

WISCONSIN GROUNDWATER COORDINATING COUNCIL

REPORT TO THE LEGISLATURE



August 1998

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Wisconsin Alliance of Cities - Jim Trierweiler



State of Wisconsin \ GROUNDWATER COORDINATING COUNCIL

Tommy G. Thompson, Governor

101 South Webster Street
Box 7921
Madison, Wisconsin 53707
FAX 608-267-7650
TDD 608-267-6897

August, 1998

To: The Citizens of Wisconsin

The Honorable Governor Tommy G. Thompson
Senate Environment and Energy Committee
Assembly Environment Committee
Assembly Natural Resources Committee
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Secretary William McCoshen - Department of Commerce
Secretary Ben Brancel - Department of Agriculture, Trade and Consumer Protection
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State Geologist James Robertson - Geological and Natural History Survey

Susan L. Sylvester,
Council Chair
DNR

Carol Cutshall
DOT

James Robertson
WGNHS

Nicholas Neher
DATCP

Henry Anderson
DHFS

John Alberts
COMMERCE

Frances Garb
UWS

John Metcalf
GOVERNOR'S REP.

This is the 1998 Groundwater Coordinating Council (GCC) Report to the Legislature. The GCC was formed in 1984 to help state agencies coordinate non-regulatory activities and exchange information on groundwater. The GCC 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 its state from an advisory position.

Examples of GCC-coordinated groundwater accomplishments by your state agencies during the past year include:

- Staff from the Departments of Natural Resources, Health and Family Services and Agriculture, Trade and Consumer Protection, and the State Laboratory of Hygiene evaluated and revised language that will be issued with water sample "triazine screen" test results. Before revision, the recommendations didn't acknowledge by-products of atrazine which cannot be detected by this screening test but which have been shown to have the same health effects as atrazine. Review of technical information led to the conclusion that the triazine test should be continued and then revised language should reflect the presence of metabolites. A laboratory that will quantify the metabolites for members of the public was sought out and the new test should be available by the fall of 1998.
- Publication of the updated "Directory of Groundwater Databases" by the DNR in April, 1998. The Directory was revised to be more useful to local government staff. It is available on the DNR's Bureau of Drinking Water and Groundwater web page (<http://www.dnr.state.wi.us/org/water/dwg/gw/Pubdwld.HTM>). Through its subcommittees, the GCC continued to address other important data management issues as well. Groundwater-related forms were prepared for electronic submittal and progress was made in the integration of well construction data for public water supply wells into an automated format.

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
BMP	Best Management Practices
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
DNR	Department of Natural Resources
DOT	Department of Transportation
DPI	Department of Public Instruction
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
FSA	(USDA) Farm Service Agency
FY	Fiscal Year
GCC	Groundwater Coordinating Council
GEMS	Groundwater and Environmental Monitoring System
GIS	Geographic Information Systems
GS	Groundwater 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	(USDA) Natural Resource Conservation Service
PAL	Preventive Action Limit
PECFA	Petroleum Environmental Clean-up Fund Act
ppb	parts per billion
ppm	parts per million
SLOH	State Laboratory of Hygiene
SMP	State Management Plan
SWAP	Source Water Assessment Program
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) 1998.

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); Agriculture, Trade and Consumer Protection (DATCP); Health and Family Services (DHFS); 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, agency staff, coordinated by the Groundwater Coordinating Council have 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-six projects were funded in FY 98 by one or more of the following agencies: UWS, DATCP, DNR and COMM. 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 99 was distributed in October, 1997. A copy of the joint solicitation is contained in the Appendix. A total of 30 project proposals were received. Sixteen new projects were selected by the UWS, DNR, and/or DATCP for funding in FY 99 in addition to 8 projects which will carry over into the new fiscal year. The FY 99 groundwater monitoring and research projects and their funding agency are listed in Table 2. The GCC endorsed the UWS groundwater research plan for FY 99 as required by s. 160.50(1m), Wis. Stats.
2. The GCC continued to coordinate efforts to enhance the utility of groundwater monitoring and research funded through the joint solicitation process. In FY 97, UW Water Resources Center (WRC) staff made summaries of 72 final reports of projects funded by the State of Wisconsin between 1989 and 1994 accessible by computer through the creation of a web site (www.library.wisc.edu/libraries/Water_Resources/wgrmp/wgrmp.htm). The summaries are currently viewed and downloaded by researchers, field specialists, state agency and academic library staff, environmental consultants, legislative personnel, and citizens groups having access to the world wide web. In FY 98, the WRC web site hosted 1,152 visitors who retrieved a total of 2,518 project summaries.
3. Through its subcommittees, the GCC continued to address important data management issues. The Directory of Groundwater Databases was updated and published in April 1998. The Directory was revised to be more useful to local government staff. It is available on the DNR's Bureau of Drinking Water and Groundwater web page (<http://www.dnr.state.wi.us/org/water/dwg/gw/Pubdwnld.HTM>). Groundwater-related forms were prepared for electronic submittal and progress was made in the integration of well construction data for public water supply wells into an automated format.
4. In an excellent example of interagency achievement, staff from the DNR, DHFS, DATCP, and the State Laboratory of Hygiene evaluated and revised language that accompanied water sample "triazine screen" test results. A workgroup including several GCC Education Subcommittee members reviewed

technical information and concluded that the triazine test should be continued and then revised language reflecting the presence of metabolites. The workgroup also sought out a laboratory that will quantify the metabolites for members of the public. The new test should be available by the fall of 1998.

5. Creation of a web site for the GCC by the DNR (<http://www.dnr.state.wi.us/org/water/dwg/gcc/>). The site includes a description of the membership, purpose, objectives and activities of the GCC. The web site also contains groundwater-related documents for viewing and downloading, and links to other groundwater sites as well as the other GCC member agencies. A key link is to the Water Resources Center web site that contains the "Wisconsin Groundwater Research and Monitoring Project Summaries" (see item 2).
6. 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), the U. S. Geological Survey (USGS), and Farm Service Agency (FSA) 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 98.

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." In addition, this year we have included an article "Walking on Water" in the Appendix that captures Wisconsin's Sesquicentennial spirit by providing an historical perspective on groundwater management. This article appeared in the June/July issue of the DNR's Natural Resources Magazine

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 Family Services (DHFS). 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 Commerce (COMM) (private sewage systems, petroleum product storage tanks); 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 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, and DNR participated in a joint solicitation for groundwater-related research and monitoring proposals for funding during fiscal year 1999. 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 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.

DNR regulatory programs to protect groundwater are the responsibility of one of four Bureaus:

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.
2. Bureau of Waste Management - Regulation and groundwater monitoring of proposed, active, and inactive solid waste sites.
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.
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.

The GS 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.

Chapter 160, Stats., requires the DNR to develop numerical groundwater quality standards, consisting of enforcement standards and preventive action limits. Chapter NR 140, Wis. Adm. Code, establishes groundwater standards and creates a framework for implementation of the standards by the DNR. On January 22, 1997, the DNR's Natural Resources Board authorized the DNR to hold public hearings on the proposed revisions to ch. NR 140. The proposed amendments to ch. NR 140 would add groundwater standards for 25 additional substances based on recommendations from the DHFS. Revised standards are proposed for cyanazine. The proposed amendments to ch. NR 140 also include provisions to clarify groundwater sampling, analysis and reporting requirements, exemption procedures, and to reflect renumbering and reorganization of the environmental chapters of the Wisconsin Statutes effective January 1, 1997. Four public hearings were held throughout the state from July 28 to 31, 1997, on the proposed amendments to ch. NR 140.

Following the hearings, standards for four substances were withdrawn and standards for three substances were revised based on new toxicological information received during the hearings. On March 25, 1998, the Natural Resources Board adopted groundwater standards for 19 of 21 substances, along with the other amendments described above. The Board deferred action on ammonia and boron and requested the

Department gather more information on the impact these standards may have on industry. On April 29, 1998, the Board adopted health-based standards for both ammonia and boron. On June 10, 1998, the Assembly Committee on Natural Resources held hearings on the proposed amendments to ch. NR 140 and heard testimony which focused on standards for ammonia and boron. On June 17, 1998, at the executive session of the Assembly Committee on Natural Resources, the Committee decided that the proposed standards for ammonia should be removed from the rule package and that the proposed standards for boron be promulgated with a delayed effective date. The DNR is to advise the Committee what that date should be following consultation with the Natural Resources Board. The DNR will recommend a delayed effective date of January 1, 2000 for the boron standard to the Board at its August meeting. Following a decision by the Board on standards for both ammonia and boron, the rule package will return to the Legislature for further consideration.

GS staff serve on the Standards and Streamlining Team which identifies policy issues, develops guidance, and provides training regarding the implementation of chs. NR 720, 722, 724 and 726 dealing with soil cleanup standards, selecting and implementing remedial actions and case closures. The team is also responsible for developing additional NR 720 soil standards, supporting groundwater standards development and streamlining the cleanup process.

GS staff also serve on the Statewide Consistency Team which evaluates and makes recommendations promoting consistency, as necessary and appropriate, for statewide issues affecting the DNR's Bureau for Remediation and Redevelopment. These issues include, in part, site investigations, soil and groundwater remediations, and general case closure decisions. This team's function is critical in obtaining statewide consistency in how the Bureau of Remediation and Redevelopment evaluates, addresses and closes soil and groundwater contamination sites.

NR 141 Ad Hoc External Advisory Committee recommendations to develop a strategy for labeling wells with a unique well number to allow tracking and centralization of the data has resulted in GS staff work producing several possible additional changes to the code to be considered when the code revisions proceed.

Work was initiated to develop a DNR well forms entry program to allow electronic submittal of six DNR well-related forms. The program is intended to electronically capture, print, export, and import well-related information. The six forms are: Monitoring Well Construction Form 4400-113A, Monitoring Well Development Form 4400-113B, Well/Drillhole/Borehole Abandonment Form 3300-5B, Soil Boring Log Information Form 4400-122 and 122A, Groundwater Monitoring Well Information Form 4400-89, and Groundwater Monitoring Inventory Form 3300-67. The entry program is being developed in conjunction with the introduction of special Wisconsin Unique Well Number (WUWN) tags specifically designed for monitoring wells.

GS staff have worked with basin planners to develop more specific groundwater reports for basin plans. This includes better baseline water quality information and inventorying of potential threats to the resource.

Four monitoring well drilling operations were inspected in FY 98. These inspections are designed to educate drillers and environmental consultants about NR 141 and to enhance compliance with the code. Efforts continue to educate operators and consultants on the proper techniques for geoprobe operation.

The application and effectiveness of oxygen release compound (ORC) as a remediation enhancement is being reviewed by GS staff. When in contact with water it releases oxygen for months. ORC can be incorporated in backfill, injected into boreholes or injected into shallow aquifers.

Bureau of Drinking Water and Groundwater staff continue to operate a web site (<http://www.dnr.state.wi.us/org/water/dwg/index.htm>). The site provides an important link for people to access information on groundwater. The site contains information on public water systems, private wells, well drilling, pump installation, groundwater, and DNR staff. Groundwater sections include groundwater publications (online viewable, downloadable, or a contact for requesting copies), sampling information,

groundwater data, general groundwater information, fun with groundwater (20 question quiz and animated water cycle image), and links to other related sites. Many groundwater documents (including the GCC Reports to the Legislature) were made available on the Groundwater Information web site (<http://www.dnr.state.wi.us/org/water/dwg/gw/>) this year. All new publications developed within the Groundwater Section were posted for downloading or online viewing.

A world wide web site has been developed for the GCC. The site provides information on the GCC's purpose, the activities of the council, a list of members on the council and members of the subcommittees, documents in web viewable format and downloadable format, and links to other relevant groundwater or related web sites. The address for the home page is <http://www.dnr.state.wi.us/org/water/dwg/gcc/>.

In September 1996, GS staff published revisions to the DNR's Groundwater Sampling Desk Reference and Field Manual. 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 go into much greater detail on how to consistently collect high quality, representative groundwater samples and measurements. During FY 98 both the Desk Reference and Field Manual were widely distributed and well received. The two documents are available on the Bureau of Drinking Water and Groundwater's web page (<http://www.dnr.state.wi.us/org/water/dwg/gw/sample.htm>).

The DNR continued its groundwater monitoring program which includes problem assessment monitoring, at-risk well monitoring, management practice monitoring, and regulatory monitoring. During FY 98, \$283,317 was awarded to ten projects for the management practice monitoring program (see Table 1). The ten projects were selected during the joint solicitation process described under "Groundwater Monitoring and Research" in this report. During FY 99, approximately \$285,526 will be awarded to eight 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, the UW Water Resources Center (WRC) and GS staff continued to distribute the findings of groundwater monitoring and research funded through the joint solicitation process. In FY 96 DNR and 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. In FY 97 these summaries were made available on the WRC world wide web site (www.library.wisc.edu/libraries/Water_Resources/wgrmp/wgrmp.htm). Paper copies of all final reports and summaries continue to be 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 Systems 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.

The DNR continues a statewide public information campaign aimed at encouraging water purveyors to protect their water supplies from potential sources of contamination. This public education campaign continues with statewide media releases; direct mailings of groundwater protection materials; and a biannual newsletter to water supply operators, city and village mayors, tribal chairs and town chairs.

The DNR also provides technical assistance to water supply systems that request 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 provided funding in FY 97 for a pilot project to delineate WHP areas for all of the municipal water supply wells in Dane County. In FY 98, DNR regional water supply staff distributed the delineations to all the municipalities in the county.

GS staff completed and submitted to the US EPA in October, 1997 a biennial status report on WHP activities in Wisconsin. GS staff developed a database to track voluntary and regulatory WHP activities.

The DNR created a Wellhead Protection Team in January to facilitate discussion on WHP issues and coordinate WHP activity. Activities by the team have included reviewing team priorities, evaluating options for increasing voluntary WHP activity, and integrating with the source water assessment and vulnerability assessment programs.

The DNR also created a Source Water Protection Team to meet the requirements of the 1996 Safe Drinking Water Act Amendments relating to developing a Source Water Assessment Program (SWAP). This program will: 1) delineate source water protection areas for all public water systems in the state; 2) conduct inventories of significant potential sources of contamination (SPSCs) within those areas; 3) perform an analysis of susceptibility for each system; and 4) make the results of the assessments available to the public. In coordination with the public water system vulnerability assessment program, GS staff have produced calculated fixed radius delineations for all municipal wells in the state. Maps of those delineations were sent out to each municipality in the West Central, South Central and Northern DNR regions with a request for system operators to identify SPSCs within the delineated area. The remaining portion of the state will be completed by the end of December 1998. GS staff have solicited stakeholder input on the SWAP by setting up advisory committees, making public presentations and sending out questionnaires on the SWAP. Wisconsin must submit its SWAP Plan to the EPA by February 6, 1999.

The DNR has been 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. GS staff assisted Bureau of Waste Management staff and DNR consultants in the evaluation of the model and geologic interpretations used in the model.

During FY 98, the Water Division began a series of discussions concerning the development of an integrated watershed planning process to address work planning and project implementation at the GMU level in the reorganized Department structure. These strategic planning discussions have involved the Bureau of Drinking Water and Groundwater, the Bureau of Fisheries and Habitat, and the Bureau of Watershed Management. Simultaneously, the Bureaus of Watershed Management and Drinking Water and Groundwater have maintained efforts to address groundwater in water quality management plans. Water Quality Management (WQM) plans are developed under Section 208 of the Clean Water Act and NR 121, Wis. Adm. Code. The plans provide water resources information and recommendations along river basin and watershed boundaries.

The GS 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. GS staff obtain data from the Groundwater Retrieval Network (GRN) to identify areas with nitrate and/or pesticide contamination for use in WQM Plan maps. By providing information during development of WQM Plans, the accuracy and thoroughness of each plan is enhanced. Most WQM Plans contain a groundwater report. During FY 98, GS staff worked on groundwater reports for the Grant Platte Basin and the Lower Wisconsin Basin.

Bureau for Remediation and Redevelopment spent a considerable amount of time in FY 98 on several

major rulemaking efforts. These include proposed revisions to: 1) chapters NR 720 regarding development of additional soil cleanup standards, and 2) chapters NR 716, NR 722, NR 724, and NR 726 regarding clarification of numerous issues on the use of natural attenuation as a cleanup remedy for contaminated groundwater. In addition, work is also on-going to develop chapter NR 749 that would establish fees when a responsible party requests Department assistance. The revenue from the fees would be used to hire additional staff to help implement the Brownfield cleanup and redevelopment initiative contained in the last budget.

In addition, in early May the DNR signed an Memorandum of Understanding (MOU) with the Department of Commerce for addressing the numerous petroleum contaminated sites eligible for PECFA reimbursement. This has been a major undertaking for both agencies and will continue to take significant resources to implement over FY 99.

The program has also 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 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 sometime in FY 99. This effort should provide for more streamlined environmentally sound approaches to this category of contamination sites.

The Remediation and Redevelopment program, 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 \$2.6 million was spent during FY 98 to address groundwater contamination at existing project sites. Additionally, close to \$6 million in bonding funds were committed for construction projects associated with prevention of groundwater contamination and groundwater remediation.

A new dry cleaner environmental response reimbursement program was established by the Legislature in the 1997 - 1999 budget bill. Rules are underway for implementation. This program will reimburse dry cleaners for eligible investigation and cleanup costs. It is funded by the dry cleaners.

The Bureau of Watershed Management continued to issue WPDES permits to all communities and industrial facilities which discharge treated domestic or industrial wastewater to a land treatment system. Wastewater land treatment systems are primarily spray irrigation systems, seepage cells and ridge & furrow treatment systems. WPDES permits, issued to facilities discharging through a land treatment system, contain groundwater monitoring and data submittal requirements which are used to evaluate facility compliance with state groundwater quality standards established in ch. NR 140 Wis. Adm. Code. WPDES permits issued to new municipal discharges to groundwater via seepage cells reflect the more stringent effluent limits for total nitrogen and chloride contained in ch. NR 206, Wis. Adm. Code. A concerted effort is being made to evaluate and require upgrading of groundwater monitoring systems at existing facilities.

The Bureau of Watershed Management continues to work with unsewered communities, served by individual on-site treatment systems, in their efforts to construct centralized wastewater treatment facilities. Bureau staff are reviewing and commenting on new proposed COMM design regulations for on-site systems. The Bureau is also working with the COMM to resolve jurisdictional concerns associated with the new proposed regulations.

The Bureau of Watershed Management revised NR 204 regulations which govern the treatment, use and disposal of municipal wastewater treatment plant sludge, and NR 113 pertaining to septage management, to incorporate new federal standards. The revised NR 204 became effective January 1, 1996, and NR 113 became effective January 1, 1997. Both regulations contain land application site requirements and restrictions which are designed to prevent runoff to surface water or leaching of nutrients and pollutants to groundwater. The Bureau has completed work and implemented use of a new statewide computer system which records and monitors treatment and use of municipal sludge, septage, and industrial land application activities, including an inventory and history of all sites used for land application.

The second year of a three-year investigation into elevated iron and manganese concentrations in groundwater at industrial wastewater land application sites has been completed. This study is being conducted by the Mid-West Food Producer's Association (a trade organization representing the vegetable producing industry) in conjunction with the University of Wisconsin - Madison. Results of this investigation are scheduled to be submitted by March 1, 1999.

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.

Currently the Bureau of Watershed Management's Runoff Management Program is being restructured to better address the needs of stakeholders and partners. No new watersheds were selected for priority watershed studies in FY 98. However, projects still in planning were brought into implementation. In July 1998, new Priority Watershed Projects are scheduled to be selected for water quality assessments. Implementation of Best Management Practices to improve water quality is continuing in watersheds selected previously.

For more information, contact Susan Sylvester or Mike Lemcke, DNR, P.O. Box 7921, Madison, WI 53707-7921; phone: 608-266-1099 (Susan), or 608-266-2104 (Mike); e-mail: sylves@dnr.state.wi.us (Susan), or lemckm@dnr.state.wi.us (Mike).

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 concurred with the Generic SMP in June, 1996. 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 1998 growing season increased the number of atrazine use prohibition areas, based on groundwater sample results available as of September 1997. 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. This survey was conducted again in FY 97 and FY 98 with similar results. DATCP hopes to conduct this survey annually to analyze contamination trends in prohibition areas.

In FY 97, DATCP completed a groundwater sampling survey designed to evaluate the effectiveness of the Atrazine Rule (ch. ATCP 30, Wis. Adm. Code). The survey, required under ATCP 30, was to determine if a "statistically significant change" occurred in groundwater concentrations of atrazine and its three chlorinated metabolites between Phases 1 (1994) and 2 (1996) of the survey. The survey showed a statistically significant decline in the level of atrazine contamination in Wisconsin groundwater between 1994 and 1996. However, atrazine still reaches groundwater and in some cases exceeds the enforcement standard. The Atrazine Rule appears to be effective in reducing atrazine contamination of groundwater. DATCP recommends that current limits on atrazine use be continued. Further discussion of pesticide sampling survey results is contained under Condition of the Resource - Groundwater Quality.

