Drift Potential to Reduce Environmental and Public Health Problems.**

This research should focus on how different application methods and environmental conditions affect the potential for drift of pesticides such as metham sodium or clomazone.

3) **Evaluation of Factors Influencing the Patterns of Groundwater Contamination by Pesticides and Pesticide Metabolites in Wisconsin.**

This topic involves looking at factors which influence pesticide leaching to determine areas of the state that are susceptible to groundwater contamination by specific pesticides.

4) **Use Related Monitoring of Pesticides and Pesticide Metabolites in Groundwater.**

This Project should look at groundwater contamination by field application of pesticides in key environmental settings such as fractured bedrock areas.

5) **Identification of the Sources of Pesticide Contamination in Groundwater in Rural Wisconsin.**

Methods should be developed and investigations conducted at contaminated well sites to determine if the contamination is due to field use (nonpoint source) or spills or mishandling (point source) of pesticides.

6) **Evaluation of the Economic Feasibility of Various Chemical and Non-Chemical Weed Control Practices.**

This project should develop a methodology for evaluating the economic feasibility of modifying weed control practices and apply it to examples where practices are changed to reduce impacts on groundwater.

7) **Pesticide Use Surveys.**

These projects should conduct detailed pesticide use surveys that compliment other data gathering efforts, such as ground and surface water monitoring, in order to improve the understanding of pesticide related issues and problems.

8) **Use Related Monitoring of Pesticides in Surface Water and the Effect of Management Practices on Contaminant Levels.**

Projects on this topic should determine the impacts of pesticide use practices on surface water quality and evaluate the ability of various management practices, such as stream setbacks, to reduce contamination.

9) **Evaluation of the Effect of Pesticide Use on Endangered Species and their Habitat.**

This topic should explore how the use of specific pesticides effects the habitat and survival of endangered species in Wisconsin and how alternative pest control methods could reduce problems.

10) **Evaluation of Health Risks from Exposure to Commonly Used Lawn Care Pesticides.**

This project should evaluate the health risks following applications of lawn care pesticides such as pendimethalin, 2,4-D, dicamba, and MCP.

11) **Development of Pest Management Techniques that Lead to Efficient Use of Pesticides and Reduce Impacts on the Environment.**

This project should look at ways of reducing pesticide use through integrated pest management, use of alternative pest control strategies, best management practices, or other techniques that promote efficient pesticide use and minimize environmental problems.

DEPARTMENT OF INDUSTRY, LABOR AND HUMAN RELATIONS

RESEARCH OBJECTIVES

The Department of Industry, Labor and Human Relations (DILHR) is currently conducting research focused on the performance of onsite sewage system designs, products, and management practices that can be incorporated into the administrative rules regulating onsite sewage systems. These designs, products, or management practices must be:

- Directed toward protecting groundwater and surface water quality;
- Result in onsite sewage treatment that is consistent with the provisions of the Groundwater Protection Law;
- Be affordable by the average owner of an onsite sewage system; and
- Be practical for the climate and soils of Wisconsin.

Application Requirements: Anyone may apply for research funds. Applicants will be required to demonstrate education, training, and experience consistent with research objectives.

Budgetary Constraints: The Department is limited to a budget of \$75,000 per year, and existing projects may receive continued funding for another year. Applicants are encouraged to seek additional funding from the DNR, or other sources, where projects also meet funding priorities of other agencies.

Proposal Format: The proposal format is outlined in the joint solicitation.

Review: Each project will be reviewed individually.

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

GROUNDWATER MANAGEMENT PRACTICE MONITORING PROGRAM

Management practice monitoring is defined as groundwater monitoring or support activities associated with groundwater monitoring, such as laboratory technique development or geologic resource description, for establishing or improving management practices necessary to meet the state groundwater quality standards of NR 140, Wis. Adm. Code.

Applicant Requirements

Any individual, government body or private concern can submit project proposals; however, preference will be given to University of Wisconsin System and state agency contractors. No submittals will be accepted from out of state.

Budget Considerations

Monitoring proposals will be considered for a maximum of two years. Projects costing less than \$25,000 annually will be given greater consideration. Management practice monitoring projects are funded solely by state funds; there are no federal funds involved. Budget items to be identified should include such things as personnel costs, supplies, equipment, necessary travel, and other appropriate items. The management practice monitoring funds cannot support capital equipment or indirect costs.

A number of projects which are being funded in FY 96 will continue into FY 97. As a result, some money will be set aside to fund continuing projects. Approximately \$50,000 will be available to fund new monitoring projects in FY 97.

In preparing the budget be aware of the following contractual requirements.

Contractual Requirements

All monitoring wells installed shall meet Department regulations and approved procedures for installation, construction and documentation (Chap. NR 141, Wis. Adm. Code.)

For each new monitoring well, a well construction report shall be submitted on a form (Form 4400-113A) or in a computer format supplied by the Department.

For all groundwater sample points (monitoring wells, piezometers, and private water supplies), an inventory form supplied by the Department shall be completed and submitted.

For any water supply well that is sampled, the contractor shall determine if a well construction report was prepared. A copy of the well construction report, if available, shall be attached to the inventory form.

All groundwater quality monitoring data shall be submitted in a computer format compatible with the state Groundwater Retrieval Network and shall be reported to the Department within two (2) weeks after the data has been received by the contractor. Computerized data shall be verified by the contractor.

All groundwater samples shall be analyzed by a laboratory certified in Wisconsin for that purpose under Chapter NR 149, Wis. Adm. Code.