In FY 97, DATCP also resampled 100 private wells that had a triazine immunoassay test result of 0.8 µg/l or higher, but had never had a more comprehensive gas chromatography analysis performed. Of these 100 wells, 73 had detections of atrazine and/or its chlorinated metabolites, with the average concentration at 1.19 µg/l. Six of the 100 wells exceeded the enforcement standard for atrazine.

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 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 three and co-funded one pesticide research project during FY 98 (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 land 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 98 approximately \$100,000 was provided to develop and demonstrate better management practices for nutrients and pesticides.

In FY 98 DATCP provided \$440,000 to fund Clean Sweep projects in 31 counties for collection and disposal of waste pesticides and containers. Approximately 240,500 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 1999 fiscal year. Approximately \$560,400 will be available during FY 99 for these projects.

For further information, contact Mr. Nicholas Neher, DATCP, 2811 Agriculture Drive, P.O. Box 8911, Madison, Wisconsin, 53708-8911; phone 608-224-4567; e-mail nehernj@wheel.datcp.state.wi.us.

DEPARTMENT OF COMMERCE

In July 1, 1996 the Division of Safety & Buildings was transferred from the Department of Industry, Labor, and Human Relations to the newly created Department of Commerce (COMM). In moving to the new agency, the Division was split into two Divisions. 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 Cleanup Fund Act (PECFA) are in the newly created Division of Environmental Regulatory Services.

Private Sewage Systems - A revised private sewage system code, (COMM 83), is scheduled for hearing in 1998. The new code is substantially revised from the previous draft that went to hearing in 1997. Major changes include the requirement that large septic systems, designed to treat more than 12,000 gallons per day will be required to obtain a WPDES permit from the DNR before COMM will approve the plan designs for the system. Six manuals for standard system designs will be referenced in the code. These manuals include the following systems: conventional, mound, pressure distribution, at-grade, holding tank, and sand filter.

Recent research by the University of Wisconsin, Small Scale Waste Management Project on sand filters and aeration units has resulted in approval of their use as replacement systems for existing failed systems and their recognition in the new code as additional treatment alternatives. One advantage of both the sand filter and aeration units is that homeowners will often be able to eliminate or reduce the size of a mound system compared to what is required under the current code. To assist county staff in becoming familiar with this new technology the COMM has sponsored training presented by the University and manufacturers that focuses on theory of operation and inspection services.

The Department is developing a database to assist counties in the administration of their maintenance tracking programs that are currently required under the provisions of the Wisconsin Fund Program. The new code will greatly improve the maintenance program for all installed on-site systems. The new code will provide for mandatory system maintenance schedules and reporting of maintenance events over the life of the system.

Petroleum Storage Tanks - Flammable and combustible liquids which have a flash point of less than 200^oF are regulated by the state Administrative Code Chapter ILHR 10. The creation of COMM through the merger of the Safety and Buildings Division of DILHR with the Department of Development 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 Bureau of PECFA.

The ERS Division continues to focus on the Federal EPA underground storage tank (UST) upgrade compliance deadline of December 22, 1998. Educational outreach and enforcement strategies by the Department are structured to emphasize the requirements that must be met prior to December 1998. Wisconsin State Statute does not designate or authorize the Department regulatory authority for the non flammable/combustible hazardous substance tanks included in the federal rule. This past year the Department entered into a project with the Federal EPA to survey groundwater protection compliance of non-petroleum hazardous substance tanks. It was discovered that an exceptional number of the hazardous substance UST owners were not knowledgeable of the rule or were ignoring it. The survey generated owner consciousness that their hazardous substance tanks were exposed to regulatory assessment. A considerable number committed to compliance and approximately 12 – 15 were referred to the US EPA for enforcement action.

Since 1991 the database inventory of petroleum product tanks regulated under ILHR 10 has increased from 143,681 to 167,073 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. As of July 1, 1998 the database reflects 75,059 federally regulated tanks with only 15,575 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 number of underground tanks in use, and upgrading those in use to meet the 1998 federal upgrade 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 storage 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 liquid propane gas (LPG).

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

Petroleum Environmental Cleanup Fund Act (PECFA) - The PECFA program from August 1989 through June 1998 has reimbursed petroleum storage tank system owners approximately \$530M to remediate petroleum contamination both in the soil and groundwater. The program, in addition to auditing owner invoices and authorizing payments, performs technical reviews for site investigations exceeding \$40K, comparisons of remedial options, and grants closures for a limited number of sites.

The PECFA program is continuing to experience a funding shortfall and the backlog of audited claims awaiting payment continues to grow. Claims for reimbursement received in Summer 1997 will receive the reimbursement check in Summer 1999, and claims received by the program in Summer 1998 may not receive payment until Spring 2001. The program currently receives claims at a rate of approximately \$15M per month and has spending authority of approximately \$7M per month. The petroleum inspection fee supports PECFA's spending authority.

COMM 47 Emergency Rule became effective in April 1998 to address the above mentioned backlogs and refocus remedial efforts on site closures. The Emergency Rule includes elements to; clarify the decision making process for remedial action approvals, reduce the frequency of payments and base access to the fund and decisions by owners on outcomes rather than reimbursement on a time and materials basis. The remedial alternative selection process includes the creation of environmental factors that determine paths and options for a remedial alternative selection. Additionally, provisions for reviews of existing sites

include establishing site bundles, public bidding of the remedial action, and reestablishment of cost caps to the point of site closure.

In addition to the Emergency Rule, the DNR and COMM have revised the MOU between the two agencies. This MOU contains provisions for data exchanges, conflict resolution, transfer of sites and reporting to the legislator.

For more information, contact Mr. John Alberts, Department of Commerce, P. O. Box 7839, Madison, Wisconsin 53707-7839, phone: 608-266-9403, fax: 608-267-0592; e-mail alberjo@mail.state.wi.us.

DEPARTMENT OF HEALTH AND FAMILY SERVICES

Chapter 160, Wis. Stats., directs the DHFS to recommend health-based enforcement standards for substances found in groundwater and specifies the protocol for developing the recommended standards. Recommended standards are sent to the DNR which proceeds through the rule-making process to amend ch. NR 140, Wis. Adm. Code. In June 1996, DHFS forwarded recommendations for 21 new groundwater standards. These proposals were taken to public hearings during July 1997. Comments were received on the proposals for acenaphthylene, ammonia, boron, prometon, and trimethylbenzenes. In response to these comments, the proposed standard for acenaphthylene was removed from the recommended standards. In addition, proposed enforcement standards for boron, prometon and trimethylbenzenes were revised to reflect new toxicity information that was submitted by commentors. The revised package was approved by the DNR board at its April meeting and forwarded to the legislature. In response to industry's concerns about the financial impacts of regulations for boron and ammonia, the Assembly Committee on Natural Resources held hearings during June 1998. Following these hearings, the committee decided to delay the date at which the boron enforcement standard (ES) would become effective, and returned the proposed ES for ammonia to DNR for additional public comment.

DHFS is responsible for investigating suspected cases of water-borne 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 DHFS staff worked with the University of Wisconsin Department of Preventive Medicine to investigate the financial and human health impacts of nitrate-contaminated groundwater. This research was funded by the DNR through the GCC's joint solicitation process.

DHFS staff are the primary resource for information about the health risks posed by drinking water contaminants. Toxicologists, public health educators, and epidemiologists employed in the Department's Bureau of Public Health present this information to the public at public meetings and conferences, and provide direct assistance to Wisconsin families via home visits, letters to well owners, and telephone consultations. DHFS staff review correspondence sent to well owners by DNR representatives. The agency provides additional advice to owners of wells that are seriously contaminated with volatile substances such as benzene and vinyl chloride. Follow-up letters sent by DHFS explain the health effects of the specific contaminant and suggest strategies for reducing exposure until a safe water supply can be established. DHFS also prepares and distributes a wide variety of informational materials.

For more information, contact Henry Anderson, Lynda Knobeloch or Mark Werner, 1414 E. Washington Ave., Rm.96, Madison, Wisconsin, 53703-3044; phone: 608-266-1253 (Henry) or 608-266-0923 (Lynda), or 608 266-7480 (Mark).

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

The 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, Buffalo, Milwaukee, Trempealeau, Walworth, Burnett, Kewaunee, and Oconto Counties.

In FY 98, 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 145 wells (in cooperation with the USGS), collect, and describe geologic samples from 300 wells per year.

The WGNHS, cooperating with the Wisconsin DNR and Sturgeon Bay Utilities, completed a wellhead-protection study for the city of Sturgeon Bay, Wisconsin focused on capture-zone delineation in a fractured-rock setting. Sturgeon Bay obtains water from municipal wells finished in fractured Silurian-age dolomite which are vulnerable to contamination. The project combined detailed hydrostratigraphic analyses of the dolomite with extensive hydrogeologic testing and numerical modeling. The WGNHS used downhole gamma and flowmeter logs to delineate near-horizontal zones of high hydraulic conductivity and to correlate these zones, which appear to correspond to bedding-plane fractures, across the study area. A series of short-interval packer tests and pumping tests provided detailed information about the hydraulic conductivity distribution in the dolomite. These data were integrated using a 12-layer transient, three-dimensional groundwater flow model of the Sturgeon Bay area, which simulated horizontal fractures as discrete layers. The model was calibrated to water levels measured in local domestic wells and to the long-term water-level fluctuations measured in a well from the statewide water-level observation network. Once the model was calibrated, the WGNHS used reverse particle tracking to delineate capture zones for five municipal wells serving the city. Field data and model simulations revealed very high groundwater velocities in the area, and the model showed how the fracture network controls groundwater movement to the city wells. The time of travel from the surface to the wells is less than one year in most cases. These analyses show the extreme vulnerability of the city's wells. Using these results, the local water utility has begun working with county officials and local landowners to educate the public about water-quality concerns and to alter land-use practices within the mapped capture areas.

The WGNHS also undertook major studies of the hydrogeology of southeastern Wisconsin in cooperation with the Southeastern Wisconsin Regional Planning Commission and the DNR. Southeastern Wisconsin includes the cities of Milwaukee, Racine, and Kenosha, and recent population increases in this area have stressed local groundwater resources. As part of this effort the WGNHS began a detailed investigation of the hydrogeologic properties of the Maquoketa Formation, an important regional aquitard in southeastern Wisconsin. The shaley Maquoketa lies between the Silurian dolomite and Cambrian sandstone aquifers in southeastern Wisconsin, and limits the exchange of water between them. However, the hydraulic properties of the Maquoketa are poorly known. In 1997 the WGNHS obtained the first of two continuous rock cores through the entire Maquoketa section. This is the first continuous core of the Maquoketa ever obtained in southeastern Wisconsin. The resulting hole has been instrumented with a multilevel sampling system for acquisition of water samples and water-level data. The geochemical and hydraulic head information should be invaluable for improving our understanding of the regional hydrogeology of southeastern Wisconsin.

Research projects completed this year or in progress include:

1. Investigation of groundwater flow 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. Hydrogeologic properties of the Maquoketa shale.

5. Hydrogeology of Southeast Wisconsin.
6. Delineation of hydrogeologic units throughout Wisconsin.
7. Extent of atrazine contamination in the Lower Wisconsin River valley.
8. Hydrology and hydrogeology of the Kickapoo River
- 9 Nitrate monitoring near Arena, Lower Wisconsin River Valley.
10. Delineation of wellhead protection areas for the City of Sturgeon Bay.
11. Review of material submitted regarding proposed Crandon mine.

For more information, contact Ken Bradbury or Ron Hennings, WGNHS, 3817 Mineral Point Road, Madison, Wisconsin, 53705-5100; phone: 608-263-7389.

WGNHS Publications

Miscellaneous Map 40: Groundwater Quality Investigation Maps of Trempealeau Co, Wisconsin.

Compiled by M.S. Bridson, 1997, 6 plates. Scale 1:100,000. Plate 1: Nitrate as Nitrogen in mg/L. Plate 2: Chloride in mg/L. Plate 3: Laboratory Measurement of Alkalinity in mg/L. Plate 4: Total Hardness in mg/L. Plate 5: Laboratory Measurement of Electrical Conductivity in $\mu\text{mhos/cm}$. Plate 6: Ferrous Iron in mg/L.

Miscellaneous Map 42: Groundwater Quality Investigation Maps of Burnett County, Wisconsin.

Compiled by M.S. Bridson, 1997, 6 plates. Scale 1:100,000. Plate 1: Nitrate as Nitrogen in mg/L. Plate 2: Chloride in mg/L. Plate 3: Laboratory Measurement of Alkalinity in mg/L. Plate 4: Total Hardness in mg/L. Plate 5: Laboratory Measurement of Electrical Conductivity in $\mu\text{mhos/cm}$. Plate 6: Ferrous Iron in mg/L.

Miscellaneous Map 43: Groundwater Quality Investigation Maps of Polk County, Wisconsin. Compiled by M.S. Bridson, 1997, 6 plates. Scale 1:100,000. Plate 1: Nitrate as Nitrogen in mg/L. Plate 2: Chloride in mg/L. Plate 3: Laboratory Measurement of Alkalinity in mg/L. Plate 4: Total Hardness in mg/L. Plate 5: Laboratory Measurement of Electrical Conductivity in $\mu\text{mhos/cm}$. Plate 6: Ferrous Iron in mg/L.

Miscellaneous Map 45: Water-Table Elevation of Burnett County, Wisconsin. M.A. Muldoon and M. Dahl, 1997. Scale 1:100,000.

Miscellaneous Map 47: Water-Table Elevation of Trempealeau County, Wisconsin. M.A. Muldoon and J. Craven, 1998. Scale 1:100,000.

Miscellaneous Map 48: Water-Table Elevation of Polk County, Wisconsin. M.A. Muldoon and J. Craven, 1998. Scale 1:100,000.

Educational Series 15: Groundwater Levels in Wisconsin, Annual Summary, 1997-98. A. Zaporozec, 1998, 4 p.

Open-File Report 1996-7: Correlation of high-permeability zones with stratigraphic features in the Silurian dolomite, Sturgeon Bay, Wisconsin. Gary L. Gianniny, Maureen A. Muldoon, J. Antonio Simo, Kenneth R. Bradbury, 1996, 102 p. with 1 plate.

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 helps determine the sand and salt application rates. 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.

Beginning in the 1997-98 winter season some counties are using alternative anti-icing/deicing chemicals on test sections in an effort to reduce the amount of chlorides being applied to the pavement and its impact on groundwater. Use of the pro-active anti-icing approach should produce lower chemical usage along with lower overall total winter maintenance costs for materials, labor and equipment. Seven counties are using liquid $MgCl_2$ anti-icing applications on test sections. In another test and evaluation program, seven other counties are using a product called "Ice Ban" in place of liquid $CaCl_2$ for the prewetting road salt. In laboratory tests, "Ice Ban" has been shown to be less detrimental to the environment than $CaCl_2$.

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 highway improvement program, DOT performs an estimated 50 to 100 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 COMM on 5 to 15 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 7 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. The final report on this study is anticipated September 1998. An extended phase of this project is comparing continuous recording ground water level measuring equipment during the 1998 field season. Summary results are expected December 1998. In addition, DOT has several ongoing wetland monitoring projects which evaluate wetland hydrology, water quality and biotic response to constructed mitigation sites.

Since July 1993, DOT has had an interagency approved wetland mitigation banking program. Currently wetland loss due to highway, bridge and airport projects may be compensated for in the bank system. For the period from January 1990 to December 31, 1997 wetland losses of 1299.30 acres at 538 construction projects were compensated by 1903.5 acres of wetland restoration and creation statewide. Compensation at bank sites was 65.1%, while compensation on-site and off-site (including consolidated sites) was 18.4% and 16.5%, respectively. The acres of wetland loss for the 188 projects compensated on- and off-site was 577.40 and resulted in 829.6 acres of compensation.

As of December 31, 1997 there are 15 open bank sites, which contain 1027.70 available acres. There are 9 planned bank sites, which are expected to yield 860.70 acres. 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 has been revised to include management of storm water runoff from transportation facilities. The revised Manual contains 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). Another effort to improve water quality from highway runoff includes a research project to evaluate the effectiveness of high efficiency street sweepers for pollutant reduction and participating in a study sponsored by the Civil Engineering Research Foundation to verify the effectiveness of various storm water treatment devices. 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 451, P. O. Box 7965, Madison, Wisconsin 53707-7965; phone: 608-266-9626, e-mail ccutshal@mail.state.wi.us

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 98 the UWS directed a wide-ranging program of priority groundwater research consisting of 11 projects. 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. Interactions of lake and wetland systems with groundwater and the impacts of land use patterns on groundwater quality.
2. Development of a variable rate nitrogen application approach for corn to control nitrogen losses to groundwater.
3. Determination of groundwater recharge rates and the factors which control them in Southern Washington County.
4. New and improved air-sparging technologies and models for in situ remediation of contaminated groundwater. (2 projects)
5. New and improved technologies for enhancing in situ bioremediation of contaminated groundwater (2 projects)
6. An evaluation of the effects of agricultural contaminants on Wisconsin's declining and endangered amphibian species.
7. A watershed scale study of the impacts of agricultural and other land use practices on groundwater quality.
8. Development and evaluation of a flow-thru bioreactor for treatment of groundwater contaminated with chlorinated aliphatic hydrocarbons.
9. Evaluation of time domain reflectometry to ascertain the integrity of exploration borehole seals.

The 11 funded projects provided training in several disciplines for postdoctoral research associates, graduate student research assistants, and undergraduate students at UW-Madison, UW-Milwaukee, and UW-Stevens Point.

The UWS selected 8 new groundwater research projects from this year's Joint Solicitation for support during FY-99 (see Table 1). One new project will be co-funded with DATCP and 5 projects selected from the previous year's Joint Solicitation will receive continuation support during FY 99.

Teaching - The UWS institutions continue to offer courses and programs at the undergraduate and graduate level focusing on diverse aspects of 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 - Information Transfer - The updated (June 1998) UWS Water Resources Center web site (www.library.wisc.edu/libraries/water_resources/page.htm) now provides convenient links to the UW-Madison's WRC Library, the Wisconsin Groundwater Research and Monitoring Project Summaries, a compilation of the WRC's Publications from 1966 to 1994, and a WRC Staff Directory. The recently updated WRC Library site includes information about the library; an electronic reference service (AskWater); quick access to the UW Electronic Library catalog, databases and services; and an extensive list of links to Wisconsin and national water resources information on the World Wide Web. The WRC Library is one of only two libraries in the United States devoted to water resources. It houses over 26,000 hard copy and microfiche documents covering all major topics in water resources, and over 35 journals and

130 newsletters dealing with water issues or technology. The Library produces a monthly Recent Acquisitions list which is distributed to over 300 people nationally. In 1995, the entire collection was added to MadCat, the UW online catalog, making it a national resource accessible to all over the Internet. Since adding the collection to MadCat, circulation has increased by 80% and student usage by 400%. The Library has two new Electronic Library workstations for walk-in use by Center Staff, UWS faculty, staff, and students, state government employees, and Wisconsin business, industry, and citizens.

The network edition of the Wisconsin Groundwater Research and Monitoring Project Summaries has had its first full year of operation during FY-98. During this period, the WRC Project Summaries web site hosted 1,152 visitors who retrieved a total of 2,518 project summaries. The average number of summaries retrieved from among the 72 that are currently posted was 35, with a range 10 to 137 downloads per summary.

The UWS Water Resources Center completed editorial review of the "***Directory of Water Resources Expertise in Wisconsin***" during FY-98. The abundance and quality of Wisconsin's surface and groundwater is a reflection of the diverse talents, expertise, and dedication of the 770 listed individuals who are the stewards of Wisconsin's water resources. They are affiliated with Wisconsin's Colleges and Universities, State, Local, Tribal, and Federal Government Agencies, commercial and consulting enterprises, private associations, public service commissions, and citizens groups. The Directory has been prepared in several different program formats which will be made available for retrieval as compressed files from WRC's web site. This method of distribution will provide full search capability of the database from any field including the 3 expertise fields (job description, keywords, expertise narrative) for anyone with access to a PC or workstation running Microsoft Access, Excel, or Visual Fox Pro, Claris Filemaker Pro, Paradox, or Alpha 5. An Acrobat PDF file of the printed output of the database will also be posted on the web site for retrieval and printing, but search capacity will be limited to sort fields (entrants last name, first name).

The UWS Water Resources Center underwent a major administrative change at the end of FY-98. Dr. Gordon Chesters, Academic Program Director, and Dr. George Blondin, Program Coordinator, retired on June 30, 1998. Dr. Gordon Chesters' replacement will be Dr. Anders W. Andren, who will combine his duties as Academic Program Director of the Wisconsin Sea Grant Program with parallel duties in the Water Resources Center. Both Programs will be housed together on the second floor of Goodnight Hall, 1975 Willow Drive, Madison, WI 53706. A search committee has been established to find a replacement for Dr. George Blondin.

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, is being used as an educational tool for Environmental Quality Incentive Programs in at least five counties, 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, several Canadian provinces, Australia, and Mexico 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. Extensive information is available on the internet at <http://www.wisc.edu/farmasyst/>.

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 youth, age 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 50 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 with water resources and natural resource issues. In 1998, UW-Extension entered into a new partnership with the DNR and USDA-NRCS in Wisconsin. This new partnership provides land and water resources education in the state's 22 major river basins. In 1998 seven, multi-agency supported river basin educators were hired. These river basin educators provide educational program support to approximately 10 basins. They work collaboratively with three publication/editorial specialists, two evaluation experts, and one coordinator who works on volunteer-based issues. Collectively this river basin focus works to support other local conservation professionals such as county Extension agents, Land Conservation Department staff, and NRCS staff. This focus on river basins includes drinking water fact sheets, newsletter articles about groundwater, and in some instances, specific watershed studies that address unique water quality problems.

Extension's Environmental Resources publishes a monthly newsletter, [Keeping Current](#), which brings information about water issues to more than 1,400 agency staff throughout the state.

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.

In 1997, the Center assisted 2,441 households in having their water tested in conjunction with county Extension offices and the UW - Stevens Point Environmental Task Force Lab. Of these, 6% exceeded drinking water standards for nitrate-nitrogen. Fifteen percent were unsafe because of coliform bacteria. Twenty-three percent had moderate to severe corrosivity indexes. Ten education programs helped 613 well users understand potential remedies for these problems and the relationship of land use practices to groundwater quality.

The Center published reports in the last year on agrichemical loading to groundwater under irrigated vegetables in the Central Sands and on basin-scale modeling of contaminant loading and migration to the Stevens Point, Whiting and Plover (SWP) municipal wells. The latter report can also be accessed at <http://www.uwsp.edu/groundwater/swp.htm>. A public and media outreach effort was also conducted on the SWP findings. Other outreach included grant-funded workshops which provided sand-tank groundwater flow models to six Central Wisconsin schools and continuing to assist in a Golden Sands Resource Conservation and Development area project to develop and distribute education materials on corrosive water. The Center's main Web site is at <http://www.uwsp.edu/groundwater/>.

For more information on research or information transfer contact Dr. Anders W. Andren, Director, UW-Madison Water Resources Center, 1975 Willow Drive, Madison, WI 53706; phone (608) 262-0905, Fax (608) 263-2063, email awandren@seagrant.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.

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On Farm Demonstration Guidebook

Nutrient Management Fast Facts

Water Resources web site

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

Home*A*Syst: An Environmental Risk Assessment for the Home
Focus on Farm*A*Syst and Home*A*Syst

Expanded Basic Model

Farm & Home Resource Management Assessment - Draft

Evaluacion de las Condiciones que Pueden Afectar la Calidad del Agua Potable

Farm and Home Pollution Prevention Update Newsletter Subscription

National Farm*A*Syst Directory

Farm*A*Syst/Home*A*Syst Brochure

Impact Profile Statements

Farm*A*Syst Decision Support System Version 4.0 Software

Home*A*Syst: An Environmental risk Assessment for the Home

Worldwide web site: www.wisc.edu/farmasyst and www.wisc.edu/homeasyst

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 92 active, licensed solid waste landfills, all of which are required to monitor groundwater. Two studies conducted over four years revealed that out of 51 landfills (all but one are currently closed - 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 COMM. This registration program has identified a total of 167,073 tanks as of July 1, 1998 of which 75,059 tanks are regulated by the federal underground storage tank program. Only 15,575 regulated tanks are currently in use, and 59,484 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 June 10, 1998, DNR records indicate there are 8,712 active underground storage tank contamination cleanups and approximately 7,027 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 5,000 LUST sites have BTEX groundwater standards exceedances. Drinking water at more than 250 households has been contaminated by leaks from underground storage tanks.

Hazardous waste treatment storage and disposal facilities are another VOC source. The DNR Bureau for Remediation and Redevelopment is investigating or remediating contamination at 27 sites. Approximately 140 sites statewide are subject to corrective action authorities. However, only a small percentage will follow 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. All new generator remediation cases statewide and many existing actions are to be addressed in accordance with the NR 700 Wis. Adm. Code series.

The Hazardous Substance Spill Law, ch. NR 292.11 Wis. Adm. Code, formerly 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 1200 discharges are reported annually to the DNR, and of those, approximately 65% are petroleum related, with another 15% being agrichemicals. The NR 700 Wis. Adm. Code 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 ethane sulfonic acid (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 exceedences of the ES or ESA exceedences 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.

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 exceedence still use their well for drinking water. This report is available by contacting the DATCP.

Atrazine Rule Evaluation Survey- DATCP conducted this survey to evaluate the restrictions on the use of atrazine in Wisconsin. The purpose of the survey was to determine how levels of atrazine and its metabolites in groundwater were changing three and five years after the atrazine rule was put into place. The survey was conducted in two phases: phase one in 1994 and phase 2 in 1996. A total of 567 samples were collected from 429 wells (138 wells were sampled in both phases.) DATCP made statistical estimates of several atrazine properties in groundwater including: the percent of Wisconsin groundwater containing a detectable amount of atrazine residues and the concentration of atrazine and metabolites in wells with detectable levels. The results show a significant decline in atrazine concentrations in Wisconsin between 1994 and 1996. The average atrazine plus metabolite concentration in wells with detections declined from 0.96 to 0.54 ppb in the two year period, a 44% decrease. The percent of contaminated wells, however, did not show a significant decline.

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 10,000 individual results for drinking water wells from the triazine screen analysis. Data received from the SLOH indicates that approximately 42 percent of the samples indicated a detection for a triazine based compound. Approximately 17 percent of the samples have a result which exceeds the PAL for atrazine of 0.3 ppb, and approximately 1.7 percent 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.

In 1993, DATCP completed a study in cooperation with CIBA-GEIGY that involved splitting well samples for triazine screen and gas chromatographic analysis. The two main results were 1) low triazine detects were confirmed (i.e. the triazine screen was not producing false positives) and, 2) the triazine screen overestimates parent atrazine and underestimates total chlorinated residues.

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 common contaminant found in Wisconsin's groundwater. Detections of nitrate in private water supplies frequently exceed the state drinking water standard of 10 milligrams/liter (mg/l). Consumption of water that contains high concentrations of nitrate by infants under 6 months of age can induce a condition called methemoglobinemia or "blue baby syndrome." This condition occurs when red cell 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 five times the current standard. Most infant deaths have involved rural wells 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. Several investigators have reported associations between maternal exposure to nitrogen oxides (nitrate and nitrite) and the occurrence of pregnancy complications such as anemia, pre-eclampsia, threatened abortion, pregnancy loss, and birth defects.

The chronic health effects of nitrate exposure are not well understood, however, many experts believe that long-term exposure may increase the risk of cancer. This theory is supported by some scientific studies. For example, in 1996 researchers in the Netherlands published an article in which they described finding high urinary levels of cancer-causing nitroso-compounds and genetic mutations in the lymphocytes of individuals who consumed nitrate-contaminated water. Two years earlier, these same researchers had reported a link between consumption of high-nitrate water and the incidence of thyroid disorders. In 1996, a team of U.S. scientists from the National Cancer Institute, the University of Nebraska, and Johns Hopkins University reported that individuals who consumed water that contained more than 4 mg/L nitrate-N were twice as likely to develop Non-Hodgkin's lymphoma as those whose water contained lower nitrate levels. These findings have yet to be reviewed by the U.S. Environmental Protection Agency and were not considered in the National Academy of Sciences report that was released in 1995.

Currently, DHFS and the DNR recommend testing of all newly constructed private wells and wells that have not been tested during the past five years. 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, approximately 50,000 of Wisconsin's approximately 800,000 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 nitrate, 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 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.

DHFS and the UW Dept. of Preventive Medicine received funds from the DNR to study the economic and health impacts of nitrate-contaminated groundwater. Their study was completed in June of 1997. Researchers sent surveys to more than 1500 families whose wells had been tested for nitrate during 1994-1996 and found to have nitrate-N levels below 2 mg/L (low exposure) or greater than 12.9 mg/L (high exposure). High and low-exposure families were matched by county of residence. Surveys requested information about the age and depth of the household well, water consumption habits, response to their nitrate test result, and health histories. In addition, the female head of each household was asked to complete a health and reproductive history questionnaire. Five hundred sixty-two surveys were completed and returned for analysis.

The study found that families with nitrate contaminated wells were slightly older, had lower household incomes, were more likely to live on a farm, and had lived in their homes longer than families in the low exposure group. The majority of respondents understood whether their nitrate result exceeded the drinking water standard, however few in the high exposure group reported taking action to reduce their exposure to this contaminant. Of those who took action, most purchased bottled water for use by an infant or pregnant woman.

Residents of homes with nitrate contaminated water supplies reported a higher incidence of thyroid disorders, arthritis, and fibromyalgia than others, however, these differences were not statistically significant. Compliance with the drinking water advisory for pregnant women was very high and few women in the study population consumed significant quantities of contaminated water during pregnancies that occurred after the advisory was issued in 1993. Women who consumed water that was high in nitrate during their pregnancies were slightly more likely to report an early pregnancy loss than others, however, due to the small number of pregnancies in the study population this difference was not statistically significant. Due to the small number of pregnancies in the nitrate-exposed population, researchers were unable to evaluate the incidence of low birth weight and birth defects.

COMM 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. A new nutrient management budget initiative was proposed in FY 97 that would give DATCP the authority to promulgate regulatory and non-regulatory rules related to nutrient management.

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 statewide 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.

CONDITION OF THE RESOURCE - GROUNDWATER QUANTITY

This is the Executive Summary of the "Status of Groundwater Quantity in Wisconsin" report published in April, 1997. The full report is available from the DNR and is downloadable from the world wide web at: <http://www.dnr.state.wi.us/org/water/dwg/gw/Pubdwnld.HTM>

Purpose of Report

In August of 1994, the Wisconsin Groundwater Coordinating Council (GCC) suggested that the Wisconsin Department of Natural Resources (DNR), in cooperation with the GCC and other interested parties, prepare a report describing groundwater quantity problems and issues in Wisconsin. This report was prepared by the Groundwater Section of the DNR's Bureau of Drinking Water and Groundwater with the assistance of a Technical Advisory Committee (TAC). The objectives of this report are to summarize what we know about Wisconsin's groundwater quantity problems; discuss information that is available on groundwater quantity and where more information is needed; and discuss potential options for addressing groundwater quantity issues.

Findings

Despite a general abundance of groundwater in Wisconsin, there is a growing concern about the overall availability of good quality groundwater for municipal, industrial, agricultural, and domestic use and for adequate baseflow to our lakes, streams, and wetlands. Groundwater quantity problems have occurred naturally and from human activities. Natural shortages of groundwater have occurred due to weather conditions (e.g., drought) and geologic setting (e.g., crystalline bedrock aquifer with low yields).

Human activities such as groundwater withdrawal and land use activities may also cause groundwater quantity problems. The effect of groundwater withdrawals are well documented on a regional scale in the Lower Fox River Valley, southeastern Wisconsin, and Dane County. There are substantial declines in groundwater levels in these three areas.

Localized effects from groundwater withdrawals are not as well documented as the regional effects. Cases exist around the state where wells, springs, and wetlands have gone dry; lake levels have dropped; streamflow has been reduced; and contamination has prevented installation of new wells.

The availability of groundwater may also be affected by groundwater quality. The presence of naturally-occurring substances in groundwater (e.g., iron, sulfate, arsenic) or human-caused contamination has limited groundwater use in some areas.

Information from the U. S. Geological Survey (USGS) indicates water use in Wisconsin has increased steadily since 1950. Groundwater use grew from 570 to 754 million gallons per day (Mgal/d) from 1985 to 1995.

Groundwater withdrawals can affect both groundwater and surface water. Declining groundwater levels from pumping may increase pumping costs due to the need to pump water from a greater depth, dewater or mine an aquifer until it no longer meets water supply needs, dry up nearby shallow wells (e.g., domestic wells), decrease baseflow (i.e., natural groundwater discharge) to lakes, streams, and wetlands, and cause surface water to recharge a depleted aquifer. A loss of baseflow may harm fisheries or wildlife habitat.

There is an ongoing effort by state and federal agencies and university staff to gather data and information on groundwater quantity issues. The Wisconsin Geological and Natural History Survey (WGNHS) and the USGS maintain a statewide groundwater-level observation network to evaluate short-term changes and long-term trends in groundwater levels. The USGS also maintains a network of streamflow gauging stations across the state to record surface water flow. Historical groundwater-level and streamflow data is valuable as we look at the relationship between surface water and groundwater.

Historically in Wisconsin, only a few research studies have focused on groundwater quantity issues. Currently, groundwater quantity studies are underway in Dane County, the Little Plover River Basin, the Lower Fox River Valley, and the Driftless Area. Because of the many factors involved, gathering definitive data on the effects of groundwater withdrawals is complex, time-consuming, and expensive. Additional information is needed to increase our understanding of groundwater-surface water interactions, identify areas with groundwater quantity problems, and determine the impacts of groundwater withdrawals.

Under Wisconsin Law, chapter 281, Wis. Stats. (formerly ch. 144), the DNR is 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, Waste Management, and Fisheries Management and Habitat Protection programs. The DNR regulates high capacity wells and surface water diversions. Other agencies involved in groundwater quantity issues include the WGNHS, Central Wisconsin Groundwater Center, GCC, Public Service Commission, the USGS, local units of government and water utilities.

Groundwater quantity will continue to be an issue of concern in Wisconsin. A coordinated effort is needed to determine appropriate management options for addressing groundwater withdrawals, to prioritize information needs, and to implement information and education programs. Funding is needed for additional data collection and research to address groundwater quantity management issues.

COORDINATION OF GROUNDWATER MONITORING AND RESEARCH

Four state agencies have had approximately \$750,000 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. Since FY 96 there was approximately \$200,000 to \$300,000 available for monitoring projects. Through FY 98, the DNR has spent approximately \$4.1 million on 152 monitoring projects. Seven projects have been co-funded with DATCP, four projects have been co-funded with the UWS, 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 98, the UWS has spent \$2.6 million on 70 groundwater research projects. Four of the 70 projects have been co-funded with DATCP, four 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 98, DATCP has spent about \$1,075,000 on 19 pesticide projects. Four 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/COMM 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 98, DILHR/COMM has spent approximately \$550,000 on five projects. COMM opted not to participate in the joint solicitation for new projects in FY 98 or FY 99.

Approximately \$8.2 million has been spent through FY 98 on 237 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 (GRAC) 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 98 Joint Solicitation

The joint solicitation for FY 98 was distributed in November, 1996. A total of 22 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 January 1997 to review and rank the projects submitted for funding. As a result of the subcommittee meeting, the GRAC meeting in March, and review of the proposals by agency staff, 16 new projects were selected for funding in FY 98. Ten on-going projects were carried over into FY 98. A total of 26 projects were funded through the joint solicitation at a cost of approximately \$680,000 (see Table 1).

FY 99 Joint Solicitation

A joint solicitation for project proposals by the UW System, DNR, and DATCP was distributed in October, 1997 for funding in FY 99. The deadline for proposals was December 5, 1997. The joint solicitation package 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 99 were reviewed by the Monitoring & Data Management and Research Subcommittees of the GCC and DNR staff. The two subcommittees met in January to rank the 30 proposals submitted. Sixteen 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 99 are listed in Table 2.

In FY 96, the GCC began compiling information about other groundwater research programs. There was discussion at GCC meetings of groundwater-related research programs within and outside of Wisconsin. Groundwater-related research projects funded through the Fertilizer Research Council in FY 98 are listed in the Appendix.

The GCC resolved to contact other states with groundwater research programs to prevent research duplication and to make efficient use of limited research funds. A strategy for interstate coordination of groundwater research was developed which consists of identifying groundwater research program contacts in each neighboring state and sending each contact information on the GCC, the joint solicitation process, the state groundwater monitoring and research programs, and the project summaries. Initial contacts were made in FY 96 and have continued in FYs 97 and 98.

**Table 1 - Groundwater Projects Funded Through
the Joint Solicitation for FY 98**
(Map numbers are for locating projects on the State map in Figure 3)

DNR Projects

*A Study of Well Construction Guidance for Arsenic Contamination in Northeast Wisconsin. Annette Weissbach \$17,548 (Map # 1)

*Stratigraphic Controls on Distribution of Hydraulic Conductivity in Carbonate Aquifers. Juan Antonio Simo \$31,655 (Map # 2)

*Pesticides and Groundwater Impacts. Jeff Postle \$4,154 (Map # 3)

Relationships Between Water Quality in Stream Base Flow and Private Wells and Land use in the Tomorrow/Waupaca River Watershed. Byron Shaw \$28,400 (Map # 4)

Northeast Region Public water Supply Location Utilizing Geographic Information Systems and Global Positioning Systems. Richard Stoll \$28,000 (Map # 5)

Determination of the Hydrostratigraphy of the Deep Sandstone Aquifer in Southeastern Wisconsin. Timothy Eaton \$26,447 (Map # 6)

Evaluation of Geology and Hydraulic Performance of Wisconsin Ground-Water Monitoring Wells Alexander Zaporozec \$19,894 (Map # 7)

Further Evaluation of Well Seals Using an Ultrasonic Probe. Tuncer Edil \$27,108

Groundwater-Surface Water Interactions in the Nine Springs Watershed. Jean Bahr \$45,387 (Map # 8)

Evaluation of the Confining Properties of the Maquoketa Formation in the SEWRPC Region of Southeastern Wisconsin. Ken Bradbury \$51,724 (Map # 9)

The total cost for all projects funded by the DNR through the FY 98 joint solicitation process is \$283,317

UWS Projects

* Development of a Variable Rate Nitrogen Application Approach for Corn. Larry Bundy \$14,400 (Map # 10)

* Hydrogeochemical and Microbiological Studies for Enhanced Ground Water Bioremediation. Jean Bahr \$32,000 (Map # 11)

* Groundwater Bioremediation: Monitoring with MMO Probes. Mary Perille Collins \$29,000

* Treatment of Groundwater Contaminated with Chlorinated Aliphatics Using a Silicone Tubing Supported Methanotrophic Biofilm Reactor. Jae K. Park \$30,000.

* *In situ* Air Sparging: Air Plume Characterization and Removal Effectiveness. Craig H. Benson. \$29,000.

Assessment of Impacts on Groundwater/Lake and Wetland Systems Mary Anderson UW-MAD \$21,400 (Map # 12)

Investigation of Air Sparging: Numerical Modeling, Laboratory Verification and Design Guidelines John Hoopes UW-MAD \$26,600

Watershed-Scale Nitrate Contamination and Chlorofluorocarbon Ages in the Little Plover Basin: A Study at

the Groundwater/Surface Water Interface Bryant Browne UW-SP \$30,600 (Map # 13)

Determining Ground-Water Recharge Rates in Southern Washington County Douglas Cherkauer UW-MIL \$29,000 (Map # 14)

Evaluation of Exploration Borehole Seals Using Time Domain Reflectometry (TDR) Tuncer Edil UW-MAD \$24,400

The total cost for all projects funded by the UWS through the FY 98 joint solicitation process, including the co-funded project below is \$281,400.

DATCP/UWS Co-Funded Project

The Direct Effect of Agricultural Chemicals on Wisconsin's Declining and Endangered Amphibians. William Karasov UW-MAD \$14,420 UWS/ \$14,420 DATCP

DATCP Projects

Effects of Fosamine, Picloram, and Triclopyr on Reducing Aspen in Prairie Bush Clover Habitat (West) 6,020 (Map # 15)

Impact of Ginseng Production on Groundwater Quality (Shaw, De Vita) \$10,650 (Map # 16)

Fate of Metalochlor, Alachlor, and Nitrate in Granular Iron/Soil/Water Systems (Eykholt, Davenport, Wonsettler) \$28,240

The total cost for all projects funded by DATCP through the FY 98 joint solicitation process, including the co-funded project above is \$59,330.

COMM Projects

* Molecular Techniques for Detection and Identification of Sewage-Borne Human Pathogens in Soils. William Hickey \$25,136.