The contractor shall request labels with Wisconsin Unique Well Numbers from the Department for wells constructed and/or sampled to allow identification of wells. Wells shall be labeled to allow identification. Abandonment of monitoring wells shall be the responsibility of the contractor. Wells shall be abandoned in accordance with Department regulations (Chap. NR 141, Wis. Adm. Code) and approved procedures upon completion of the project, unless alternative prior arrangements have been made with the Department.

Review of Proposals

All proposals will be reviewed and rated by DNR staff, and the Monitoring and Data Management and Research Subcommittees of the Groundwater Coordinating Council.

Two of the important criteria in evaluating each proposal are whether the proposal addresses a priority monitoring topic as listed below (either a high priority or other) and whether the project involves either groundwater monitoring or activities conducted to support groundwater monitoring. Support functions can include, among other things, laboratory analysis technique development, well drilling and construction methodology development, data management and definition of geologic and hydrogeologic conditions for groundwater management purposes. Other criteria for funding include project cost, proposed timeline, whether the proposed project methodology will meet the objectives stated, whether the resources requested are adequate to carry out the project, and whether the project investigators have the abilities to complete the proposed project.

In making final funding decisions, the DNR's Groundwater Management Section will formulate its recommendations based on the input from all project reviewers. The Bureau Director of the DNR's Bureau of Water Resources Management will make the final funding decisions.

Priority Monitoring Topics

For state FY 97, the following priority topics for groundwater management practice monitoring have been selected based on input from a number of state agency staff and university researchers to identify priorities to meet state needs. Five priorities have been designated as higher priorities than the remaining twelve. The higher priorities are listed first and represent more important DNR monitoring needs. Within the lists of "High" and "Other" priorities the list is not in any specific order.

High Priorities

1. **Nitrate management** Evaluation of the impacts of nitrate management on groundwater quality. Examples: monitoring to determine the percentage of fertilizer (including manure) applied to the land surface which reaches groundwater and the factors that affect the amount of leaching that occurs; monitoring to determine if changes in fertilizer application procedures and/or tillage practices have significant potential for reducing nitrate impacts on groundwater; monitoring to correlate groundwater quality with the extent of land owner implementation of best management practices in environmentally sensitive areas; monitoring to evaluate the impacts of animal waste management practices including barnyards, storage design and operation and manure application on groundwater quality; and monitoring to distinguish nitrate contamination caused by chemical fertilizer application from nitrate contamination from other waste sources.
2. **Data management** Improving existing state methods for managing groundwater monitoring data.

Examples: interpretation techniques for comparing groundwater quality data to groundwater standards; methods to make groundwater quality or contaminant source data more readily available; and spatially relating various chemical and geologic conditions.

3. Wellhead protection Delineation of wellhead protection areas in various geologic settings. Evaluation of methods and planning strategies used to protect groundwater in wellhead protection areas in various geologic settings, especially with respect to the use of pesticides. Investigators should be familiar with the state Wellhead Protection Plan.
4. Groundwater - surface water connection Monitoring of surface and groundwater flow to determine hydrologic connections and pathways between them to assess the potential movement and fate of contaminants from one hydrologic regime to another. Examples: Monitoring of groundwater between wastewater lagoons located near streams or wetlands. Investigate the occurrence and causes of aquifer drawdowns that affect surface water features such as springs, streams and wetlands. Investigate the impact of groundwater quality and quantity on overlying fauna/flora populations.
5. Land use management Examination of the impact of land use (e. g. urbanization) on groundwater quality and quantity.

Other Priorities

6. Pesticide management Evaluation of pesticide use impacts on groundwater quality. Examples: monitoring to determine if changes in pesticide application procedures and/or tillage practices have significant potential for reducing pesticide impacts on groundwater, especially projects focusing on atrazine, alachlor (Lasso™) and metolachlor (Dual™) and the potential reduced groundwater impact from pesticide use under low input agricultural practices; monitoring to identify the soil and geologic conditions under which pesticides contamination is likely to occur; evaluation of the extent of groundwater contamination from agricultural and nonagricultural pesticide use and handling in various geologic settings; contamination potential of pesticide metabolites and alternatives to atrazine; monitoring at pesticide loading facilities to evaluate the effectiveness of the facility to protect the surrounding soils and groundwater from contamination; development of laboratory procedures for analyzing metabolite concentrations in water and soil.
7. Landfill regulation Evaluation of current or innovative landfill design, operation or monitoring criteria in relation to compliance with groundwater quality standards.
8. Groundwater remediation Monitoring to evaluate current or developing remediation technologies. Examples: monitoring of vapor extraction or air sparging systems to determine their effectiveness in removing volatile organic compounds from various depths and soil types; monitoring various types of bio-remediation methods to determine how effective they are in Wisconsin.
9. On-site wastewater disposal Monitoring to evaluate the extent to which current and alternative on-site wastewater (private sewage) systems comply with state groundwater quality standards. Examples: Identification and quantification of contaminants in groundwater resulting from wastewater disposal through private sewage systems, including commercial and industrial operations; determination of the extent to which current septic system technology prevents wastewater contaminants from complying with groundwater quality standards in various hydrogeologic settings or varying operating conditions; determination of the performance of new or innovative alternatives to current technology, design criteria or management practices with respect to groundwater quality; field monitoring studies to separate the

impacts of septic systems from those from other sources, such as current and previous agricultural practices, lawn fertilizer use, road salt use and nearby commercial operations.