* Holding Tank Effluent and Fecal-Contaminated Groundwater: Sources of Infectious Diarrhea in Central Wisconsin? Mark Borchardt \$28,218 (Map # 17)

The total cost for all projects funded by COMM through the joint solicitation process in FY 98 is \$53,354.

* Projects preceded by an asterisk were also funded in FY 97.

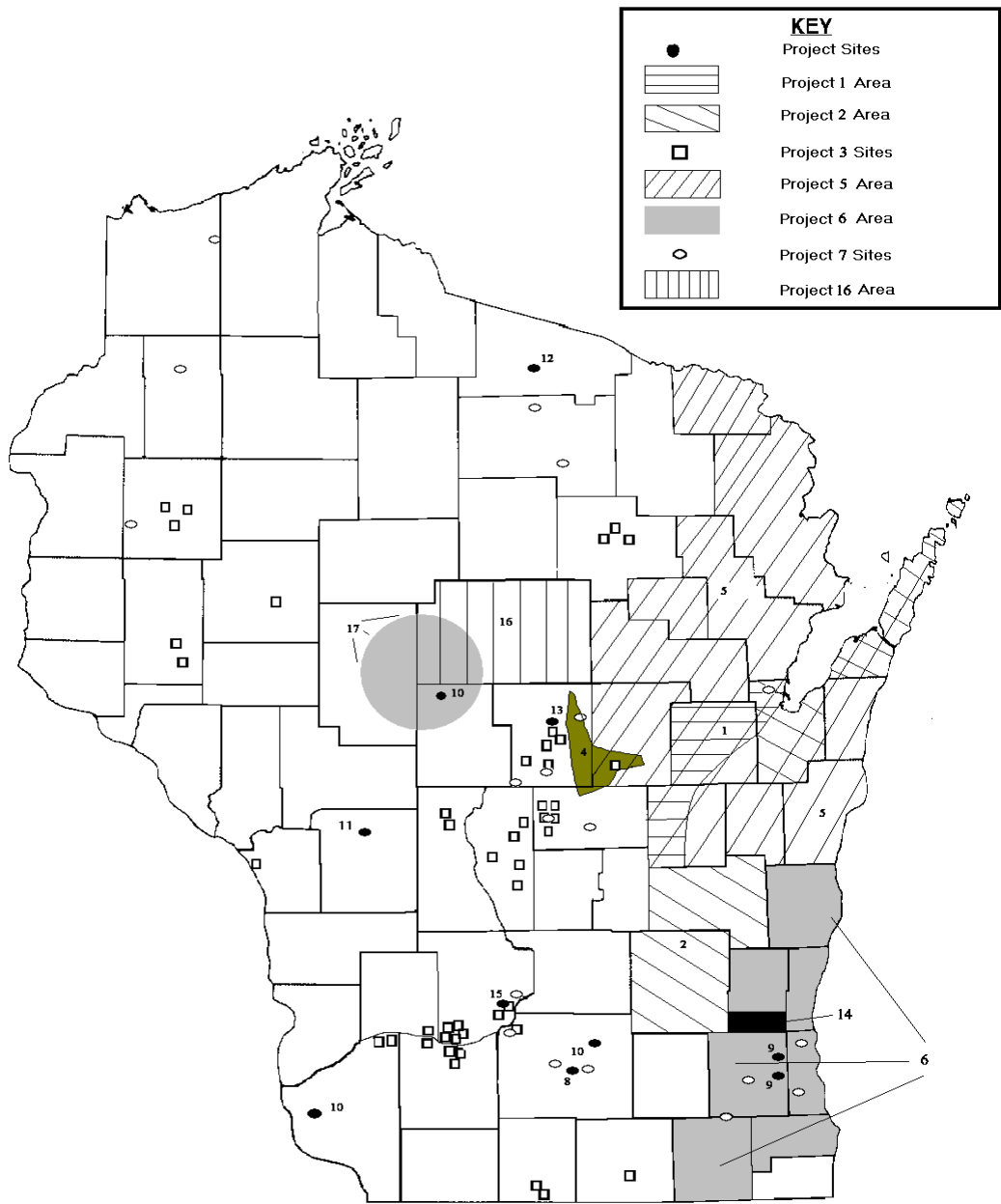


Figure 1- Location of groundwater monitoring or research studies for F.Y. 1998

**Table 2 - Groundwater Projects to be Funded Through
the Joint Solicitation for FY 99**

DNR Continuing Projects

Relationships Between Water Quality in Stream Base Flow and Private Wells and Land use in the Tomorrow/Waupaca River Watershed. B. Shaw \$28,400

Determination of the Hydrostratigraphy of the Deep Sandstone Aquifer in Southeastern Wisconsin. T. Eaton \$27,578

Groundwater-Surface Water Interactions in the Nine Springs Watershed. J. Bahr \$46,382

The total cost for all continuing projects funded by the DNR through the FY 99 joint solicitation process is \$102,360

DNR New projects

Acute and Chronic Toxicity of Nitrate to Brook Trout (*Salvelinus fontinalis*) R. Crunkilton \$35,230

Makoqueta Shale as Radium Source to the Cambro-Ordovician Aquifer System T. Grundl \$29,987

Mechanical Controls on Fracture Development in Carbonate Aquifers: Implications for Groundwater Flow Systems M. Cooke \$27,967

Analysis of Microbiological and Geochemical Processes Controlling Biodegradation of Aromatic Hydrocarbons in Anaerobic Aquifers W. Hickey \$45,198

Viral Contamination of Household Wells Near Disposal Sites for Human Excreta M. Borchardt/W. Sonzogni \$48,384

The total cost for all new projects funded by the DNR through the FY 99 joint solicitation process is \$186,766

The total cost for all projects funded by the DNR through the FY 99 joint solicitation process is \$289,126.

UWS Continuing Projects

Investigation of Air Sparging: Numerical Modeling, Laboratory Verification and Design Guidelines J. Hoopes \$22,337

Watershed-Scale Nitrate Contamination and Chlorofluorocarbon Ages in the Little Plover Basin: A Study at the Groundwater/Surface Water Interface B. Browne \$29,900

Determining Ground-Water Recharge Rates in Southern Washington County D. Cherkauer \$28,048

Evaluation of Exploration Borehole Seals Using Time Domain Reflectometry (TDR) T. Edil \$27,469

The total cost for all continuing projects funded by the UWS for FY 99, including the co-funded project below is \$121,647

UWS New Projects

Sedimentology, Stratigraphy, and Porosity-Conductivity Relations of the Silurian Aquifer of Ozaukee County, Wisconsin M.Harris \$24,206

Hydraulic Conductivity and Specific Storage of Maquoketa Shale H.Wang \$22,284

A Rational Design Approach for Permeable Reactive Walls C. Benson \$26,282

Water and Land Use: Interpretation of Existing Data to Foster Constructive Public Dialogue and Policy Formulation H.Read \$13,760

Groundwater Flow and Heat Transport in Wetlands: Transient Simulations and Frequency-Domain Analysis H. Bravo \$21,781

Monitoring: Evaluation of the Abundance, Diversity, and Activity of Methanotroph Populations in Groundwater M. Collins \$ 25,898

Natural Attenuation of Fuel and Related Groundwater Contaminants - A Measurement Method W. Sonzogni \$14,754

The total cost for all new projects funded by the UWS through the FY 99 joint solicitation process is \$160,333

The total cost for all projects funded by the UWS through the FY 99 joint solicitation process is \$281,980

Continued UWS /DATCP Co-Funded Project

The Direct Effect of Agricultural Chemicals on Wisconsin's Declining and Endangered Amphibians. William Karasov \$13,893 UWS/ \$13,893 DATCP

New UWS /DATCP Co-Funded Project

On-line SFE/GC for Improved Detection of Trace Organic Pollutants in Ground Water Monitoring (Armstrong, Noll) \$11,368/11,368

DATCP New Projects

Fate of the Herbicides Atrazine, Cyanazine, and Alachlor and Selected Metabolites D. Stoltenberg \$32,272

Using Geographic Information Systems and Soil Landscape Models to Predict Critical Sites for Nonpoint Source Pollution B. Lowery \$22,950

Assessing and Reducing Leaching of Agricultural Chemicals on Silt Loam Soils under Different Farming Systems K-J. Kung \$25,000

The total cost for all projects funded by DATCP through the FY 99 joint solicitation process, including the co-funded projects above is \$105,483

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/COMM, and the UWS. There are 228 projects listed. One hundred-thirty-three 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, the funding agency or agencies, and the project number if assigned.

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 $\mu\text{g/l}$ 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 DNR's Solid Waste Management (SWM) program received project funding eight times from 1985 to 1995 through the joint solicitation process. These projects have benefited the 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 SWM program 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 SWM program 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 cost savings while maintaining 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 SWM program 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 revise rules and establish policy regarding monitoring and siting of construction and demolition (C/D) landfills, deer pits, and yard waste sites in Wisconsin. The groundwater study of deer pits showed that impacts were minimal and helped the SWM program 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 SWM program 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 regulations (effective June 1996) allowing lined intermediate size C/D landfills which can provide the economic benefits of a large site without the potential negative impacts of very large sites. Based on the research, the regulations were written to require groundwater monitoring of inorganic parameters at small size C/D landfills but only require VOC sampling when establishing background. Since these studies have been conducted, many states and the EPA have contacted the SWM program about the information collected.

A more recent DNR-funded study undertaken by the SWM program (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 SWM program 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 SWM program. 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 follow up study by the SWM program (Svavarsson, 1995) compared low flow pumping and bailing for VOC groundwater sampling at landfills. The study indicated, in contrast with what some were claiming, that there was very little difference in the results when using the two different methods. These findings were incorporated into the new groundwater sampling code and allowed the use of either method for sampling VOCs. This reduced the cost that landfill owners would otherwise have had to bear to purchase and operate low flow pumping equipment.

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. In one case, the sources of metals in these drinking water supplies were given priority for removal (Door County Lead Arsenate Mixing Sites). In an Arsenic Advisory Area (AAA), well construction criteria were defined to avoid arsenic associated with a mineralized zone located at the contact between the St. Peter Sandstone and the Galena-Platteville Dolomite. The DNR coordinated with the DHFS to conduct health surveys on individuals consuming locally contaminated water supplies and made appropriate health recommendations. Local County Health Departments in affected areas are also actively monitoring groundwater quality and are providing assistance to homeowners. Ongoing research indicates that casing off the upper parts of the St. Peter Sandstone is effective in eliminating or reducing the presence of arsenic in drinking water. DNR guidance recommends the installation of 80 feet of casing through the sandstone for drinking water wells in the AAA. However, in an effort to save costs, the majority of well drillers are not following the recommendations. A current study appears to indicate that shorter casing lengths (~40 feet) may also be adequate in reducing the risk of arsenic exposure. Over the last several years, some wells that were not constructed according to guidance have exhibited increasing arsenic concentrations over time and have required replacement or reconstruction. It doesn't appear that the overall level of arsenic is increasing. The latest study recommends a required casing length in a couple of townships, but that overall in the AAA, recommendations should remain in place. The study also recommends that more education about potential signs of arsenic bearing rock should be provided to area well drillers.

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 nonpoint 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 moneys. 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. Two projects were funded in FY 98 to gather data for a similar project in Southeast Wisconsin.

Prevention and Remediation of Groundwater Contamination - Fifteen 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 and studies in progress 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 (Hoopes, 1997-98), (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
- Development of new technologies for evaluating the integrity of water supply well and exploration borehole seals (Edil, 1996), (Edil and Benson, 1997-98).

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 groundwater contamination adversely affects the value of real estate as perceived by prospective buyers and sellers. 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-WRC has solicited research projects during the last 4 years that deal with biological aspects of groundwater contamination. Two of the 5 biological projects, which have been supported, 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 WRC recently completed a DATCP supported 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.

Mary Lynne Perille Collins of the UW-Milwaukee Department of Biological Sciences completed a 2 year project during FY 98 that was 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 WRC recently completed 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 effectively 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 more rigorous assembly of the most efficient test suite. William Karasov of the UW-Madison Department of Wildlife Ecology has recently initiated a new biological study of a possible relationship between common agricultural chemicals and Wisconsin's declining and endangered amphibian population.

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 195,600 wells. These represent public and private water supply wells, piezometers, monitoring wells, and non-potable wells. Enhancements to the system, suggested by regional and central office staff, are implemented annually, to improve system functionality and ease of use. The current GRN system links to data systems in the Bureaus of Waste and Drinking Water and Groundwater for retrieval. The Wastewater program data systems will be made accessible to the retrieval network when the redesign of this program system is completed. GRN documentation and training has been provided and is always available upon request.

A statewide Geographic Information System (GIS) coverage of well locations is created through a maintenance link. Through an option on the GRN download menu, users can extract well and sample information in ARCVIEW format (a desktop GIS viewing software package produced by the makers of ARC/INFO). A customized ARCVIEW application is also available 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.

The GRN system is currently undergoing a conversion to the Windows environment. This conversion is underway and is expected to be completed early in August 1998. When completed, the system should be easier to use, provide additional capabilities and include new features, and provide the user with more access to the information contained within the Bureau program level database systems.

In order to more fully allocate groundwater programming hours from two full time programming staff, a solicitation was conducted in April 1998. The solicitation was done within the Department to develop a list of projects and expected completion hours for the fiscal year starting in July. Four bureaus participated in the solicitation process within the Department. Additionally, programming project ideas were developed from contact with outside agencies and submitted through participating Bureaus.

A solicitation will be conducted each year to continue to develop DNR groundwater systems, databases, and closely related issues. The goal is, with the distributed allocation of staff programming resources among all systems, a more consolidated and complete picture of our groundwater resource will emerge.

Groundwater staff are currently finalizing a PC program developed to capture information from six Department well related forms. These six forms are in use within several Bureaus. The program will allow entry, editing, printing, and data sharing. The goal of the project is, in conjunction with the launch of Wisconsin Unique Well labels for monitoring wells, to provide a way of electronically entering the information and sending that information back to the DNR. The information will be used to develop statewide databases. Currently only paper copies exist and are not consolidated in a centralized location for access.

DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION

DATCP needs up-to-date, reliable data about pesticide and nitrate-N contamination of groundwater. DATCP uses these data to develop substance specific rules about pesticide use, such as DATCP's "Pesticide Product Restrictions" (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 paper lab slips and computerized data received from DNR and other sources. DATCP practices this level of scrutiny in order to use these data for regulatory purposes. DATCP also works closely with other local and state agencies to coordinate groundwater data collection and to improve the integrity of groundwater data in Wisconsin.

DATCP's groundwater database currently contains information for over 20,100 wells and over 60,000 pesticide and nitrate-N results. These data represent samples analyzed by DATCP, SLOH, and other public and private laboratories. The groundwater database currently operates as a multiuser application developed in Paradox 4.0. Members of DATCP's Groundwater Unit and Containment and Remediation Unit access the database via Pathworks operating on the DATCP's VAX computer. DATCP plans to convert this application to Microsoft Access in fiscal year 1999. DATCP is also developing links between its groundwater sample database and the Agrichemical Management Bureau's new compliance tracking system (also an Access application). This link will allow staff to view groundwater sample results for specific compliance cases.

DATCP uses GIS tools to analyze groundwater data and prepare maps for public hearings, DATCP board meetings, presentations, and other uses. DATCP prepares and maintains Arc/Info data layers of well locations and atrazine concentrations, atrazine prohibition areas, and other pesticide and nitrate-N data. These GIS layers and associated database information are used to generate maps of statewide pesticide and nitrate-N detections in wells, as well as maps for the Atrazine Rule. Other GIS analyses involve identifying groundwater wells that may be impacted by point sources of pesticide and nitrate-N contamination. DATCP has recently acquired global positioning system (GPS) receivers which will also be used to locate and map wells and other features, such as agrichemical facilities and spill sites, that may affect groundwater quality.

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 GIS. 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 COMMERCE (COMM)

COMM has embarked on an information technology initiative, the purpose of which is data integration. With regard to groundwater protection, COMM will, at the completion of this project, be able to identify sites that have underground petroleum storage tank systems, groundwater and soil remediation and private sewage systems. Sanitary permit information will ultimately be combined with a database that will track maintenance and/or inspection of all private sewage systems.

DEPARTMENT OF HEALTH AND FAMILY SERVICES

DHFS does not maintain a centralized database on groundwater data. The Department relies on other state agencies for computerized groundwater information.

UNIVERSITY OF WISCONSIN SYSTEM

The Central Wisconsin Groundwater Center 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 nearly 228,000 individual test results for approximately 36,800 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-seven counties are represented by 100 or more samples in the databases, and 18 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, 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. 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-six projects were funded in FY 98 by one or more of the following agencies: UWS, DATCP, DNR and COMM. The projects funded are listed in Table 1. The GCC approved the 1999 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 October 1997 and is contained in the Appendix. A total of 30 project proposals were received. A comprehensive review process ensued that resulted in the selection of 16 new projects for funding for FY 99. The 16 new projects selected by the UWS, DNR, and/or DATCP for funding in FY 99 are in addition to 10 projects which carried over from FY 98. At their March 12, 1998, teleconference the GCC unanimously approved the proposed UWS groundwater research plan as required by s. 160.50(1m), Wis. Stats. The UWS will fund 5 continuing and 8 new projects in FY 99. The FY 99 groundwater monitoring and research projects are listed by funding agency in Table 2.
- Through several of its subcommittees, the GCC continued to address important data management issues. Data management activities include:
 - Updating the Directory of Groundwater Databases, a DNR publication that lists contacts for and describes groundwater databases at federal and state government agencies and the University of Wisconsin;
 - Implementing a strategy to identify the groundwater data needs of local government entities through the Local Government Subcommittee;
 - Evaluating and preparing groundwater-related forms for electronic submittal; and
 - Examining issues related to coordination and integration of well construction data into an automated format.
- The GCC continued to coordinate efforts to enhance the utility of groundwater monitoring and research funded through the joint solicitation process. In FY 97, UW WRC staff made 72 groundwater monitoring and research summaries accessible by computer through the creation of a web site (www.library.wisc.edu/libraries/Water_Resources/wgrmp/wgrmp.htm). The project summaries are positioned for inspection and downloading by researchers, field specialists, state agency, and academic libraries, environmental consulting firms, legislative personnel, and citizens groups having access to the world wide web. The network edition of the Wisconsin Groundwater Research and Monitoring Project Summaries has had its first full year of operation during FY 98. During this period, the WRC Project Summaries web site hosted 1,152 visitors who retrieved a total of 2,518 project summaries. The average number of summaries retrieved from among the 72 that are currently posted was 35, with a range 10 to 137 downloads per summary.
- The GCC continued to promote communication, coordination, and cooperation between the state agencies through its quarterly meetings. The GCC received briefings and heard presentations on:

- Subcommittee activities (see below)
 - DNR new appointments
 - Results from survey of joint solicitation proposal authors
 - FY 99 Joint Solicitation timeline
 - Relevance of research and monitoring to groundwater problems
 - FY 1997 GCC Report to the Legislature
 - Relationship of land use to groundwater and surface water quality
 - Water Resources Center web page activity
 - GCC web site
 - Metallic Mining Rule (NR 182) revisions
 - Source Water Assessment Program
 - Synergistic Effects Of Endocrine Disruptors In Drinking Water
 - UWS FY 99 Groundwater Research Plan
 - Directory of Groundwater Databases
 - Triazine Screen Workgroup
 - COMM 47 (PECFA) Emergency Rule development
 - ATCP 29, 30 and 31 revisions
 - Agrichemical Impacts to Groundwater Under Irrigated Vegetables in the Central Sand Plain
 - Data gathering for atrazine use reinstatement
 - New proposed NR 140 groundwater quality standards
 - Federal groundwater funding through Section 106
 - Clean Water Initiative
 - Evaluation of Well Seals Using an Ultrasonic Probe
- 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, FSA, 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 99. The revised priorities were included in the joint solicitation distributed by the UWS, DNR, COMM, and DATCP in October, 1997.

The subcommittee met with the Monitoring and Data Management Subcommittee in January to review the 30 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 FY 99. The projects to be funded in FY 99 are listed in Table 2.

Monitoring & Data Management Subcommittee (MDMS) - Workgroups established by the MDMS to complete tasks related to confidentiality, database documentation, WUWN assignment, automated well construction data format coordination, electronic data submittal, and state and county data integration continued to explore procedures to improve data transfer and reporting (see p.6 and p.48).

The MDMS reviewed the priorities for the DNR's groundwater management practice monitoring program for FY 99. The revised priorities were included in the joint solicitation distributed by the UWS, DNR, COMM, and DATCP in October, 1997. The subcommittee met with the Research Subcommittee in January to review the 30 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 FY 99. The projects to be funded in FY 99 are listed in Table 2.