10. Urban nonpoint pollution Evaluation of best management practices to control sources of urban nonpoint source contamination. Examples: evaluation of infiltration trenches, infiltration basins leaking sewer lines, and grass swales; determination of the constituents of urban discharge runoff water; monitoring in areas of continuous use of fertilizer and pesticide, such as at golf courses or cemeteries.
11. Wastewater treatment Monitoring of different types of wastewater land application and land spreading practices. This would include the landspreading of waste water byproduct solids, such as sludges and septage, as well as the land application of industrial and municipal wastewaters through dedicated systems.
12. Organic chemicals Evaluation of the extent of groundwater contamination from organic chemicals in various geologic and land use settings. Example: evaluation of the potential impacts to groundwater from landspreading contaminated soils.
13. Naturally occurring substances Evaluation of the distribution and seasonal fluctuation of naturally occurring substances such as radionuclides, arsenic, sulfate or saline waters.
14. New technology Development of new laboratory or field technology (or new applications of existing technologies) for determining the characteristics of groundwater and geologic formations for management purposes, including toxicity testing, and downhole groundwater monitoring techniques.
15. Resource definition Studies to better describe the geologic and groundwater properties including groundwater quality and quantity in the state for management purposes. Example: effects of water conservation on groundwater quantity in a county.
16. Evaluation of health effects of groundwater contaminants Investigation of health effects of groundwater contaminants, especially nitrate, ammonia, pesticide metabolites, and alternatives to atrazine. Investigate interactive or synergistic effects of substances which are frequently found together in groundwater.
17. Microbial contamination of groundwater Investigation of the incidence, analytical and monitoring techniques and infective dosages of microbial contaminants, including parasites, bacteria and viruses.

**TABLE 3 - STATE OF WISCONSIN
GROUNDWATER MONITORING/RESEARCH PROJECTS 1986-1996**
(title, principal investigator, years funded, funding agency, project # if assigned)

A Simple Stochastic Model Predicting Conservative Mass Transport Through the Unsaturated Zone into Groundwater. J. Hoopes. 1986. DNR. DNR Project #1.

Groundwater Monitoring for Pesticides. J. Postle. 1986-1994. DNR. DNR Project #2.

Fate of Aldicarb Residues in A Groundwater Basin near Plover, Wisconsin. G. Kraft. 1986-87. DNR. DNR Project #3.

Volatile Organic Compounds in Groundwater and Leachate at Wisconsin Landfills. M. Friedman. 1985-87. DNR. DNR Project #4a.

VOC Contamination at Selected Wisconsin Landfills - Sampling Results and Policy Implications. J. Battista. 1988-89. DNR. DNR Project #4b.

Volatile Organic Compounds in Small Community Wastewater Disposal Systems Using Soil Absorption. W. Boyle, W. Sonzogni. 1986. DNR. DNR Project #5.

The Use of Groundwater Models to Predict Groundwater Mounding Beneath Proposed Groundwater Gradient Control Systems for Sanitary Landfill Designs. J. Hoopes. 1986. DNR. DNR Project #6.

Evaluation Techniques for Groundwater Transport Models. J. Hoopes. 1986. DNR. DNR Project #7.

West Bend Road Salt Use and Storage Study. M. Sucht. 1986-91. DNR. DNR Project #9.

Barnyard Management Practices: Effect on Movement of Nitrogen Through Soils and Impact on Groundwater Quality. B. Shaw. 1991-92. DNR. DNR Project #9.

The Prediction of Nitrate Contamination Potential Using Known Hydrogeologic Properties. D. Cherkauer. 1986-87. DNR. DNR Project #10.

Nitrate Contamination in West-Central Wisconsin with Emphasis on Mill Run First Edition Subdivision. J. Tinker. 1987-90. DNR. DNR Project #11.

Investigation of Hydrogeology and Groundwater Geochemistry in the Shallow Fractured Dolomite Aquifer in Door County, Wisconsin. K. Bradbury. 1986-1990. DNR. DNR Project #12.

Lead Migration from Contaminated Sites - Door County, Wisconsin. J. Wiersma, R. Stieglitz. 1987-88. DNR. DNR Project #13.

Graphical and Statistical Methods to Assess the Effect of Landfills on Groundwater Quality. K. Potter. 1986-87. DNR. DNR Project #14a.

Methods for Determining Compliance with Groundwater Quality Regulations at Waste Disposal Facilities. K. Potter. 1988-89. DNR. DNR Project #14b.

Groundwater Quality Monitoring - Long Term Effects of Intensive Farming and Sprinkler Irrigation on

Groundwater Quality. P. Kammerer. 1986. DNR. DNR Project #15.

The Effect of Construction, Installation and Development Techniques on the performance of Monitoring Wells in Fine-Grained Glacial Till. D. Cherkauer, C. Palmer. 1986. DNR. DNR Project #16.

Field Investigation of Groundwater Impacts from Absorption Pond Systems Used for Wastewater Disposal. J. Hoopes. 1985-86. DNR. DNR Project #17a.

A Case Study of Nitrogen Transformations at a Rapid Infiltration System Used for the Disposal of Food Processing Wastewater. W. Boyle, J. Hoopes. 1986. DNR. DNR Project #17b.

The Occurrence of Volatile Organic Compounds in Wastewater, Sludges and Groundwater at Selected Wastewater Treatment Plants in Wisconsin. C. Hunger. 1985-90. DNR. DNR Project #18.

Fate and Mobility of Radium-226 in Municipal Wastewater Sludge Following Agricultural Landspreading. T. Portle. 1986. DNR. DNR Project #19.

Filtration Preservation Study of Groundwater Samples. D. Sauer. 1984. DNR. DNR Project #21a.

Groundwater Survey of Bacterial Contamination Near Rapid Infiltration Wastewater Treatment System. C. Norenberg, J. Standridge. 1987. DNR. DNR Project #21b.

Hydrogeology of the Wisconsin River Valley in Marathon County, Wisconsin. K. Bradbury. 1986. DNR. DNR Project #22.