Planning and Mapping Subcommittee (PMS): The PMS met three times during FY 98. The primary focus of the subcommittee continues to be the review and evaluation of groundwater mapping and analysis tools. Subcommittee members represent state and federal agencies with groundwater planning and mapping responsibilities.

In FY 98 the group focused on four major topics. These include (1) mapping Wisconsin's karst features, (2) collecting locational data using global positioning system (GPS) and address matching tools, (3) status of the Source Water Protection Plan program and how groundwater related data from member agencies could be used in the planning process, and (4) agency updates.

- **Karst Features:** Subcommittee members discussed how their agencies locate and record karst data. Maureen Muldoon, a geohydrologist with the WGNHS, updated the group on the status of karst mapping in Wisconsin and surrounding states. At the request of the subcommittee, the GCC endorsed the idea of a central repository for karst data. WGNHS volunteered to be the repository, and is currently developing guidelines for all state agencies to follow when collecting and reporting karst information back to WGNHS. The subcommittee will continue to focus on karst related issues in FY 99.
- **GPS and Address Matching:** Several member agencies use GPS and/or address matching tools to locate features that may affect groundwater resources. Subcommittee members described how their agencies use these tools and provided information to others about them. The subcommittee will continue with this issue in FY 99.
- **Source Water Assessment Program:** As part of this federal program, DNR will need to map features that have the potential to contaminate groundwater and surface water resources in Source Water Protection areas. The subcommittee discussed the types of data that might be important for this planning process and ways in which the data could be collected by the various agencies and shared with DNR. The subcommittee will continue with this issue in FY 99.
- **Agency Updates:** Subcommittee members update the group on planning and mapping activities happening in their respective agencies. This information is very important for coordination of data collection and mapping purposes. The subcommittee will continue to keep each other informed in FY 99.

Education Subcommittee: The Education Subcommittee met five times during the past year. Subcommittee work focused on an outreach strategy for elected officials, better information for homeowners on the health effects of drinking water contaminants, and review and coordination of educational materials.

The subcommittee is planning an educational event at the Capitol Rotunda during Groundwater Protection Week in February, 1999. Member agencies have been invited to prepare and staff displays about their groundwater protection and education activities. Researchers funded through the Joint Solicitation will also be invited to present some of the practical applications of their research findings.

Information given to homeowners who test their water for triazines (atrazine and related herbicides) was improved in the last year. Laboratories have been using a simple screening test for triazines, but the screen does not detect all triazine components. More information was needed on which wells needed a more expensive and intensive gas chromatographic test for atrazine. After subcommittee discussion, DNR funded a small study carried out by DATCP which better defined the wells most in need of additional testing.

Subcommittee members from DATCP, DNR, and DHFS developed interpretive information to be sent to homeowners, which was approved by the Council. The subcommittee also began to examine recommendations for homeowners on testing for other contaminants, such as VOCs.

The subcommittee reviewed its coordination efforts for the 1997 Farm Progress Days and developed an improved strategy for 1998. This year the focus will be on encouraging area high schools to have their students visit the many groundwater education displays on the site. The Wisconsin Ground Water Association is providing funds to buy prizes for the students who participate. The subcommittee also suggested revisions of the "Groundwater - Protecting Wisconsin's Buried Treasure" magazine, reviewed a DNR brochure on Unique Well Numbers, and heard a presentation on national youth groundwater education materials and efforts.

Local Government Subcommittee(LGS) The LGS was formed in 1993 to represent local units of government and organizations representing local units of government. In February 1998, the LGS met via teleconference. At the meeting, the LGS provided comments on a revised draft of the Directory of Groundwater Databases. The comments were included in the final report which was published in April.

The LGS also discussed the need for additional followup to the State and County Data Integration Strategy prepared by the subcommittee in 1997 to address the data management needs of local units of government. The LGS expressed interest in having groundwater data available on a county-by-county basis. The subcommittee also provided comments on two groundwater standards documents and got an update on the Source Water Assessment Program (SWAP). The subcommittee made suggestions for the SWAP.

DIRECTIONS FOR FUTURE GROUNDWATER PROTECTION

PRIORITY ISSUES THAT NEED TO BE ADDRESSED

- * **Promote consistency between the agencies on data management issues:** Through the recent update 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. This effort must be maintained by continuing to identify what local government data needs exist. Data consistency must be promoted by use of translatable geolocational coordinate systems and consistent data elements for use in a GIS environment. The GCC will continue to provide leadership and communication on data management through its 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. Several projects that study the impacts of land use on groundwater have been and continue to be funded through the joint solicitation. These projects must be managed in such a way as to maximize their relevance to state land use problems. 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 benefited 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 containing 72 of these summaries. All 72 of these summaries are available on the UW-WRC web site maintained by UW-WRC. In FY 98 the rate of response to this way of distributing Wisconsin groundwater research findings has been approximately 210 summary downloads per month. To maintain and enhance this encouraging response it will be important to add new summaries annually as they become available, create a more visually appealing set of front-end pages for the site, and publicize the web site location and content more 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:** Studies have 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 and FY 97, the Planning & Mapping and Monitoring & Data Management Subcommittees began to prioritize, promote, and help facilitate the development of data layers as part of a larger data integration initiative. Through the upcoming Source Water Assessment Program, to be implemented starting in FY 99, this work will continue and may result in improved predictive capabilities.
- * **Continued evaluation of alternatives to on-site septic systems:** Although the DNR and COMM have recently funded monitoring projects in this area, additional work is needed to find state-of-the-art private sewage system technologies that provide efficient, cost-effective options.

- * **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 human health implications of consuming nitrate contaminated groundwater and the effect of discharge of this groundwater on surface waters and their ecosystems. 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.
- * **Solutions to groundwater nonpoint pollution problems:** A 1997 DATCP report indicates that 8.5% of Wisconsin's wells still contain detectable atrazine residues. In addition, 10% exceed the nitrate standard. 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. Further effort is needed to improve dialogue between state and local governments. In FY 97, the subcommittee began to address data management needs of local governments. However, subcommittee 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 97, DNR staff with help from the Groundwater Quantity Technical Advisory Committee completed a report on the groundwater quantity issue (see "Condition of the Resource - Groundwater Quantity" for the Executive Summary of this report). 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 15, 1997

Members Present: Susan Sylvester (DNR), Jack Metcalf (Gov. Rep.), Henry Anderson (DHFS), Eric Scott (COMM), Carol Cutshall (DOT), Jim Vanden Brook for Nick Neher (DATCP), Ron Hennings for James Robertson (WGNHS), Fran Garb (UWS).

Others Present: Chris Mechenich (CWGC); Lisa Morrison (DATCP); Byron Shaw (UW-SP); Barb Lensch (NRCS); George Blondin (UWS); Gary Lueck (WRWA); Jill Jonas, Mike Lemcke and Jeff Helmuth (DNR).

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

1. **General Business** - Introductions were made. The minutes of the May 30th meeting were approved with the following two changes: 1) In the Education Subcommittee report "Some" was added to the beginning of "Subcommittee members favored use of the preventive action limit (PAL) as the target." (second sentence of the fourth paragraph), to reflect that a consensus had not been reached on the issue ; and 2) In the first paragraph on page 4 "Eric Scott noted that the PECFA program may be able to support some remediation related research in the future" was changed to "Eric Scott noted that in past legislative committees, there were discussions regarding the PECFA program reimbursing costs for research. However, PECFA funds could not be used for research (only actual remediation) and that the GCC should be aware of any such proposals and may want to encourage the funding of such research."
2. **DNR new appointments** - Susan Sylvester announced three recent DNR appointments: 1) Lloyd Eagan, Air Management Bureau Director; 2) Allen Shea, Watershed Management Bureau Director; and 3) Richard Wedepohl, Floodplain, Shoreland Zoning and Dam Safety Section Chief. Susan also noted that the Runoff Management Section Chief position should be filled by the end of September.
3. **ATCP 30 and ATCP 31 rule revisions** - Jim Vanden Brook summarized the status of the two proposed rules. Proposed changes to ATCP 30, commonly known as the Atrazine Rule, include creating two new atrazine prohibition areas (PAs) in Columbia and Waupaca Counties; expanding five existing PAs in Adams, Columbia, Marathon, Rock and Vernon Counties; and creating standards for the repeal or reduction of a PA. Public hearings are scheduled for Eau Claire on Sept. 23, Stevens Point on Sept. 24, Appleton on Sept. 25, Richland Center on Sept. 29, and Madison on Sept. 30. The hearing record will remain open for additional written comments until October 8, 1997. If approved, the rule changes would go into effect on or about April 1, 1998. Jim added that ATCP 31, the generic pesticide rule was going to the legislature as final and included a provision for PA repeal. Jim handed out a diagram of the PA repeal process specifically for atrazine. There was some discussion of the choice of 50% of the Enforcement Standard (ES) as the target level for PA repeal. Jim said that a statistical analysis showed that if levels dropped to 50% of the ES for atrazine within a PA then there was little likelihood of levels increasing to over the ES. Jim added that the ultimate goal was to show compliance with the PAL.
4. **Source Water Protection** - Jill Jonas gave an overview of the source water assessment program (SWAP) required by the 1996 Safe Drinking Water Act amendments. U.S. EPA has issued its final guidance for states to develop SWAPs. The guidance provides the states with a flexible approach to develop source water delineations and contaminant assessments for each public water system. SWAPS must: 1) delineate the boundaries of the areas providing source waters for public water systems; 2) identify, to the extent practicable, the origins of regulated and certain unregulated contaminants in the delineated area to determine the susceptibility of public water systems to such contaminants; and 3) make assessment results available to the public.

In Wisconsin a Safe Drinking Water Act statewide advisory *ad hoc* committee and four internal workgroups have been formed. Jill is leading the Source Water workgroup. She emphasized the importance of working closely with other interest groups and coordinating with other Drinking Water and Groundwater programs such as vulnerability assessments, sanitary surveys, monitoring programs and the state wellhead protection program. Jill also explained the source water petition program which is an optional loan program to assist in the development of voluntary local incentive-based partnerships to protect water systems from specific contaminants.

The deadline for Wisconsin's SWAP plan completion will be February 6, 1999. If approved implementation will begin within 9 months. The SWAP should be completed within 2 years of approval of the plan unless an extension is granted which could extend the program for an additional 18 months.

- 5. Education Subcommittee Report** - Chris Mechenich reported that, at their August 6th meeting the subcommittee had reviewed the four letters sent to Susan Sylvester from the Stevens Point area regarding nitrate contamination of groundwater and that the subcommittee had noted the concerns raised by the letter-writers. Ron Hennings added that in future replies to such letters it could be suggested to also contact state legislators about groundwater concerns.

Chris reported that the subcommittee had also discussed triazine screen reporting language and had facilitated an arrangement where DNR Private Water Supply program funds would support split sampling and analyses for DATCP's Jeff Postle to investigate the correlation between triazine screen and gas chromatographic results at certain levels of atrazine contamination. Jim Vanden Brook added that the split sampling was already in progress and that DATCP would work with DHFS on the reporting language.

The subcommittee had also explored ways to make the GCC more visible to state Legislators. One idea discussed was to make the annual report more interesting. However, the subcommittee determined that, in its present form, the report was a useful reference and fulfilled its purpose. Furthermore, one attempt to popularize the report had failed in the past. Jim Vanden Brook said that the report was useful because of its comprehensiveness. Two other ideas supported by the subcommittee were to: 1) add a list of groundwater contact information by legislative district to the report or as a separate brochure; and 2) emphasize the results of programs in the report. Henry Anderson said he thought the legislative district information could be helpful but might not be used.

Chris Mechenich suggested that, next year, the GCC hold a public meeting or press conference to present the 1998 Report to the Legislature. This would give the Legislature, public and environmental groups a better opportunity to understand groundwater issues and make the GCC more visible. Susan Sylvester questioned who and how many would attend the meeting and suggested that the subcommittee discuss the idea further and consider tying the idea to an occasion such as Groundwater Protection Week.

Chris reported that the brochure "A Guide to Groundwater Information Sites" was distributed at Farm Progress Days. Chris and the subcommittee produced the brochure to assist people in finding various groundwater displays in the Farm Progress Pavilion, the DNR Tent, and in the Youth Tent. Chris discussed having an unfolded brochure with a site map next year so that people would recognize its immediate purpose. Carol Cutshall suggested that a poster might be effective too.

- 6. Planning and Mapping Subcommittee Report** - Lisa Morrison reported that at their July 28th meeting the subcommittee resumed work on more planning- and mapping-related topics after their recent data integration activities. The subcommittee examined its mission, direction and membership. Membership changes include Mike Bohn stepping down and consideration of new members from the PECFA program and the NRCS. Susan Sylvester suggested contacting Paul Strom for a replacement for Mike Bohn. Barb Lensch said she would find an appropriate person from NRCS.

Areas of interest to the subcommittee include source water information coordination for mapping, land use planning, tools for planning and mapping such as address matching and Global Positioning Systems (GPS), continued integration of locational information across agency lines, distribution of GIS layers, special purpose mapping, and agency updates. Address matching and GPS were discussed at the July meeting with Lisa spearheading efforts in both areas. The next subcommittee meeting was set for October 28th.

- 7. Approval of Certificate of Appreciation for past subcommittee members** - Susan Sylvester asked for the GCC's approval of certificates of appreciation prepared to recognize service by past subcommittee members. Certificates were prepared for Bennette Burks, Phil Kammerer, Jon Cleveland, Jean MacCubbin, Jay Payton, Cathy Cliff, Dave Lindorff and Jeff Postle. The certificates were unanimously approved and then signed by Susan and the appropriate subcommittee chair.

8. **Results from survey of proposal authors/FY 99 Joint Solicitation timeline** - Jeff Helmuth summarized responses to a survey of Joint Solicitation proposal authors designed to determine preferences regarding the proposal deadline. There were 30 respondents, in total authoring 129 proposals, 60% of which were funded. Most investigators favored proposal due dates either before or after the weeks around final exams. They also preferred to be notified of their funding status by mid-march in order to hire quality research assistants to work on the projects. Jeff added that notification before the state budget is complete is a risk in that the funding may be lost after investigators have been told they will be funded. The GCC decided that the risk was small compared to the benefits of earlier notification. Based on the survey responses and time needed for the proposal review process, December 5th, 1997 and March 6th, 1998 were chosen as the optimal proposal and notification due dates, respectively, for the FY 99 joint solicitation.
9. **Relevance of research/monitoring proposals to groundwater problems of the State** - Susan Sylvester gave some background on the proposal relevance issue that first came up in the March GRAC meeting and asked what specific issues people had brought for discussion. Henry Anderson asked if there was some way for agencies to help coordinate private data collection and academic research so that the data generated by site investigations could be utilized for policy or technology evaluation. Carol Cutshall said that the DOT has large amounts of site-specific data and that she would like to see research encouraged, especially in social areas. Eric Scott said that, with so many sites that coordination would be a large undertaking. Ron Hennings said that there is a need for research on natural attenuation. Eric added that when a site is closed there is no more funding available from PECFA and that most research would require more monitoring wells than are typically present at a PECFA site. Ron suggested that it was important not to allow research funds to be used for remediation projects. It was agreed that agencies should look for opportunities to reach out to private groups to see the potential for public/private partnerships.
10. **Approval of FY 1997 GCC Report to the Legislature** - Jeff Helmuth handed out a list of proposed substantive changes and additions to the GCC second draft Report to the Legislature. The changes included updating Senate and Assembly committee names, federal agency acronyms, descriptions for the DNR Bureau of Watershed Management and the UWEX Priority Watershed programs and correcting the estimated number of private wells reported in the Nitrate section. Ron Hennings questioned the number of private wells reported in the Nitrate section and asked that Jeff get an estimate from Bill Rock before finalizing the report. Additions to the report included: a description of the DHFS Nitrate Followback study to the Nitrate section; a description of the GCC's efforts to begin compiling information about other groundwater research programs and to contact other states with groundwater research programs to the "Coordination of Groundwater Monitoring and Research" section; and a list of projects funded by the Wisconsin Fertilizer Research Council projects to the Appendix. The 1997 Report to the Legislature, with the above changes, was unanimously approved. Jeff Helmuth said he would make the changes and distribute the final report.
11. **Relationship of land use to groundwater and surface water quality** - Byron Shaw began by talking about a project titled "Agricultural Chemicals, Land Use, and their Impact on Surface Water Quality in the Little Plover River Watershed" which was funded by DATCP in FY 96 and FY 97. The Little Plover River is a Class A trout stream that drains an area with irrigated and non-irrigated agriculture, developed areas and greenspace. Water quality problems include high nitrate concentrations in groundwater which have forced municipal water systems to use costly nitrogen removal systems.

Historical surface water and groundwater quality information was available for the watershed. Base flow, surface water samples, seepage meters and mini-piezometers were used to make estimates of groundwater discharge to the stream. A geographic information system and ASCS air photos were used to analyze land use patterns since 1985. MODFLOW with Groundwater Vistas pre- and post-processing software was used to model groundwater flow.

Although trends in agricultural nitrogen use were difficult to document, it appeared to have increased. Long term monitoring data since 1900 has shown a steady increase in stream nitrate concentrations and showed the presence of pesticides. In groundwater, nitrate levels showed an upward trend in most wells and a number of pesticides were also found. When sewers were installed nitrate levels decreased in those areas. Current septic systems are not thought to be a big part of nitrogen loading in the watershed. Byron said he felt that Best Management

Practices (BMPs) have had only a limited impact on nitrogen loading. Triazines were found in nine piezometers through the stream bed. A comparison of pesticide levels measured from mini-piezometers and seepage meters showed some attenuation occurring through the streambed. Water tables declined near the shallow municipal and industrial wellfields in Whiting and Plover. Modeling predicts a 30% decline in stream flow resulting from these declines.

Byron also discussed a similar project funded by the DNR in FY 98 that he is conducting in the Tomorrow/Waupaca watershed in Waupaca and Portage Counties. The Tomorrow River is a class A trout stream. Land use in the watershed is more dairy-oriented with less irrigated agriculture. Byron has access to over 2000 private well sample data and 4 years of stream baseflow data at 40 sites. Groundwater quality is a big concern in this watershed. Stream nitrate levels are as high as 8 mg/l and there is local interest in triazine data.

Byron concluded that the overall nitrogen balance for agricultural crops must be looked at and that most nitrogen that does not go into the crop will go into the groundwater. Conveying this concept is the key. Byron noted that he had heard of at least one instance where a farmer had actually increased nitrogen application due to UWEX recommendations. Based on the lack of positive results on the effectiveness of BMPs in protecting groundwater Byron asked if we really need to get the high agricultural yields that are currently sought by using high nitrogen inputs. More modest yield goals are likely to achieve better groundwater quality.

The meeting adjourned at 3:00. The next meeting is scheduled for November 21st in the Board Room of the Department of Agriculture, Trade and Consumer Protection at 2811 Agricultural Drive in Madison.

Respectfully submitted,

Jeff Helmuth, Groundwater Specialist
Department of Natural Resources

**Wisconsin Groundwater Coordinating Council
Meeting Minutes - November 21, 1997**

Members Present: Susan Sylvester (DNR), Jack Metcalf (Gov. Rep.), Nick Neher (DATCP), James Robertson (WGNHS), Fran Garb (UWS), Henry Anderson (DHFS), Eric Scott for John Alberts (COMM), Carol Cutshall (DOT).

Others Present: Lynda Knobeloch (DHFS); Lisa Morrison, Jane Larson, and Jeff Postle(DATCP); George Blondin (UWS); David Webb and Jeff Helmuth (DNR).

The meeting was held in the Board Room of the Department of Agriculture, Trade and Consumer Protection at 2811 Agricultural Drive in Madison, beginning at noon.

1. **General Business** - Introductions were made. The minutes of the August 15th meeting were approved.
2. **Education Subcommittee Report** - Jane Larson reported that, at their November 12th meeting, the subcommittee had heard a presentation on national youth education efforts and materials by Elaine Andrews of UWEX who has a prominent national role in youth education. Among other materials, Elaine had provided the subcommittee with a brochure, "Community Water Education and Action Opportunities", that describes and lists contacts for Wisconsin water resources volunteer programs. Jane also reported that the State Laboratory of Hygiene (SLOH) was developing materials to encourage private well users to test their water for bacteria during *Public Health Is Everywhere Week* in April. Chris Mechenich and Jim Peterson of the subcommittee are also on the committee to write those materials. The subcommittee was also reviewing a potential DNR brochure, "The Need for Assigning Wisconsin Unique Well Numbers - A Bankers Perspective".