Treatment of Cheese Processing Wastewater by Ridge and Furrow Disposal - Nitrogen Transformations. W. Boyle 1986. DNR. DNR Project #23.

Environmental Investigation of the City of Two Rivers Landfills, Manitowoc County, Wisconsin. T. Van Biersel. 1986-87. DNR. DNR Project #24.

Hydrogeologic Investigation and Groundwater Quality Assessment (Havenswood Landfill). P. Singh. 1987. DNR. DNR Project #28.

Groundwater Quality and Laundromat Wastewater: Summit Lake, Wisconsin. J. Saltes. 1986-1988. DNR. DNR Project #29.

Flambeau Paper Sulfite Lagoon Site Contamination Study. W. Lantz 1987. DNR. Project #30.

Monitoring of Volatile Organic Compounds in Tomah, Wisconsin. C. Krohn. 1986, 1989. DNR. Project #31a.

Hydrogeological Investigation of VOC Contaminated Private Wells Near Hudson, Wisconsin. J. Anklam. 1986. DNR. DNR Project #31b.

Sealing Characteristics of Sodium Bentonite Slurries for Water Wells. T. Edil. 1988. DNR. DNR Project #34.

Barron County Nitrate Study. D. Hanson. 1986-87. DNR. DNR Project #37.

Mutagenic Effects of Selected Toxicants Found in Wisconsin's Groundwater. L. Meisner, D. Belluck. 1988-89. DNR. DNR Project #38.

Downward Movement of Water Below Barnyard Grass Filter Strips - Case Studies. G. Bubenzer, J. Converse. 1987-1989. DNR. DNR Project #39.

1987 Volatile Organic Compound Testing Project in Rock County, Wisconsin. D. Holman. 1987. DNR. DNR Project #40.

Volatile Organic Compound Contamination of Private Water Supplies Adjacent to Abandoned Landfills in Marathon County. T. Wittkopf. 1986-1989. DNR. DNR Project #41.

Investigation of Large Scale Subsurface Soil Absorption Systems. D. Peerenboom. 1987. DNR. DNR Project #42.

Characterization of Groundwater Impacts at an Above Ground Petroleum Storage Terminal. G. Becker, R. Ham. 1987. DNR. DNR Project #43.

Lead Contamination Study of Door County. R. Stoll. 1988. DNR. DNR Project #44.

Freedman Creek Hydrogeologic Baseline Report. A. Wilson 1988-89. DNR. DNR Project #45.

Analytical Determination of Atrazine, Alachlor and Their Selected Degradation Products in Contaminated Groundwater: Implication for Wisconsin Groundwater Standards. W. Sonzogni. 1988-89. DNR. DNR Project #47.

Plover Area Nitrate Study. F. Bailey. 1987-88. DNR. DNR Project #48.

Assessment of Geologic Controls on Groundwater Flow and Distribution in Precambrian Bedrock, Central Wisconsin, Using Remote Sensing and Geophysical Analysis. B. Brown, D. Davidson Jr. 1988. DNR. DNR Project #49.

A Ground Penetrating Radar Study of Water Table Elevation in a Portion of Wisconsin's Central Sand Plain. M. Anderson, C. Bentley. 1988. DNR. DNR Project #50.

Mineralogical and Geophysical Monitoring Naturally Occurring Radioactive Elements in Selected Wisconsin Aquifers. G. Morsky, R. Taylor. 1988. DNR. DNR Project #51.

Degradation of Atrazine, Alachlor, Metolachlor in Soils and Aquifer Materials. G. Chesters. 1988-1990. DNR. DNR Project #52.

Evaluation of the Effect of Stormwater Disposal on Groundwater. G. Nienke, B. Shaw. 1988-89. DNR. DNR Project #53.

Radionuclides in Drinking Water of North central Wisconsin. B. Dobbins, C. Fitzgerald. 1988-89. DNR. DNR Project #54.

Pesticide Migration Study. Shaw. 1989-90. DNR. DNR Project #55.

Research and Data Analysis of Groundwater Contamination from Municipal Rapid Infiltration Land Disposal Systems. W. Boyle, J. Hoopes, K. Potter. 1987-88. DNR. DNR Project #56.

Digital Simulation of Solute Transport to Green Bay and Lake Michigan by Groundwater from Door County, Wisconsin. D. Cherkauer. 1988-91. DNR. DNR Project #57.

Grade A Dairy Farm Water Well Quality Survey. G. LeMasters, D. Doyle. 1989. DNR. DNR Project #58.

Demo of Low Input Strategies for Potato/Vegetable Production in Irrigated Sands. Shaw, Curwen, Kraft, Osborne. 1989-90. DNR. DNR Project #59.

Groundwater Quality Investigation of Selected Townships in Jefferson County, Wisconsin. F. Madison. 1989. DNR. DNR Project #60.

Effects of Volatile Organic Compounds on Clay Landfill Liner Performance. Edil, Berthouex, Park, Sandstrom. 1989. DNR. DNR Project #61.

Effect of Soil Type, Selected BMPs, and Tillage on Atrazine and Alachlor Movement Through the Unsaturated Zone. Lowery, McSweeney. 1991. DATCP and DNR. DNR Project #62.

Designs for Wellhead Protection in Central Wisconsin. Osborne, Sorenson, Knaak, Mechenich, Travis. 1989. DNR. DNR Project #63.

Atrazine Contamination of Groundwater in Dane County, Wisconsin. Bradbury, McGrath. 1990-91 DNR., DATCP DNR Project #64.

Sources and Extent of Atrazine Contamination of Groundwater at a Grade A Dairy Farm in Dane County, Wisconsin. Chesters, Levy. 1990-91. DATCP, UWS, and DNR. DNR Project #65.

Effect of Soil Type on Atrazine and Alachlor Movement Through Unsaturated Zone. T. Daniel. 1989. DATCP, DNR. DNR Project #66.

Subdivision Impacts on Groundwater Quality. Shaw, Ameson, VanRyswyk. 1989. DNR. DNR Project #67

Incorporation of County Groundwater Inventory Data into the DNR Groundwater Information Network (GIN). M. Bohn. 1990. DNR. DNR Project #68.

DNR and DATCP Rural Well Survey. LeMasters. 1990. DNR, DATCP. DNR Project #69.

Follow Up to the Grade A Dairy Farm Well Water Quality Survey. Cowell, LeMasters. 1990. DATCP, DNR. Project #70.

Optimum Manure Application Rate - Corn Fertility Management and Nitrate Leaching to Groundwater in Sandy Soils. Shaw. 1989-90. DNR. DNR Project #71.

Report on Bacteriological Water Quality Monitoring of Door County Variance and Special Casing Approval Wells. Hutchinson. 1990-91. DNR. DNR Project # 72.

Volatile Organic Chemical Attenuation in Unsaturated Soil Above and Below an Onsite Wastewater Infiltration System. Tyler, Peterson, Sauer. 1990-91. DNR, UWS. DNR Project #73.

Variation in Hydraulic Conductivity in Sandy Glacial Till: Site Variation Versus Methodology. Mickelson, Bradbury, Rayne. 1990-92. DNR, UWS. DNR Project #74.

A Field Evaluation of Drainage Ditches as Barriers to Contaminant Migration. Bahr, Chambers. 1990-91 DNR.

DNR Project #75.

Nitrogen Isotope Monitoring at Unsewered Subdivisions. Tinker. 1990. DNR. DNR Project #76.

Analytical Determination of Pesticide Metabolites and Carrier Chemicals in Wisconsin Wells. Sonzogni, Eldan, Lawrence. 1990. DNR. DNR Project #77.

Integrated Decision Support for Wellhead Protection. Adams, Bensen. 1991. UWS.

Nitrate Movement Through the Unsaturated Zone of a Sandy Soil in the Lower Wisconsin River Valley. Lowery, Kussow. 1991-93. UWS.

In-situ Removal of Fe, Mn, and Ra from Groundwater. Christensen, Cherkauer. 1991. UWS.

Effect of Complex Mixtures of Leachate on the Transport of Pollutants in Groundwater. Grundl, Cherkauer. 1991-92. UWS.

Adsorptive Behavior of Atrazine and Alachlor in Organic-Poor Sediments. Grundl. 1991. UWS.

The Economic Effects of Groundwater Contamination on Real Estate. Page. 1991. UWS.

Near-Source Transport of Contaminants in Heterogeneous Media. Hoopes. 1991-92. UWS.

Chemical Transport Across a Sediment-Water Interface. Green. 1991-92. UWS.

Role of Mobile Colloids in the Transport of Chemical Contaminants in Groundwaters. Armstrong, Shafer. 1991-93. UWS.

Prediction of Organic Chemical Leachate Concentrations from Soil Samples. Park. 1991. UWS.

Using Ground Penetrating Radar to Predict Preferential Solute Movement and Improve Contaminant Monitoring in Sandy Soils. Kung, Madison. 1991. UWS.

A Tracer Technique for Measuring Regional Groundwater Velocities from a Single Borehole. Monkmeyer. 1991. UWS.

Tracking Contaminant Pathways in Groundwater Using a Geologically Based Computer Code for Outwash. Mickelson, Anderson. 1991-92. UWS.

Bioremediation of Herbicide-Contaminated Soil and Water. Harris, Armstrong. 1991. UWS.

Renovation of Pesticide Contaminated Rinse Waters. Chesters, Harkin. 1991. UWS.

Contamination Attenuation Indices for Sandy Soils: Tools for Information Transfer. McSweeney, Madison. 1991. UWS.

Reactions of Chlorohydrocarbons on Clay Surfaces. Fripiat. 1991. UWS.

Design of a Small Scale Transportable Mixing/Loading System. Kammel. 1991. DATCP.

Evaluation of Potential Phytotoxicity and Crop Residues when Using Sprayer Rinsate as a Portion of the Diluent

in Pesticide Spray Mixtures. Binning. 1991. DATCP.

To Expand Groundwater Sampling in the Lower Wisconsin River Valley. Cates, Madison, Postle. 1991. DNR. DNR Project #78.

Waupaca County Groundwater Project: Towns of St. Lawrence and Little Wolf. Wilson, Blonde. 1991. DNR. DNR Project #79a.

Waupaca County: Towns of Lebanon and Scandinavia. Wilson, Blonde. 1992. DNR. DNR Project #79b.

Crop Rotations Effects on Leaching Potential and Groundwater Quality. Posner, Bubenzer, Madison. 1991-92. DNR. DNR Project #80.

A Study of the Response of Nitrate and Pesticide Concentrations to Agricultural BMPs in Sandy Corn Fields. Madison, Cates. 1991-94. DNR. DNR Project #81.