Jane introduced Jeff Postle to report on his work with the subcommittee regarding triazine screen reporting language and the results of split sampling and analyses of 50 wells in atrazine prohibition areas (PAs) to determine the relationship between triazine screen and gas chromatographic (GC) data. Current SLOH triazine screen reporting language says that for screen results under 3 ppb the water is "safe to drink". This is a cause of concern because the triazine screen picks up atrazine and only a portion of one of its metabolites. The 3 ppb Enforcement Standard (ES) applies to parent atrazine and all three of its metabolites. Approximately 7000 triazine screen tests have been performed on private wells in the State in the last 5 years. Jeff's data showed that screen results compared well with atrazine parent compound amounts but for screen results above 0.1 ppb the total atrazine (TA) as measured by GC was often above the ES of 3 ppb. This may be considered to represent a worst case scenario because the samples were all from wells in PAs where the atrazine was likely to be more degraded than at most sites. A potential confounding factor is that the metabolites that partially compose the TA may come from other triazine compounds such as cyanazine and/or simazine. Jeff noted that the triazine screen has a lower level of detection than the GC and that 70% of samples analyzed in the state with the screen do not detect anything.

Questions to be answered include: How should the reporting language be revised? Who should pay for a follow-up GC analysis? What are the legal implications of potentially misleading well owners? Should the triazine screen be abandoned? Can a better screening test be developed? What is the health issue? What treatment options exist? How should well owners be advised to follow-up a screen with a GC since so few labs offer GC analysis for TA?

Susan Sylvester thanked Jeff Postle for his presentation and asked that a workgroup headed by Bob Krill, Henry Anderson and Nick Neher address the above questions and report back to the GCC at the February meeting.

- 3) **Planning and Mapping Subcommittee Report** - Lisa Morrison reported that at their October 28th meeting the subcommittee welcomed three new members: Gordon Kline (COMM-PECFA), Mark Rolloff (NRCS), and Mike Lemcke (DNR). Key issues that the subcommittee will address in the upcoming year include: identifying software for address matching and geolocation, identifying and tracking sites/features affecting groundwater, Global Positioning System tools for locating sites/features, status of Source Water Assessment Program and its affects on planning and mapping activities, and creating a repository for data on Karst features.

- 4) **FY 99 Joint Solicitation** - George Blondin reported that this year the UW-System distribution list for the Joint Solicitation package grew to 350 individuals by the addition of 98 new potential groundwater researchers or Grants and Contract officers. This was the result of efforts by George and Fran Garb to identify UW people and programs that address scientific and policy concerns related to groundwater.
- 5) **Directory of Water Resources Expertise in Wisconsin** - George presented a draft of the Directory and asked that the agencies review it for completeness and accuracy. Jeff Helmuth asked that the Directory be sorted by agency and forwarded to each agency for review. George said he would send the sorted version to each agency soon.
- 6) **Water Resources Center web page activity** - George Blondin reported that the Water Resources Center research summary web site was functioning well and had so far provided over 2250 downloads.
- 7) **GCC web site** - Jeff Helmuth asked for comments and suggestions on the GCC web page. It was noted that: 1) Gordon Kline was not yet listed on the Planning and Mapping Subcommittee list; and 2) it would be useful to be able to index and search the GCC website rather than the DNR page. Jeff said see that those changes were made and finalize the web site.
- 8) **ATCP 29, 30 and 31 Rules** - Nick Neher reported that revisions to ATCP 31, the General Pesticide Rule, had been through public hearings and were undergoing legislative review in the Senate. Nick reviewed the primary revisions which are the conditions under which DATCP would consider a PA rescission.

Nick also reported that the public hearings and public comment period were completed for ATCP 30, the Atrazine Rule. There was concern by DNR and others over the selection of 50 percent of the ES as the “trigger” point at which the rescission process could begin. DATCP feels that use of this trigger point for beginning the PA rescission process will result in little likelihood of levels increasing to over the ES. Further declines in atrazine concentrations in groundwater are likely due to implementation of management strategies. If approved, the rule changes will go into effect on or about April 1, 1998

Nick added that ATCP 29 would go to the ATCP Board in December and that DATCP would work with DPI to communicate risks regarding pesticide use in schools.

- 9) **Metallic Mining Rule (NR 182) revisions** - Larry Lynch, Hydrogeologist, Mining Team Leader, and Proposed Crandon Mine contact at DNR summarized the proposed revisions to NR 182. The proposed revisions include groundwater quality provisions. Since 1982 the rule has required compliance with Maximum Contaminant Levels (MCLs) or Groundwater Standard to the area outside a compliance boundary set at 1200 feet from a mine. Chapter 160 and NR 140 have exemptions for mining facilities. Permit criteria require demonstration that standards are met at the compliance boundary through predictive modeling, leaching studies and design elements. When operating, mining facilities must monitor within the compliance boundary and at the compliance boundary. Intervention is required if monitoring at intermediate points indicates that, without intervention, the standards would be exceeded at the compliance boundary.

The NR 182 rule revision process began in 1996. The revisions include changing the 1200 foot radius compliance boundary to the outer boundary of a Design Management Zone (DMZ). Additionally, a Mandatory Intervention Boundary (MIB) would be set at 150 feet. Preventive Action Limit exceedences at the MIB would require remedial action. Predictive modeling would still be required. The revisions retain the requirement to investigate any statistically significant change in background groundwater quality. Larry stated that the reason that the 1200 foot radius DMZ was larger than the 150 foot DMZ for landfills was that the required predictive modeling is done using conservative assumptions.

Larry added that the rule revisions would go to the Natural Resources Board in December (Note: the rule revisions were approved by the NRB at their December meeting). Jamie Robertson emphasized that any comparison between NR 140 and NR 182 was complicated and that it was not clear which was more stringent.

- 10) **Source Water Assessment Program** - Jeff Helmuth gave a brief update on the DNR’s development of a Source Water Assessment Program (SWAP) as required by the 1996 Safe Drinking Water Act Amendments.

Development of the SWAP is being addressed by the SDWA Oversight Committee, and an internal Source Water Protection Workgroup, with input from stakeholders. Jeff is heading up the workgroup and has been Acting Source Water Protection Team Leader since Jill Jonas took the Runoff Management Section Chief position in October.

The DNR, is in the early stages of developing an approach to delineating Source Water Assessment Areas (SWAAs) for all public water systems and completing potential contaminant source assessments for those areas. Determining and compiling system locational information is the first step. The DNR is building a GIS database layer of system location for municipal wells, other public wells, and all surface water intakes.

Jeff outlined a proposed strategy for completing the SWAA delineations and assessments. For groundwater SWAA delineations the DNR is proposing two methods: 1) calculated fixed radius (minimum 1200 feet) for community wells; and 2) fixed radius for non-community wells. For surface water intakes located in Lake Michigan and Lake Superior, subwatersheds may be assigned to each intake/intake cluster based on proximity to intakes, potential to impact intakes, and local jurisdictions. For surface water intakes located in Lake Winnebago the entire watershed may be assigned to all intakes. Further subdivision and/or designation of critical areas may facilitate differing levels of assessment based on size and proximity to intakes, land use and/or contaminant occurrence.

To achieve source water protection goals the DNR will be working closely with interested groups and individuals and utilizing existing programs such as vulnerability assessments, sanitary surveys, surface water monitoring and wellhead protection. The deadline for Wisconsin's SWAP plan completion is February 6, 1999. Approval and beginning implementation should begin 9 months later. The SWAP should be completed within 2 years of approval of the plan unless an extension is granted which could extend the program for an additional 18 months.

- 11) **Approval of proposed meeting schedule for 1998** - The GCC approved their 1998 meeting schedule. Meetings will be held February 27 at WGNHS; May 29 at Dodgeville; August 21 at DOT; and November 13 at COMM. All meetings are on Fridays, starting at noon.
- 12) **Synergistic effects of endocrine disrupters in drinking water** - Dr. Warren Porter of the UW-Madison, Department of Zoology spoke about research on endocrine disruption and the sublethal effects of mixtures of substances such as nitrate, triazines, carbamates, and other agricultural chemicals. The subject is very complicated from technical and regulatory standpoints.

Dr. Porter focused mainly on human health issues that include nervous system disorders (e.g. aggression, learning disabilities), developmental disorders (e.g. limb abnormalities, fetal brain development changes, male and female sexual development, sexual orientation changes, low sperm counts), immune system disorders (e.g. autoimmune problems like juvenile onset diabetes, certain kinds of arthritis) and endocrine disorders (e.g. hyperthyroidism, hypothyroidism, insulin changes), etc. As support for his concern about the effects of ever-increasing concentrations of man-made chemicals in the environment, Dr. Porter showed a Feb. 10, 1997 Wisconsin State Journal article indicating increases in various categories of disabled children in the Madison school system. One category was limb deformities. He went on to suggest that this statistic and limb deformities in frogs may possibly be related. This suggestion was contested by several in attendance who felt that the increase in disabled students in Madison was more likely related to demographics and the availability of handicapped services. However, Dr. Porter pointed out that similar changes are occurring widely in the US. He also pointed out that several recent epidemiological studies, especially one in Minnesota by Garry and colleagues, showed significantly higher birth defect rates in children of pesticide applicators and in the general populace in regions of heavy pesticide use. Additional evidence of pediatric effects of pesticides in routine use includes a recent large study in Canada that has linked premature births to pesticide exposure in humans.

Dr. Porter discussed healthy vs. sick systems with respect to cellular/molecular processes like energy, mass and nutrient balances, organ system functions like central nervous system function and endocrine system function. In his research on the effects of aldicarb, atrazine, and nitrate on mice, Dr. Porter found that multiple stressors such as nutrition and disease status influenced the sensitivity to effects of chemicals. Dr. Porter also mentioned declining sperm counts in various global human populations and possible links to environmental chemicals. Also cited as important observations were increases in feline hyperthyroidism, canine immune diseases, and the possibility of cats and dogs being sentinels of "things to come" for humans.

Dr. Porter indicated future areas for special observation if we pursue a "do nothing" policy regarding the use of endocrine disrupting chemicals. Some of these areas of potential concern would be decreased fertility, increases in children's learning disorders, limb-malformation, and other developmental/reproductive disorders.

Susan Sylvester thanked Dr. Porter for his talk. Various GCC members commented that results from this set of very complicated topics should be interpreted carefully.

The meeting adjourned at 3:00. The next meeting is scheduled for 12 noon, February 27th in the Conference Room of the Wisconsin Geological and Natural History Survey at 3817 Mineral Point Road.

Respectfully submitted,

Jeff Helmuth, Groundwater Specialist
Department of Natural Resources

Wisconsin Groundwater Coordinating Council
Meeting Minutes - February 27, 1998

Members Present: Susan Sylvester (DNR), Jack Metcalf (Gov. Rep.), Nick Neher (DATCP), James Robertson (WGNHS), Fran Garb (UWS), Henry Anderson (DHFS), Eric Scott for John Alberts (COMM), Carol Cutshall (DOT).

Others Present: Chris Mechenich and George Kraft (CWGC); Lisa Morrison and Jeff Postle (DATCP); George Blondin (UWS); Ron Hennings and Ken Bradbury (WGNHS); Jeff Helmuth (DNR).

The meeting was held in the Conference Room of the Wisconsin Geological and Natural History Survey at 3817 Mineral Point Road in Madison, beginning at noon.

1. **General Business** - Introductions were made. The agenda was amended to postpone approval of the UWS Research Plan. The teleconference was scheduled for March 12 at 12:00. The minutes of the November 21st meeting were approved with the following change to item 7): "... 2) ~~it would be useful to be able to index and search the entire DNR website rather than just the GCC page~~, it would be useful to be able to index and search the GCC website rather than the DNR page." (Note: This change has been made to the website)
2. **FY 99 Joint Solicitation** - George Blondin handed out a summary of the UWS FY 99 research project selection process. George reported a technical review response rate of 61%, or 4% less than average. One proposal received two reviews, 19 proposals received 3 reviews, nine proposals received 4 reviews and one proposal received five reviews. The average score was 3.69, compared to 3.46 during the FY 98 joint solicitation. The Groundwater Research Advisory Council (GRAC) met on February 25, 1998. As a result of the proposal scorings and the GRAC's input the UWS proposed to fund 7 top-ranked projects. George listed three possibilities for the remaining UWS funds and mentioned that the third was a lesser-ranked project, restructured to reflect reviewer's and the GRAC's comments. George said the options given in the handout were prioritized and that it was the WRC Director's prerogative to make the decision. James Robertson questioned whether it was fair to allow one proposal to be reworked without giving others the same opportunity. There was agreement that this was a concern but no consensus on how this should be resolved. Susan asked that the WRC report to the GCC at the March 12 teleconference on how this funding decision was made. George said the proposed UWS research program would be finalized soon and the GCC would receive a description of it before the teleconference on March 12th. Fran Garb said she would be vacationing on March 12th and would call in her vote before the teleconference.

George suggested that there was a need to discuss the timing of the joint solicitation. Technical review return rate had decreased this year due to the review requests arriving near winter break, a time when many professors are not at their offices. Jeff Helmuth said he would send out the results of the proposal author survey conducted in the summer of 1997 to the GCC members before the next meeting so the timing could be discussed.

George reported on the frequency of each of the proposal categories compared to past years. The most noticeable changes in the FY 98 joint solicitation were the decrease in the percentage of Biological Effects of Pollutants proposals and increase in the percentage of Contaminant Transport proposals.

George also reported on the download activity of the research and monitoring project summaries on the WRC web site. The average number of downloads per summary was up to 37 with over 100 downloaded each month. Pesticide impact project summaries were the most popular so far.

Education Subcommittee Report - Chris Mechenich reported that, at their January 14th meeting, the subcommittee had discussed materials being assembled for "Public Health is Everywhere" week. There was concern from DHFS regarding lack of advice on contaminants other than nitrate and bacteria. Chris showed the packet of information that was proposed to be used for the week in April.

Chris reported on a proposed action strategy that a workgroup within the subcommittee had come up with to promote awareness of groundwater issues and the GCC to the Legislature. The strategy consists of: 1) having groundwater displays on agencies responsibilities and research projects in the Capitol Rotunda during Groundwater Protection Week in February 1999, in conjunction with the WI Water Well Association (WWWA).

This would entail having each agency represented on the GCC produce a display on their role in protecting groundwater; 2) preparing a one-page description of the GCC for this event; and 3) in the fall of 1999, holding a statewide technical conference in Madison highlighting research projects done through the Joint Solicitation. Chris asked the GCC for feedback on the merits of these ideas.

Susan Sylvester said that it would be hard to get Legislators or Department Secretaries to attend events such as 1) or 3) but that Legislator's aides might attend 1). Ken Bradbury said that another technical conference might not have value to the Legislature, but that there is a need to show how the research projects have affected public policy. George Blondin said that some researchers would and could speak well on the impact of the projects. Jamie Robertson said that field trips to the research sites would be more effective than a technical conference but realized that the trips would also be difficult for Legislators to attend. Nick Neher suggested targeting key committees and freshman Legislators with specific issues and/or projects rather than the entire Legislature. There was general agreement that the first two parts of the strategy were well conceived, but that the third would probably not be effective. Jack Metcalf said that the first two would help protect the groundwater research funding. Ron Hennings volunteered to contact the WWA and to convey the information to Jeff Helmuth. Susan asked Jeff to locate a DNR poster on interagency groundwater cooperation.

- 3) **Planning and Mapping Subcommittee Report** - Lisa Morrison reported that the key issue discussed at the subcommittee's January 13th meeting was the need to identify and map karst features and areas on a statewide basis. Bob Pearson initiated the discussion and was interested in karst feature mapping from the DOT perspective of stormwater discharge, liability and geotechnical concerns. DATCP, COMM, DNR, and WGNHS also have specific concerns related to karst features. Lisa recommended that a central repository for karst-related data be established. The repository agency would 1) develop standard data elements and a format that all agencies would use to describe karst features they encounter, 2) collect and process the karst data from all agencies, and 3) map and disseminate karst-related information back to state agencies and the public. Lisa said that the subcommittee believes that the WGNHS is the logical home for the repository. James Robertson said he was enthusiastic about the repository. Nick Neher suggested that an effort be made to link to counties, associations, the NRCS and DNR basin teams. The GCC endorsed having a karst data repository at the WGNHS.
- 4) **Local Government Subcommittee Report** - Ron Hennings reported that the subcommittee had reviewed the Directory of Groundwater Databases and had agreed that it should be targeted to local officials, county executives, UW Extension, county zoning and planning offices, local health departments, municipalities with water supplies, etc. The Directory should be a valuable planning tool. The subcommittee also recommended providing breakdowns of data by county and discussed data elements for county groundwater summaries.

The subcommittee reviewed two documents describing Wisconsin's groundwater standards process which had been sent to LGS and GCC members. There wasn't a consensus on whether a new document for the public was needed on this issue.

The subcommittee also heard an update on the Source Water Assessment Program and provided input to Jeff Helmuth on what local government interest there might be in helping to implement that program.

- 5) **Directory of Groundwater Databases** - Jeff Helmuth said that the Directory had been updated by Groundwater Section staff with input from Monitoring & Data Management and Local Government Subcommittee members. Jeff asked if there were any comments on the Draft Directory that had been sent to the GCC for their review. Eric Scott and Lisa Morrison had minor comments about contact information. Jeff said he would ask Randell Clark to contact them regarding their specific comments. Susan Sylvester said that addressing the directory to local government officials and planners rather than the citizens of the state was a needed improvement. The GCC approved the directory with the above edits.
- 6) **Triazine Screen Workgroup** - Jeff Postle gave some background on the development of transmittal language to be sent with triazine screen laboratory results. Jeff worked with Bill Rock and Lynda Knobeloch to develop four sets of language to give recommendations to well owners within four ranges of detection level: 1) no detect, 2) 0.1-0.2 parts per billion (ppb) of atrazine, 3) 0.3 - 3.0 ppb of atrazine, and 4) greater than 3.0 ppb atrazine. Language

for the first and fourth ranges was not changed. Language for the two middle ranges was changed to acknowledge the possibility that the water may also contain by-products of atrazine that have same health effects as atrazine. Language was added for the third range suggesting that the well owner consider approved water treatment devices or well construction changes. Jeff added that there was no lab to use for the full analysis yet but that the Environmental Task Force Lab was interested and may be able to do the analysis soon. If not, private labs may be interested. If no other lab is interested, then the State Lab of Hygiene will do it. Jeff expects to have a lab in place for the analysis by early summer. The new language will go into effect then. There was some discussion regarding whether recipients of the older language should be readvised but the safety factor of the standards was thought to be protective enough not to pursue this. Lisa Morrison suggested that the phone number to receive information on treatment devices should be included. George Blondin suggested using the word "adverse" before "health effects". James Robertson said the language was a tremendous improvement. Susan thanked Jeff and the other workgroup members for their efforts.

- 7) **COMM 47 (PECFA) Emergency Rule Development** - Eric Scott gave an update on the financial status of the Petroleum Environmental Cleanup Fund Administration (PECFA) program and the status of the COMM 47 Emergency Rule revisions. The program has reimbursed over ½ billion dollars on petroleum cleanup projects. However, there is a large backlog of cases awaiting review and payment. Currently \$250 million in invoices are awaiting review and payment but only \$7.4 million is allotted to pay invoices per month.

Eric discussed several elements of the proposed Emergency Rule revisions. Administrative elements include an updated scope of rules to match current legislated coverage, clarified decision-making for remedial action approvals and provision of new direction to owners, operators and consulting firms. Reimbursement provisions include provisions to reduce the frequency of payments and base access to the fund on outcomes rather than time and materials. Remedial alternative selection provisions include the creation of environmental factors that determine paths and options for a remedial alternative selection. Provisions for existing site reviews include establishing criteria for site bundles, remedial action bidding and cost caps. Interest rates were revised by statute and are also included in the emergency rule. The rule provisions are significant because they may impact funding for approximately 5,000 existing PECFA program sites and a projected 5-6,000 new sites to be added to the program over the next two years.

- 8) **ATCP 29, 30 and 31 Revisions** - Nick Neher said that DATCP had been working with the Senate Committee on Agriculture and Environmental Resources on including a note in ATCP 31, the General Pesticide Rule, clarifying the intent to comply with the Preventive Action Limit and that if pesticide concentrations levels increased in an area where a prohibition area (PA) had been rescinded then DATCP would consider reinstating the PA. Due to a miscommunication with the committee, DATCP published the revised rule on February 1 before the committee had officially released the rule. DATCP would now have to republish the old rule and then republish the new rule.

Nick also reported that ATCP 29 and ATCP 30 were still in the Legislature with no hearings scheduled. If no action is taken then the rule changes will go into effect on or about April 1, 1998. Nick added that ATCP 29 had been made more reader-friendly.