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Corn Fertility Management and Nitrate Leaching to Groundwater in Sandy Soils (Shaw, Trapp) [DNR 71]

Crop Rotations Effects on Leaching Potential and Groundwater Quality (Posner, Bubenzer, Madison, Iragavarapu) [DNR 80]

Demonstration of Low-input Strategies for Potato/Vegetable Production on Irrigated Sands (Shaw, Curwen, Kraft, Osborne) [DNR 59]

Effect of Barnyard Management Practices on Groundwater Quality in the Central Sands of Wisconsin (Shaw, Bowen, Wilson, Victor, Widdel, Jelinski) [DNR 9]

Management of Sweet Corn Processing Wastes to Protect Groundwater Quality (Bundy, Widen) [UWS 93-BMP-1]

Contaminant Transport

Effects of Volatile Organic Compounds on Clay Landfill Liner Performance (Edil, Berthouex, Park, Sandstrom, Zelmanowitz) [DNR 61]

Evaluation of Groundwater Susceptibility Assessment Systems in Dane County, Wisconsin (Bohn, Muldoon, Madison, Bradbury, Zaporozec) [DNR 100]

Near-Source Transport of Contaminants in Heterogeneous Media (Hoopes) [UWS 91-CTP-3]

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The Biological Impact of Landfill Leachate on Nearby Surface Waters (Sonzogni, Standridge, Geis) [DNR 83]

The Effects of Complex Mixtures of Chemicals in Leachates on the Transport of Pollutants in Groundwater (Grundl, Cherkauer) [UWS 91-CTP-2]

Tracer Study in a Complex Three-Dimensional Flow System (Bahr, Meigs) [UWS 92-CTP-2]

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Hydrogeology

Distribution of Radionuclides in Wisconsin Groundwater (Bradbury, Mudrey) [DNR 91]

Estimating the Spatial Distribution of Groundwater Recharge Rates Using Hydrologic, Hydrogeologic and Geochemical Methods (Potter, Bowser) [UWS 92-HDG-1]

Evaluation of the Correlation between Glacial Landforms, Glacial Sediments, and Hydraulic Conductivity in Dane County, Wisconsin (Mickelson, Oelkers) [DNR 119]

Preliminary Comparison of a Discrete Fracture Model with a Continuum Model for Groundwater Movement in Fractured Dolomite (Bradbury, Muldoon) [DNR 89]

Tracer Study for Characterization of Groundwater Movement and Contaminant Transport in Fractured Dolomite (Bradbury, Muldoon) [DNR 101]

Three-dimensional Characterization of Hydraulic Properties of a Coarse Glacial Outwash Deposit (Mickelson, Aiken) [UWS 91-HDG-3]

Variation of Hydraulic Conductivity in Sandy Glacial Till: Site Variation versus Methodology (Mickelson, Bradbury, Rayne) [DNR 74, UWS 91-HDG-2]

On-site Wastewater

A Comparative Study of Nitrate Loading to Groundwater from Mound, In Ground Pressure and at Grade Septic Systems (Shaw, Turyk) [DNR 82]

Groundwater Quality Impacts from the Storage of Sludge and Septage (Portle, Dunn) [DNR 85]

Long-term Transformation and Fate of Nitrogen in Mound-type Soil Absorption Systems for Septic Tank Effluent (Harkin, Peng) [DNR 103]

Nitrogen Isotope Monitoring at Unsewered Subdivisions (Tinker) [DNR 76]

Nitrogen Removal in Renovated Municipal Wastewater Rapid Infiltration Basins (Gilbert, Oman) [DNR 97]

Onsite Nitrogen Removal Systems Research/Demonstration Project (Otis, Apfel, Whitmyer) [DILHR Project]

Subdivision Impacts on Groundwater Quality (Shaw, Arnsten, VanRyswyk) [DNR 67]

Volatile Organic Compound Attenuation in Unsaturated Soil Above and Below an On-site Wastewater Infiltration System (Tyler, Peterson, Sauer) [DNR 73]

Pesticides

Adsorptive Behavior of Atrazine and Alachlor in Organic-Poor Sediments (Grundl, Small) [UWS 91-PTC-1]
Assessing Aquifer Susceptibility to and Severity of Atrazine Contamination at a Field Site in Southcentral Wisconsin (Chesters, Levy) [DATCP 91-01, UWS-91-PTC-2]

Assessment of 1992 Wisconsin Atrazine Rule (Ag30) (Nowak, Wolf, Hartley, McCallister)

Column Leaching Study of Six Pesticides, Nitrate, and Chloride Through Four Wisconsin Soils (Shaw, Heitman) [DNR 55]

Design of a Small Scale Transportable Pesticide Mixing/Loading System (Kammel)
[DATCP 89-02]

Distribution, Sources, and Fate of Atrazine in a Sandy-Till Aquifer (Chesters, Levy)
[DATCP 91-01, UWS-91-PTC-2]

Effect of Soil Type on Atrazine and Alachlor Movement Through the Unsaturated Zone (Daniel, Fermanich, Wietersen) [DNR 62]

Effect of Soil Type, Selected Best Management Practices, and Tillage on Atrazine and Alachlor Movement through the Unsaturated Zone (Lowery, McSweeney, Fermanich, Hart, Wang, Seybold) [DNR 66]

Field Study of Atrazine Contamination of Groundwater in Dane County, Wisconsin (Bradbury, McGrath) [DNR 64]

Follow-Up to the Grade A Dairy Farm Well Water Quality Survey (Cowell, LeMasters)
[DNR 70]

1994 Groundwater Survey of Alachlor in Southern Wisconsin (Vanden Brook) [DNR 112]

Hydrogeologic and Land-use Controls on Atrazine Detections in Dane County, Wisconsin (Bohn, Madison, Muldoon, Connors) [DNR 99]

Persistence of Aldicarb Residues in a Groundwater Basin Near Plover, Nine Years After Aldicarb Use (Kraft)

[DNR 84]

Role of Mobile Colloids in the Transport of Chemical Contaminants in Groundwater (Armstrong, Shafer, Dean) [UWS 91-CTP-5]

Simulation of Atrazine and Metabolite Transport and Fate in a Sandy-Till Aquifer (Chesters, Levy) [DATCP 91-01, UWS 92-PTC-2]

Sources and Extent of Atrazine Contamination of Groundwater at a Grade A Dairy Farm in Dane County, Wisconsin (Chesters, Levy, Gustafson, Read) [DNR 65]

Spatial Attributes of the Soil Landscape Groundwater System of the Lower Wisconsin River Valley (McSweeney, Madison, Attig, Bohn, Falk) [DNR 88]

Using an Approximation of the Three-Point Gauss Hermite Quadrature Formula for Model Prediction of Atrazine Fate and Transport (Levy, Chesters) [DATCP 91-01, UWS 91-PTC-2]

Remediation

Bioremediation of Herbicide-Contaminated Soil and Water (Harris) [UWS 91-REM-1]

Remediation of Soils Contaminated by Leaking Underground Storage Tanks by Vapor Extraction and *In situ* Biostimulation (Hickey, Jacobsen, Bubenzer) [DNR 96]

Renovation of Pesticide Contaminated Rinse Waters (Chesters, Read) [UWS 91-REM-2]

Retardation of Organic Compound Movement in Landfills using Shredded Tires (Edil, Park, Kim) [UWS 92-REM-1]

Sampling and Analytic Methods

Analytical Determination of Pesticide Metabolites and Carrier Chemicals in Wisconsin Wells (Sonzogni, Eldan, Lawrence) [DNR 77]

Assessment of Wisconsin's Groundwater Monitoring Plan (GWM) Program for Active Non-Approved Landfills (1985-1990) (Pugh, Gear) [DNR 92]

Factors Affecting the Determination of Radon in Groundwater (Sonzogni) [DNR 111]

Investigation of Potential Groundwater Impacts at Demolition Landfills, Deer Pits, and Yard Waste Sites (Svavarsson, Faule, Connelly) [DNR 98]

Low Flow Pumping Versus Field Filtering Analysis with Respect to Implementation (Connelly, Ostergren) [DNR 106]

Volatile Organic Compounds at Wisconsin Landfill: Recent Findings (Batista, Connelly) [DNR 104]

Social Science

Designs for Wellhead Protection in Central Wisconsin: Case Studies of the Town of Weston and City of Wisconsin Rapids (Osborne, Sorensen, Knaack, Mechenich, Travis) [DNR 63]

The Economic Effects of Groundwater Contamination on Real Estate (Rabinowitz, Page) [UWS 91-SOS-1]
Water Supply

Bacteriological Water Quality Monitoring of Door County Variance and Special Casing Approval Wells (Hutchinson, Urben, Beaumier) [DNR 72]

Drinking Water and Groundwater Quality in the Lower Wisconsin River Valley (Cates, Madison, Postle) [DNR 78]

In Situ Removal of Iron, Manganese, and Radium from Groundwater (Christensen, Cherkauer) [UWS 91-WSP-1]

Naturally Occurring Arsenic in Sandstone Aquifer Water Supply Wells of Northeastern Wisconsin (Stoll, Burkel, LaPlant) [DNR 87 and DNR 110]

Ultrasonic Verification Technique for Evaluating Well Seals (Edil, Yesiller, Benson) [UWS 93-WSP-1]

Waupaca County Groundwater Testing and Educational Program: Towns of Lebanon, Scandinavia, St. Lawrence and Little Wolf (Wilson, Blonde) [DNR 79]

Groundwater Education Activities of the Department of Public Instructors

The Department of Public Instruction (DPI), though not a member agency of the GCC does promote and support educational activity related to surface and groundwater quality. DPI is represented on the GCC Education Subcommittee. In FY 96 DPI staff were involved in the following activities:

Sustainability Workshops - DPI Agricultural Education staff worked with DNR Education staff to deliver 10 workshops for agricultural education instructors and all other interested educators on sustainable forestry methods. These workshops emphasized environmental stewardship and impacts on groundwater, surface water, soils, wildlife and forest resources. Over 200 teachers attended these workshops.

Professional Development Programs - During the 1996 Wisconsin Association of Vocational Agriculture Instructors Summer Conference, a workshop was conducted on "Get Your Feet Wet - Water Education for Teachers." This workshop was attended by Pam Packer, Susan Gilchrist, and Mindy Habecker from the DNR. Approximately 20 people attended this session.

**Groundwater Activities of the U.S. Geological Survey
Water Resources Division - Wisconsin District**

The mission of the U.S. Geological Survey-Water Resources Division is to provide the hydrologic information and understanding needed for the optimum utilization and management of the Nation's water resources for the overall benefit of the people of the United States. This mission is accomplished, in large part, through cooperation with other Federal, State and local agencies, by:

- * Collecting, on a systematic basis, data needed for the continuing determination and evaluation of the quantity, quality, and use of the Nation's water resources.
- * Conducting analytical and interpretive water-resource appraisals describing the occurrence, availability, and physical, chemical, and biological characteristics of surface water and ground water.
- * Conducting supportive basic and problem-oriented research in hydraulics, hydrology, and related fields of science to improve the scientific basis for investigations and measurement techniques and to understand hydrologic systems sufficiently well to quantitatively predict their response to stress.
- * Disseminating the water data and the results of these investigations and research through reports, maps, computerized information services, and other forms of public releases.
- * Coordinating the activities of Federal agencies in the acquisition of water data for streams, lakes, reservoirs, estuaries, and ground water.
- * Providing scientific and technical assistance in hydrologic fields to other Federal, State, and local agencies, to licensees of the Federal Energy Regulatory Commission, and to international agencies on behalf of the U.S. Department of State.