- 9) **Source Water Assessment Program (SWAP) Development** - Jeff Helmuth reported that the Source Water Team was focusing on developing delineation and assessment strategies for surface water systems and formulating specific questions for public input, which had been limited so far. The Safe Drinking water Act Ad Hoc Advisory Committee had reviewed the draft SWAP plan. They were concerned with avoiding the duplication of existing programs and questioned the value of doing detailed assessments for surface water systems. Jeff handed out a list of key issues that EPA had identified for input from stakeholders and asked GCC members to direct their comments and questions to him. More state-specific questions are being developed for the Ad Hoc Advisory Committee and other stakeholders.

Jeff said that the program would encourage intra-agency and inter-agency cooperation to build Geographic Information System data layers. The DNR is identifying who would have information on specific potential contaminant sources. The next step is to work with these groups to determine if the information they have is useful to the SWAP and how can it be shared. The Source Water Protection Team may partner future work in data gathering with these groups.

Jeff also reported that a pilot project on vulnerability assessments for municipal systems was being done in the West Central Region. So far the DNR has calculated annual pumping rates for use in calculated fixed radius delineations. The next step will be to map delineated source water assessment areas for contaminant inventories. The maps will be mailed out to system operators who will begin the process of collecting potential contaminant inventory information.

10) Agrichemical Impacts to Groundwater Under Irrigated Vegetables in the Central Sand Plain- George Kraft gave a broad overview of groundwater quality concerns in agricultural areas. Nitrate and pesticides from agriculture are the most common groundwater pollutants in Wisconsin. While nitrate can come from a number of sources, agriculture is responsible for 90-95%. Nitrate may cause health problems in humans, livestock, fish and amphibians, and has been blamed for anoxia in the so-called "dead zone" in the Gulf of Mexico.

Monitoring below study vegetable fields indicated nitrate concentrations averaged greater than 20 ppm in the upper 10 feet of groundwater. This is not surprising with nitrate loading in these fields averaging about 160 lbs. per acre. Residues of five pesticides were also identified in a monitoring study. Monitoring locations downgradient of vegetable fields contained high nitrate and the same pesticides found under fields; monitoring locations outside of agricultural plumes contained no pesticides and low nitrate concentrations. George asserted programs like Farm*a*Syst and Home*a*Syst do almost nothing to improve groundwater quality, and are mainly a tool that might protect an individual well. He also stated that the Best Management Practices approach had not been very effective in controlling nitrate contamination of groundwater. George presented several alternative methods of controlling nitrate such as controlling the density and mix, changing the nitrogen balance on the cropland and capturing nitrogen in crop residue. George suggested harnessing the private sector to address the problem. George also suggested that some older UWEX brochures were misleading on the causes and effects of nitrate contamination. George questioned how many eggs should be placed in the BMP basket since farmer adoption is low, and since even universal adoption in the Central Sands would only reduce nitrate loading by about 30% in vegetable agriculture areas.

Nick Neher said that George had raised some excellent questions. There was some discussion on the best ways to deal with the nitrate issue. Susan thanked George for his presentation.

The meeting adjourned at 3:00. The next meeting is scheduled for 12 noon, May 29 in the Conference Room of the DNR Area Office in Dodgeville.

Respectfully submitted,

Jeff Helmuth, Groundwater Specialist
Department of Natural Resources

**Wisconsin Groundwater Coordinating Council
Teleconference Minutes - March 12, 1998**

Members On-line: Susan Sylvester (DNR), Jack Metcalf (Gov. Rep.) James Robertson (WGNHS), Nick Neher (DATCP), Carol Cutshall (DOT), Eric Scott for John Alberts (COMM). Fran Garb (UWS) and Henry Anderson's (DHFS) comments were communicated to Susan Sylvester prior to the teleconference.

Others On-line: George Blondin and Gordon Chesters (UW-WRC), and Jeff Helmuth (DNR).

The sole agenda item for the teleconference was to review the proposed University of Wisconsin System (UWS) groundwater research plan for fiscal year (FY) 1999 which begins July 1, 1998. George Blondin provided a summary of the proposed UWS Groundwater Research Plan for FY 99. Gordon Chesters and George proposed to fund five continuation projects for \$121,647, eight new projects for \$160,333 and set aside \$18,020 for administrative and reporting costs. The new project funding will provide support for seven top-ranked projects and seed money for partial funding of one lower-ranked project. One top-ranked project (SAM-3) will be co-funded with DATCP.

The partially funded project will be funded with \$13,760 remaining after funding the seven top-ranked projects. The UWS decided to restructure SOS-1 based on advice from the Groundwater Research Advisory Council (see George's 3/10/98 memo to GCC members). Gordon added that it had always been difficult obtaining proposals related to groundwater policy options that are eligible for UWS funding.

Susan and others expressed concerns regarding establishing a process to equitably extend the opportunity to restructure proposals. George added that the GCC also needs to address how to handle proposals that address multiple problems such as REM-3 and how to handle the possibility of combining complementary projects such as BMP-1 and BMP-2. There was a consensus that these aspects of the joint solicitation process should be evaluated at the next meeting. Susan asked that the 1989 Memorandum of Understanding (enclosed) that established procedural guidelines for the prioritization of groundwater research and the selection of research proposals to be funded by the UWS be sent to GCC members before the May meeting so that the process could be evaluated and updated if necessary.

The GCC unanimously endorsed the recommended UWS groundwater research plan for FY 99. Letters of endorsement will be sent to the UWS and the Department of Administration for release of funds. Susan Sylvester thanked Gordon and George for their efforts in assembling the UWS Research Plan and helping to coordinate the Joint Solicitation. Gordon Chesters, in light of his approaching retirement on June 30th, thanked the GCC for the success of the Joint Solicitation.

Respectfully submitted,

Jeff Helmuth, Groundwater Specialist
Wisconsin Department of Natural Resources

Wisconsin Groundwater Coordinating Council
Draft Meeting Minutes - May, 29 1998

Members Present: Susan Sylvester (DNR), Jack Metcalf (Gov. Rep.), Nick Neher (DATCP), James Robertson (WGNHS), George Blondin for Fran Garb (UWS), Lynda Knobloch for Henry Anderson (DHFS), Eric Scott for John Alberts (COMM), Bob Pearson for Carol Cutshall (DOT).

Others Present: Barb Lensch (NRCS), Mike Lemcke, Tom Riewe 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 27th meeting and the March 12th teleconference were approved without changes.
2. **Outline for 1998 GCC Report to the Legislature** - Jeff Helmuth presented a proposed outline for the annual GCC Report to the Legislature that was essentially unchanged from the previous year's report. Nick Neher suggested tying in the State's Sesquicentennial by giving a historical perspective on groundwater management. To do this Mike Lemcke suggested using a recent Natural Resources Magazine article titled "Walking on Water" authored by Dave Johnson and Laura Chern of the Groundwater Section. Barb Lensch suggested including a summary of NRCS groundwater-related activities. Jeff said he would incorporate the two suggestions into the first draft of the report, which would be ready by mid-July.
3. **Education Subcommittee Report** - Jeff Helmuth reported on the following subcommittee activities:
 - The Triazine Screen Language Workgroup reported that they will add a statement regarding the availability of full GC analysis when a lab is up and running with the analysis. (Note: This language will soon be implemented now that the UW-Stevens Point Environmental Task Force Lab has this capability)
 - A youth education strategy was developed for Farm Progress Days (to be held in Dunn County 9/22-24) consisting of: 1) Posters showing location of groundwater-related booths, 2) "Passports" to be stamped at each groundwater-related booth, and 3) Prizes (a baseball cap with the Buried Treasure logo) will be awarded to participants with fully stamped passports. The Wisconsin Groundwater Association has offered to pay for the prizes.
 - The subcommittee made recommendations for the "Buried Treasure" magazine insert errata/update sheet that will be distributed with the insert at the State Fair.
 - Work is progressing on the educational event to occur at the Capitol during Groundwater Protection Week at the Capitol. A brochure about the GCC with member's pictures and biographies is in the works.
 - The Subcommittee reviewed a wellhead protection public service announcement that is being considered for revision by the DNR.
 - The Subcommittee reviewed a section on groundwater in the "Healthy Tips for Your Home" booklet produced by DHFS, UWEX, and WI Poison Control Center.

Jeff handed out a proposal by Lynita Docken (COMM) of the Education Subcommittee for the GCC to coordinate a biannual interagency water symposium for agency technical planners and staff to communicate and educate one another on policy, rule changes, and network resources. Jeff reported that although there was some support for the symposium within the Education Subcommittee, there was some doubt of whether the symposium would lie within GCC's nonregulatory mandate. Considering the regulatory nature of the symposium, Susan Sylvester spoke for the GCC in saying that it would be unwise for the GCC to coordinate or endorse it. Other members used examples of educational roles that the Education Subcommittee had played to show the GCC's appropriate role. Nick Neher suggested that it would be better for a GCC member to be on the agenda to present the GCC's coordinating and educating role than for the GCC to coordinate or endorse the symposium.

4. **Data gathering for atrazine use reinstatement** - Nick Neher reported that DATCP was involved in setting up a study to monitor atrazine concentrations in fields where atrazine is being used again. They had originally hoped for 21 sites but had only 15 so far. Eighty farmers had volunteered but most had been screened out. Background concentrations had been measured at those 15 sites. Three years of data is needed for "clear and convincing evidence". Nick added that there was a new bill that changes how prohibition areas are established in a specific

area in Grant County. The new bill states that DATCP cannot use existing test results to create a prohibition area. However, if a new result exceeds the enforcement standard a prohibition area can be established based on the new data. Mike Lemcke asked if farmers seem concerned over the safety of atrazine. Based on the small number of farmers that volunteered for the study, Nick said probably not many. Jack Metcalf said that he had used alternatives to atrazine for five years and had seen better weed kill with less carryover. Nick said many farmers want to use atrazine in combination with other pesticides for the synergistic effect.

5. **New proposed NR 140 groundwater quality standards** - Mike Lemcke reported that at the March 25th Natural Resources Board meeting, 19 of the 21 proposed new groundwater standards had been adopted. The Board deferred action on standards for ammonia and boron and requested that the Department gather more information on the impact these standards may have on industry. Mike explained that the economic impacts of these standards would probably be limited. Boron, though sometimes present in groundwater at coal ash landfills, is not usually the only contaminant of concern that needs attention. Ammonia in groundwater above the proposed 9.7 mg/l level has not been a problem at most food processing sites. As with boron, when ammonia is found in groundwater at high concentrations, other problems usually exist. In cases of liquid or dry ammonia spills at agricultural sites, the 10 mg/l standard for nitrate is currently used as a groundwater cleanup standard. Mike added that on April 29th the Board adopted health-based standards for both ammonia and boron. (Note: On June 10th the Assembly Committee on Natural Resources held hearings and heard testimony which focused on ammonia and boron. On June 17th the Committee decided that the proposed standards for ammonia should be removed from the rule package and that the proposed standards for boron should be promulgated with a delayed effective date. The DNR will recommend a delayed effective date of January 1, 2000, for boron to the Board at its August meeting. Following a decision by the Board on both ammonia and boron, the rule package will return to the Legislature for further consideration.)
6. **Federal groundwater funding through Section 106** - Susan Sylvester gave an update on the EPA's Clean Water Act Section 106 Grant Formula Work Group which is revising the Section 106 State allocation formula. Susan referred to information enclosed with the agenda regarding the S. 106 allocation for groundwater. The Workgroup considered the following four options for measuring the groundwater resource: 1) area of the resource; 2) safe yield; 3) groundwater use; and 4) percentage of the State population that uses groundwater as a source of drinking water. The Workgroup agreed that option 3 should be the primary measurement with lesser weight given to option 4 with consideration of community systems. Susan pointed out that using groundwater usage as a basis for grant allocation favors states, unlike Wisconsin, with little surface water usage. James Robertson mentioned the large, but difficult to quantify, impacts of groundwater on surface waters. Lynda Knobloch suggested that contamination potential should be considered. Susan asked for comments on the allocation formula by the end of June.
7. **Clean Water Initiative (CWI)**- Susan Sylvester reported that she would represent State Commissioners in meetings regarding the CWI, first announced by the President 6 months prior. The CWI involves 10 federal agencies and could result in more funding for Source Water Protection and other watershed initiatives. Susan noted that this initiative marks the first time that many federal agencies will target the same water resource priorities. She added that Wisconsin is structurally poised to receive its share of the funding. Susan offered to send copies of the CWI report to interested GCC members.
8. **Source Water Assessment Program (SWAP)** - Jeff Helmuth handed out a summary of Wisconsin's developing SWAP. The Source Water Protection Team had developed delineation and assessment strategies for surface water and groundwater systems and were preparing materials for review by the Safe Drinking Water Act *Ad Hoc* Advisory Council and interested members of the public. Jeff also reported that through the vulnerability assessment program, the DNR has mapped source water assessment areas for municipal systems. The maps are being sent to system operators who will begin the process of collecting potential contaminant inventory information. Jeff noted that States have until February 6, 1999 to submit their SWAP plan and until September 30, 2002 to implement the program. Jeff emphasized that the SWAP will maximize the use of existing information and will utilize Geographic Information Systems (GIS) to map source water protection areas and potential contaminants for each public water system. The goal is to produce assessments that will be useful to communities that are interested in developing wellhead protection plans or watershed protection projects. Jeff asked that GCC members contact him with comments on the SWAP.

9. **Water Resources Center** - George Blondin reported that the Sea Grant Institute will be moving into the second floor of Goodnight Hall with the WRC by the end of the summer. The two entities will be directed by Anders Andren, current Sea Grant Director. There will be a search process for George's successor after he retires on July first. Susan Sylvester said she would like to be on the selection committee. George said he would be around until early fall to help out. Harry Read will continue half-time as Lab Director. Resources that Sea Grant has that could benefit the joint solicitation include: 1) a full-time webmaster, 2) a full-time science writer, and 3) 3 private servers (1 for project summaries and the Directory of Water Resources Personnel). George added that the servers would require that air conditioning be installed in Goodnight Hall.
10. **Review of Joint Solicitation Process** - George Blondin reviewed the Joint Solicitation timeline for the past year and recommended that the Joint Solicitation calendar be moved forward a few days for the next year to increase the technical review return rate. The rate was lower in the last two years due to review requests arriving near winter break, a time when many professors are not at their offices. George presented data on proposal quality that indicated, for the 30 proposals received last year, 17 received high scores, 11 received middle scores and 2 received low scores. George said that he was pleased with the proposal quality improvements and recommended that back-to-back copied proposals be disallowed in subsequent solicitations. George also reported that he would send a summary statistics to Jeff Helmuth on the download activity of the research and monitoring project summaries on the WRC web site.

Susan Sylvester asked what could be done about splitting single proposals containing multiple projects and lumping multiple proposals with similar goals. George suggested that a workgroup consisting of himself, Jeff Helmuth, John Harkin, Gordon Chesters meet to resolve those issues. (Note: In a phone conference George and Jeff resolved to invite proposal authors to submit proposals early to facilitate return with comments and rewriting prior to the due date - proposals submitted on or near the due date would get no such consideration). James Robertson and Nick Neher added that they had concerns about extending the opportunity to rewrite proposals. James said that selective rewriting of proposals should be limited to the next proposal in line to be funded and then only if there is not enough money to fully fund that proposal.

11. **Presentation of Resolutions of Appreciation** - Susan Sylvester presented a Resolution of Appreciation to George Blondin for his essential work in ensuring the success of the Joint Solicitation from 1992-1998. George thanked the GCC and encouraged it to continue improving the process. Susan also gave George a Resolution of Appreciation to pass to Gordon Chesters for Gordon's part in initiating and continuing the Joint Solicitation.
12. **Evaluation of Well Seals Using an Ultrasonic Probe** - Tom Riewe, who is a 24-year veteran of the DNR's Private Water System Section, presented a summary of three projects done in cooperation with Tuncer Edil at UW-Madison that were directed at developing a tool to evaluate the effectiveness of grout seals. The impetus for the research came in the late 1980's when the private well code was being rewritten and Tom was interested in evaluating the effectiveness of drilling mud and cuttings slurry as grout. Mud and cuttings slurry is used instead of more effective bentonite grouts or neat cement grout because of significantly lower costs for labor and materials. Tom was also looking for data to support the discontinuance of the practice of shoveling drill cuttings back in the top of the annulus after aggressive well development removes the drill cuttings slurry up and out of the annular space seal. Tom showed slides detailing rotary mud-circulation drilling equipment and procedures, and an excavated well showing settling of a well seal. Tom's first project "Sealing Characteristics of Sodium Bentonite Slurries for Water Wells" was targeted at testing different grout compositions for settling characteristics. Lab experiments showed that grout mud weight was not always a good predictor of settling. In the second two projects, "Ultrasonic Verification Technique for Evaluating Well Seals" and "Evaluation of Well Seals Using an Ultrasonic Probe", a tool was developed to evaluate well seal integrity *in-situ*. The second study concentrated on finding transducers for an ultrasonic probe that could generate distinguishable energy signatures for various grout materials and voids. The last study showed that drilling mud and cuttings slurry do not provide an adequate grout. Voids were typically found just above the water table. Consequently Tom advocated additional restrictions on the use of this material as grout.

There was further discussion of grouting techniques in geologic settings in Wisconsin. Bob Pearson commended Tom for the very practical and thorough nature of his research. Susan Sylvester thanked Tom for an excellent presentation.

The meeting adjourned at 3:00. The next meeting is scheduled for 12 noon, August 7 in room 419 of the Hill Farms State Office Building at 4802 Sheboygan Ave. in Madison.

Respectfully submitted,

Jeff Helmuth, Groundwater Specialist
Department of Natural Resources

**TABLE 3 - STATE OF WISCONSIN
GROUNDWATER MONITORING/RESEARCH PROJECTS 1986-1997**
(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, 1986-1997, 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 Tills, 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.

A Comparative Study of Nitrate-N Loading to Groundwater from Mound, In Ground Pressure and at Grade Septic Systems. Shaw, Turyk. 1991-92. DNR. DNR Project #82.

The Biological Impact of Landfill Leachate on Nearby Surface Waters. Geis, Sonzogni, Standridge. 1991. DNR. DNR Project #83.

Dependence of Aldicarb Residue Degradation Rates on Groundwater Chemistry in the Wisconsin Central Sands. Kraft, Helmke. 1991-92. DNR. DNR Project #84.

Municipal Wastewater Project. Kopecky. 1991. DNR. DNR Project #85.

Arsenic as a Naturally Elevated Parameter in Water Supply Wells in Eastern Winnebago and Outagamie Counties. Stoll. 1992. DNR. DNR Project #87.

Spatial Attributes of the Soil-Landscape-Groundwater System of the Lower Wisconsin River Valley. McSweeney, Madison, Attig, Bohn, Falk. 1992-93. DNR. DNR Project #88.

Herbicide and Nitrate Movement in a Sandy Soil in the Lower Wisconsin River Valley. Lowery, McSweeney. 1992-93. UWS, DATCP.

Preliminary Comparison of a Discrete Fracture Model with a Continuum Model for Groundwater Movement in Fractured Dolomite. Bradbury, Muldoon. 1992. DNR. DNR Project #89.

Evaluation of NURE Hydrogeochemical Groundwater Data for Use in Wisconsin Groundwater Studies. Bradbury, Mudrey, Shrawder. 1992. DNR. DNR Project #90.

Distribution of Radionuclides in Wisconsin Groundwater. Bradbury, Mudrey. 1992. DNR. DNR Project #91.

Assessment of Wisconsin's Groundwater Monitoring Plan Program for Active Non-Approved Landfills (1985-1990). Pugh, Gear. 1992. DNR. DNR Project #92.

GIS Mapping of Groundwater Contaminant Sources, Quality and Contamination Susceptibility for Door County. Carlson, Stoll, Hronek. 1992-93. DNR. DNR Project #93.

Effects of Transient Cross-Stratification Flow on Contaminant Dispersion. Bahr. 1992-93. UWS.

Geographical Information System for Subsurface Characterization. Bosscher, Adams. 1992-93. UWS.

Distribution, Transport and Fate of Major Herbicides and Their Metabolites. Chesters. 1992-93. UWS, DATCP.

Use of Tire Chips to Attenuate VOCs. Edil, Park. 1992-93. UWS.

Living Mulch Systems for Nitrate Trapping in Vegetable Production. Harrison. 1992-93. UWS.

New Approaches to Measuring Biologic Effects of Groundwater Contaminants. Porter. 1992. UWS.

Estimating the Spatial Distribution of Groundwater Recharge Rates Using Hydrologic, Hydrogeologic and Geochemical Methods. Potter. 1992-93. UWS, DATCP.