The Wisconsin District is currently conducting cooperative projects that have a significant ground-water component with the following State and local agencies: DNR, WGNHS, DOT, Dane County Regional Planning Commission (DCRPC), and Bad River Band of Lake Superior Chippewa. In addition, several projects are funded by the following Federal agencies: EPA-Region V, Department of Defense (DOD), and USGS. On-going projects and completed projects with reports in preparation that have a significant ground-water component are listed below.

On-going projects with State and local agencies

1. Ground-water observation well network (WGNHS)
2. Wisconsin water-use data file (DNR)
3. Hydrologic investigations of wetland restoration and creation projects (DOT)
4. Dane County regional hydrologic study (DCRPC, WGNHS)
5. Optimum management of ground-water resources in the Lower Fox River Valley (DNR)
6. Characterization of part of the aquifer flow system in the vicinity of the Bad River Indian Reservation (Bad River Band of Lake Superior Chippewa)

On-going projects with Federal agencies

1. Superfund remedial response support (EPA)
2. Hydrologic and biogeochemical budgets in temperate lakes and their watersheds, Northern Wisconsin (USGS)
3. Western Lake Michigan Drainages National Water-Quality Assessment (USGS)
4. Fort McCoy ground-water quality; Division of Environmental Management support (DOD)

Completed projects with reports in preparation

1. Water resources of the Lac du Flambeau Indian Reservation
2. The application of an analytic element model to investigate ground-water/lake interactions at Pretty Lake
3. Contributions of methylmercury to a northern Wisconsin seepage lake from littoral zone sediments
4. Collection of hydraulic and geologic data to improve the quality of the Wisconsin observation-well network
5. Hydrogeology and simulation of ground-water flow in the sandstone aquifer, Fox Cities
6. Water resources at Wild Rose fish hatchery, Waushara County
7. Regional groundwater flow system between the Wolf and Fox Rivers near Green Bay

A summary of the Wisconsin District projects and listing of publications is published annually in "Water-Resources Investigations in Wisconsin." Copies of the summary are available at the Wisconsin District Office or by calling 608/276-3801. For more information please contact Jim Krohelski, USGS, 6417 Normandy Lane, Madison, Wisconsin, 53619 (608/276-3850), jtkrohel@usgs.gov

Groundwater Education Goals and Principles
Groundwater Coordinating Council Education Subcommittee
Endorsed by the Groundwater Coordinating Council, February 16, 1996

Vision: Wisconsin citizens will understand the groundwater resource and act appropriately to protect and conserve its quality and quantity.

Goals

1. Wisconsin citizens will understand the origins of Wisconsin's groundwater, the basic principles of its movement, and its interrelationships with surface water and other natural resources.
2. Wisconsin citizens will understand the effects of land uses on the groundwater resource, and their personal roles in groundwater quantity and quality protection.
3. Wisconsin citizens will understand the health risks of groundwater and drinking water contamination, and will know how to take action to minimize those risks.
4. Wisconsin elected officials and agency staffs will understand their potential leadership roles and authorities for groundwater protection and management activities.

Key Principles

1. Existing groundwater education materials should be examined to see whether they can be used to meet identified goals. Gaps should be filled.
2. An effective distribution system must be developed and considered equally important to development of new materials.
3. Groundwater education partnerships should be developed among agencies and with interested organizations and user groups.
4. Agency staff need training to understand the groundwater resource and to work with affected groups.
5. Local government organizations need help in understanding laws and potential improvements in practices under their jurisdiction.
6. Community organizations, health organizations, and the medical community can help in the distribution of health risk information.
7. K-12 education is an important avenue for delivering groundwater education in Wisconsin.
8. Teachers need professional development opportunities in groundwater education.
9. All groundwater materials and programs need critical evaluation to determine their contribution to meeting identified goals.

Education Subcommittee Roles in Groundwater Education
Groundwater Coordinating Council Education Subcommittee
endorsed by the Groundwater Coordinating Council, February 16, 1996

Information sharing

The Education Subcommittee will serve as a forum for the exchange of information about agency and university programs. The Subcommittee may identify education needs during these exchanges, and may suggest to the agencies that they develop materials and programs to meet these needs. These exchanges should help to reduce duplicative efforts by the agencies. The Subcommittee will promote the delivery of consistent messages to the public by the member agencies. The Subcommittee will review educational programs and materials according to the criteria it has established.

Joint education efforts

The Education Subcommittee will identify opportunities for joint education efforts among member agencies. Subcommittee members will help coordinate and implement those ideas through their agencies where possible.

Conflict resolution

The Education Subcommittee will attempt to resolve differences in educational messages between member agencies through the following process:

- Subcommittee members will attempt to reach consensus on the message. Subcommittee members will report the discussion and consensus of the Subcommittee to their agency.
- If consensus is not achieved, the Chair will send a letter detailing the Subcommittee discussion to the involved agencies and ask them to work toward consensus.
- If the involved agencies do not reach consensus, the Chair will report the Subcommittee discussion to the Council and notify them of the inability to come to consensus.

Groundwater education strategies development

The Education Subcommittee will periodically combine identification of basic groundwater education needs with information about member agencies' plans and capabilities. The Subcommittee will develop a strategy to promote and encourage groundwater education activities which meet identified needs. Examples of Subcommittee actions might include:

- promotion of a priority program by member agencies through their usual outlets for information,
- asking Subcommittee members to commit limited amounts of time to preparation of a joint educational effort,
- sending a letter of support to an agency head for agency involvement in a program seen as important by the Subcommittee.

Statutory Language Relating to the GCC