Evaluation of Denitrification Systems for Improving Groundwater from On-Site Waste Disposal Systems. Shaw 1992-93. DNR. DNR Project # 95.

Optimization of Two Recirculating Sand Filters for Nitrogen and Organic Chemical Removal from Domestic Wastewater. Shaw. 1994. DNR. (Continuation of DNR Project #95).

Remediation of Soils Contaminated by Leaking Underground Storage Tanks by Vapor Extraction and *In-situ* Biostimulation. Hickey, Jacobsen, Bubenzer. 1992-93. DNR. DNR Project #96.

Municipal Wastewater Absorption Pond Renovation for Enhanced Nitrogen Removal. Gilbert. 1992-93. DNR. DNR Project #97.

Investigation of Potential Groundwater Impacts at Demolition Landfills and Deer Pits. Pugh, Connelly. 1992-93. DNR. DNR Project #98a.

Investigation of Potential Groundwater Impacts at Yard Waste Sites. Pugh, Connelly. 1994. DNR. DNR Project #98b.

Dane County Atrazine/Land Management Project. Conners, Bohn, Madison, Muldoon, Richardson. 1992. DNR, DATCP. DNR Project #99.

Facility Plan Amendment for Wastewater Collection for Green Lake Sanitary District, Green Lake, WI. McMahon & Assoc. 1991. DILHR.

On-site Nitrogen Removal Systems Research Demonstration Project: Phase I. Ayers & Assoc. 1991. DILHR.

Nitrogen Removal from Domestic Wastewater in Unsewered Areas. Otis, Converse. 1992-96. DILHR.

Trace Metal Transport Affected by Groundwater Stream Interactions. Bahr. 1993-94. UWS.

Management of Sweet Corn Processing Wastes to Protect Groundwater Quality. Bundy. 1993-94. UWS.

Impact of Tunnel Dewatering on Surface Water Bodies in Milwaukee County. Cherkauer. 1993-94. UWS.

Ultrasonic Verification Technique for Evaluating Well Seals. Edil 1993-94. UWS.

Field Evaluation of Near Source Transport of Contaminants in Heterogeneous Media. Hoopes. 1993-94. UWS.

Variability of Hydraulic Conductivity in Supraglacial Sediments. Mickelson. 1993-94. UWS.

The Impact of Atrazine Management Areas Designation on Weed Control Strategies in Wisconsin Corn Production. Nowak. 1993. DATCP.

Evaluation of Five Groundwater Susceptibility Assessments in Dane County, Wisconsin. Bridson, Bohn. 1993-94. DNR. DNR Project #100.

Tracer Study for Characterization of Groundwater Movement and Contaminant Transport in Fractured Dolomite. Bradbury, Muldoon. 1993-94. DNR. DNR Project #101.

Urban Stormwater Infiltration: Assessment and Enhancement of Pollutant Removal. Armstrong. 1993-94. DNR. DNR Project #102.

Long-Term Transformation and Fate of Nitrogen with Mound Type Soil Absorption Systems for Septic Tank Effluent. Harkin. 1993-94. DNR. DNR Project #103.

A Further Study of Organics at Wisconsin Municipal Solid Waste Landfills. Connelly. 1993-94. DNR. DNR Project #104.

Comparative Evaluation of Biostimulation Approaches for Enhancing in Situ TCE Degradation in Contaminated Aquifers. Hickey. 1994. UWS.

Stratigraphy, Sedimentology and Porosity Distribution of the Silurian Rocks of the Door Peninsula, WI. Harris. 1994. UWS.

Improved Design of Pump and Treat Systems for Heterogeneous Aquifers. Bahr, Anderson. 1994. UWS.

Herbicide Contamination of Soil and Groundwater at a Mixing-Loading site. Chesters. 1994. UWS, DATCP.

Photocatalytic Degradation of Volatile Organic Carbon. Anderson, Marc, Hill. 1994. UWS.

Mineral Phase Sorption of Selected Agrochemicals to Wisconsin Soils. Grundl. 1994. UWS.

Using "Predict" to Reduce Herbicide Usage and Improve Groundwater Quality. Harvey. 1994. UWS.

Leaching Potential of Imazethapyr and Nicosulfuron in Sparta Sand. Lowery. 1994. DATCP.

Integrated Computerized Mapping of Point Source Contaminants and Physical Environmental Characteristics to Protect and Manage Groundwater Quality. Stoll. 1994. DNR. DNR Project #105.

An Investigation of Field-Filtering and Low-Flow Pumping When Sampling for Metals. Connelly. 1994. DNR. DNR Project #106.

Groundwater Hydrogeology of an Agricultural Watershed. Potter 1994-95. DATCP and DNR. DNR Project #109.

The Further Incidence of Native Arsenic in Eastern Wisconsin Water Supply Wells; Marinette, Oconto, Shawano and Brown Counties. Stoll. 1994. DNR. DNR Project #110.

Factors Affecting the Determination of Radon in Groundwater. Sonzogni. 1994. DNR. DNR Project #111.

Groundwater Survey of Alachlor and ESA its Polar Metabolite in Southern Wisconsin. Vanden Brook, Postle. 1994. DNR, DATCP. DNR Project #112.

Cover Crops to Limit Herbicide Use on Sweet Corn. Newenhouse. 1994. DATCP.

The Use of Peat as an Absorptive Medium. Wiersma and Stieglitz. 1994. DATCP.

Photocatalytic degradation of volatile organic carbon. Anderson. 1994-1995. UWS. UWS Project #94REM2B2.

Improved design of pump and treat systems for heterogeneous aquifers. Bahr. 1994-1995. UWS. UWS Project #94REM3B2.

Herbicide contamination of soil and groundwater at a mixing and loading site. Chesters. 1994-1995. UWS and DATCP. UWS Project #94PES2B2.

Mineral phase sorption of selected agrichemicals to Wisconsin Soils. Grundl. UWS. 1994-1995. UWS Project #94PES1B2.

Stratigraphy, sedimentology, and porosity distribution of the Silurian rocks of the Door Peninsula, Wisconsin. Harris. 1994-1995. UWS. UWS Project #94HGE2B2

Using 'PREDICT' to reduce herbicide usage and improve groundwater quality. Harvey, 1994-1995. UWS. UWS Project #94PES6B2.

Comparative evaluation of biostimulation approaches for enhancing *in situ* TCE degradation in contaminated aquifers. Hickey. 1994-1995. UWS. UWS Project #94REM6B2.

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WISCONSIN FERTILIZER RESEARCH COUNCIL RESEARCH PROJECTS

GROUNDWATER EDUCATION ACTIVITIES OF THE DEPARTMENT OF PUBLIC INSTRUCTION

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 98 DPI staff were involved in the following professional development programs:

- During The DPI continues to make available to agricultural teachers, the video entitled "How to fill and seal a well". Copies of the video were provided by the DNR This video has been made available since January of 1997 when DPI agricultural education consultants held an in-service workshop for teachers.
- During the 1998 Wisconsin Association of Vocational Agriculture Instructors Summer Conference, a workshop was conducted by CWGC, WGNHS, and DNR staff on the "Groundwater Study Guide" Approximately 20 people attended this session.
- At the same conference, a workshop conducted by DNR staff was offered on well abandonment. The workshop was attended by approximately 15 people

For more information contact Dean Gagnon - Agricultural Education Consultant at the DPI at (608)267-9255.

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 DNR, WGNHS, Southeast Wisconsin Regional Planning Commission (SEWRPC) and, the Bad River Band of Lake Superior Chippewa. In addition, several projects are funded by Federal agencies: EPA-Region V, U.S. Fish and Wildlife Service (USFW) and USGS. On-going projects and completed projects with reports in preparation or recently published that have a significant ground-water component are listed below.

On going projects with State and local agencies

- Ground-water observation well network (WGNHS)
- Wisconsin water-use data file (DNR)
- Southeast Wisconsin Hydrologic Study (SEWRPC, DNR, WGNHS)
- Hydrologic studies to mitigate future North Fork Urbanization impacts on the Pheasant Branch Watershed in the Lake Mendota Priority Watershed (DNR)
- Characterization of part of the aquifer flow system in the vicinity of the Bad River Indian Reservation (Bad River Band)
- Hydrologic review of proposed zinc-copper mine near Crandon (DNR)

On going projects with Federal agencies

- Superfund remedial response support (EPA)

- Hydrologic and biogeochemical budgets in temperate lakes and their watersheds, Northern Wisconsin (USGS)
- Western Lake Michigan Drainages National Water-Quality Assessment (USGS)
- Characterization of groundwater and surface water systems of the Necedah National Wildlife Refuge (USFW)

Completed projects with reports in preparation or recently published

- Hydrogeology and simulation of groundwater flow in the sandstone aquifer, Northeastern, Wisconsin (East Central Wisconsin Regional Planning Commission and several Lower Fox River Valley municipalities)
- Optimum management of ground-water resources in the Lower Fox River Valley (DNR)
- Numerical simulation of groundwater in Dane County, Wisconsin (Dane County Regional Planning Commission and WGNHS)

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 608/821-3801. For more information please contact Jim Krohelski, USGS, 8505 Research Way, Middleton, Wisconsin, 53562-3581 (608/821-3850), jtkrohel@usgs.gov or visit the Wisconsin District web page (www.dwdmndn.er.usgs.gov).

Groundwater Activities of the Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) is a federal agency within the U.S. Department of Agriculture. The NRCS, formerly the Soil Conservation Service, works with private landowners to promote conservation of natural resources. The agency protects groundwater by providing technical assistance to landowners through the following ongoing conservation practices and programs:

- nutrient management: management of the amount, form, placement and timing of nutrients applied to the soil so that the amount applied is only what is needed to produce optimum crop yield. This reduces the potential for applied nutrients to pollute surface and groundwater.
- animal waste storage: proper waste storage is imperative to protect groundwater from contamination by nutrients in animal waste.
- Farm*A*Syst Program: a site assessment program to determine areas of possible groundwater contamination on a farm or rural home - enables individuals to apply management practices to their own property. <http://www.wisc.edu/farmasyst>
- Wetland Reserve Program - restores wetlands through permanent or 30-year easements or 10-year contracts.
- Environmental Quality Incentives Program - provides cost sharing for conservation practices on agricultural land. 1998 statewide priorities include groundwater protection practices such as well decommissioning and nutrient and pesticide management in addition to livestock-related activities.
- well decommissioning: proper decommissioning is essential to prevent contaminants from entering groundwater through abandoned wells, which are direct conduits to the groundwater.
- Conservation Reserve Program: participants establish permanent vegetative cover on agricultural lands in return for guaranteed rental payments.

The agency also provides leadership in the following:

- Interagency committee to find improved joint sealers for concrete animal waste storage structures. These sealers are critical to the groundwater protection provided by these structures.
- Interagency Committee to revise NRCS Conservation Practice Standard, Code 313 - Waste Storage Facility. This revision will enhance groundwater protection by increasing the distance between the base of a waste storage structure and the water table, and minimizing the number of joints allowed in concrete structures.

The Stevens Point-Whiting-Plover (SWP) Wellhead Protection Project is a cooperative effort between Portage County, the United States Department of Agriculture-NRCS and University of Wisconsin-Extension. The project has promoted groundwater protection largely through education. In addition, the project provides technical assistance. The following is a list of some of the emphasis areas of the SWP Wellhead Protection Project.

- use of ICM (integrated crop management): a method farming which seeks to use crop inputs such as fertilizer and labor most efficiently while minimizing adverse environmental effects. Because ICM cuts down on fertilizer, pesticide and irrigation water use, it helps protect groundwater.
- alternative agriculture: alternatives to traditional agriculture which reduces fertilizer and pesticide inputs.
- exploring biological control strategies for vegetable pest management of vegetable crops including establishing a bat house research project with local growers.
- maintaining the "Conservation Volunteer Network" within Central Wisconsin.
- alternative livestock enterprises - alternative livestock such as emus produce less manure, decreasing the potential for surface and groundwater contamination as well as producing meat which is 97% fat free.

- alternative tree crops and agroforestry.
- finalizing and distributing a “Value of Groundwater Survey,” which assessed Portage County residents’ perceptions and values about groundwater issues.
- conducting water education programs, “The Groundwater - Drinking Water Connection,” for Portage County Women, Infants and Children (WIC) clients.
- assisting Portage County Planning and Zoning in revising the Groundwater Management Plan.
- helping with Portage County “Clean Sweep” program.
- carrying out a water education program with local schools to infuse groundwater protection and pollution prevention in the school curriculum.
- assisting in a groundwater model training workshop and distributing groundwater flow models to schools in the Central Sands Region.
- presenting “Pesticides and Water Quality - What Public Schools Should Know” for the Fourth Annual Wisconsin Water Law Conference.
- “The Well Street Journal” - a newsletter of the SWP Wellhead Protection Project.
- conducting a drinking water education program throughout Portage County.

To find out more information about NRCS, go to the home page at <http://www.usda.nrcs.gov/> or contact Renae Anderson at 608-276-8732 ext. 227.

STATUTORY LANGUAGE RELATING TO THE GCC

SECTION 2. 15.347 (13) of the statutes is created to read:

15.347 (13) Groundwater Coordinating Council. (a) *Creation*. There is created a groundwater coordinating council, attached to the department of natural resources under s. 15.03. The council shall perform the functions specified under s. 160.50.

- (b) *Members*. The groundwater coordinating council shall consist of the following members:
1. The secretary of natural resources.
 2. The secretary of industry, labor and human relations.
 3. The secretary of agriculture, trade and consumer protection.
 4. The secretary of health and social services.
 5. The secretary of transportation.
 6. The president of the university of Wisconsin.
 7. The state geologist.
 8. One person to represent the governor.
 9. ~~One person who is a member of a local health department under s. 149.09, appointed by the governor to represent local health departments.~~ (Vetoed in part)
- (c) *Designees*. Under par.(b), agency heads may appoint designees to serve on the council, if the designee is an employe or appointive officer of the agency who has sufficient authority to deploy agency resources and directly influence agency decision making.
- (d) *Terms*. Members appointed under par. (b) 8 ~~and 9~~ shall be appointed to 4-year terms. (Vetoed in part)
- (e) *Staff*. The state agencies with membership on the council and its subcommittees shall provide adequate staff to conduct the functions of the council.
- (f) *Meetings*. The council shall meet at least twice each year and may meet at other times on the call of 3 of its members. Section 15.09 (3) does not apply to meetings of the council.
- (g) *Annual report*. In August of each year the council shall submit to the head of each agency with membership on the council, the members of appropriate standing committees of the legislature and the governor, a report which summarizes the operations and activities of the council during the fiscal year concluded on the preceding June 30, 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 in the state, an assessment of groundwater management programs, information on the implementation of ch. 160 and a list and description of current and anticipated groundwater problems. In each annual report, the council shall include the dissents of any council member to the activities and recommendations of the council.

Non-statutory provisions: Natural Resources

- (9) GROUNDWATER COORDINATING COUNCIL: INITIAL APPOINTMENTS. (a) Notwithstanding section 15.347 (13)(d) of the statutes, as created by this act, the initial member appointed to the groundwater coordinating council under section 15.347 (13) (b) 8 of the statutes, as created by this act, shall be appointed for a term ending on July 1, 1987 ~~and the initial member appointed to the groundwater coordinating council under section 15.347 (13) (b) 9 of the statutes as created by this act, shall be appointed for a term ending on July 1, 1985.~~ (Vetoed in part)
- (b) Following initial appointments under paragraph (a), members appointed to the groundwater coordinating council under section 15.347 (13) (b) 3 and 4 of the statutes, as created by this act, shall serve for the terms prescribed under section 15.347 (13) (d) of the statutes as created by this

act.

160.50 Groundwater coordinating council. (1) GENERAL FUNCTIONS. The groundwater coordinating council shall 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.

(2) SUBCOMMITTEES. The groundwater coordinating council may create subcommittees to assist in its work. The subcommittee members may include members of the council, employees of the agencies with members on the council, employees of other state agencies, representatives of counties and municipalities and public members. The council shall consider the need for subcommittees on the subjects within the scope of its general duties under sub. (1) and other subjects deemed appropriate by the council.

(3) REPORT. the groundwater coordinating council shall review the provisions of 1983 Wisconsin Act...(this act) and report to the legislature concerning the implementation of the act by January 1, 1989.

Walking on Water

Dave Johnson and Laura Chern

Whether you know it or not, with every step, you're walking on one of Wisconsin's buried treasures.

In fact, much of what you love about what happens above ground can be credited to what you don't see underground. That's groundwater -- one of Wisconsin's most important natural resources. And there's about two quadrillion (2,000,000,000,000,000) gallons of it to go around.

And unless you live in one of a few large cities in Wisconsin such as Green Bay or Milwaukee, the water you drink or use for washing came out of the ground.

Not only that, but groundwater supplies fresh water to: 2,444 trout streams; 5,002 warm- water streams; 14,949 lakes; and 5,331,392 wetland acres in the state. That's right! Your favorite fishing hole, marsh and wild rapids are replenished by groundwater.

Do you like fresh meat or vegetables on the table? Well, groundwater plays an important role in agriculture too. According to a 1992 Department of Commerce census, about 331,000 acres of Wisconsin farmland are irrigated. And cows need about 100 gallons of water a day to produce 45 gallons of milk. All of this water comes from the ground.

So what are we doing to guard what we can't even see?

Groundwater hasn't always enjoyed the protection and respect that it has today.

When Wisconsin celebrated statehood in 1848, the State Constitution declared the common law of England to be the common law in Wisconsin. In 1903, the Wisconsin State Supreme Court set out to better define what that meant for well water in Wisconsin.

In the court case of *Huber v. Merkel*, the Wisconsin State Supreme Court interpreted the State Constitution to mean that a landowner could use as much water as he wanted regardless of how it affected adjoining property owners. Huber and Merkel were neighbors near Germantown and each had a well on his property. Merkel allowed his well to run freely, letting the water run out on the ground. Huber charged that Merkel's well mismanagement caused his well to run dry.

The Supreme Court held that a landowner had a "clear right at common law, resulting from his ownership of land, to sink a well thereon, and use that water therefrom as he chose, or allow it to flow away, regardless of the effect of such use upon his neighbor's wells, and that such right is not affected by malicious intent."

Despite several challenges, the law remained unchanged until 1974 when the Wisconsin Supreme Court threw out *Huber v. Merkel* in the case of *State of Wisconsin v. Michels Pipeline Construction, Inc.* The latter case revolved around a contract with the Milwaukee Metropolitan Sewerage Commission to put in a sewer. During construction, Michels Pipeline dewatered the aquifer. As a result, the water table plummeted on surrounding properties. Several private wells dried up and others suffered as water flow to their wells slowed and water quality decreased. Also, the lower water table caused ground settling. Foundations cracked. Driveways and basement walls crumbled.

The *Michels* case brought greater attention to the concept of collective rights to groundwater and is credited as a founding tenet of Wisconsin's groundwater law which now states that a property owner is entitled to reasonable use of the groundwater under private property and must consider impacts on the water table and other users. The *Michels* decision provides a key point in Wisconsin law because it allows the State to regulate groundwater for the common good of all citizens.

Another pivotal moment came in 1984 when Chapter 160 of the Wisconsin Statutes became state law. The "groundwater law" has been hailed as the most comprehensive program for managing and protecting groundwater in the United States.

Four concepts make the Wisconsin law notable among the nation's groundwater protection programs:

* All groundwater in Wisconsin is considered a potential source of drinking water and must be protected and managed to assure that it can be potable;

- * All state agencies involved in regulating groundwater uses meet as a Groundwater Coordinating Council, to provide the same level of groundwater protection regardless of which agency oversees a given regulation;
- * The Department of Natural Resources sets numerical standards to define at what point a regulatory agency must intercede so the pollution source will start cleaning up and preventing groundwater contamination; and
- * There are separate numerical standards designed to protect the environment, public welfare and public health.

As citizens, we are becoming more aware of groundwater's importance; more involved in its protection and management. Our groundwater laws are changing to meet new challenges and minimize human contamination of its quality through wiser land use and water conservation.

Through the Groundwater Coordinating Council, state agencies such as the Department of Natural Resources, Department of Agriculture Trade and Consumer Protection, Department of Commerce, Department of Health and Family Services and Department of Transportation are working together more than ever to address issues ranging from applying fertilizers and pesticides to controlling road salt and stormwater infiltration.

Local governments are taking more responsibility for groundwater protection and management through zoning laws and education programs.

The future looks bright even for places that the light doesn't reach -- like our underground lifeline -- groundwater.

Dave Johnson and Laura Chern are hydrogeologists in DNR's Bureau of Drinking Water and Groundwater.