Wisconsin Groundwater Coordinating Council

REPORT TO THE LEGISLATURE

August 2001

GROUNDWATER COORDINATING COUNCIL MEMBERS

Department of Natural Resources - Susan L. Sylvester (Chair)
Department of Agriculture, Trade, and Consumer Protection - Nicholas Neher
Geological and Natural History Survey (State Geologist) - James Robertson
Governor's Representative - John Metcalf
Department of Health and Family Services - Dr. Henry Anderson
Department of Commerce - John Alberts
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Department of Commerce - Harold Stanlick
Department of Health and Family Services - Henry Anderson and Lynda Knobeloch
Department of Natural Resources - David Lindorff and Steve Karklins
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Department of Commerce - Harold Stanlick
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Geological and Natural History Survey - Ron Hennings
Wisconsin Alliance of Cities - Jim Trierweiler
Wisconsin County Code Administrators - Ray Schmidt and Bruce Haukom
Wisconsin Rural Water Association - Gary Lueck

State of Wisconsin \ GROUNDWATER COORDINATING COUNCIL

Scott McCallum, Governor

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August, 2001

To: The Citizens of Wisconsin
The Honorable Governor Scott McCallum
Senate Agriculture and Environmental Resources Committee
Assembly Environment Committee
Assembly Natural Resources Committee
Secretary Terrence D. Mulcahy - Department of Transportation
Secretary Brenda J. Blanchard - Department of Commerce
Secretary James E. Harsdorf - Department of Agriculture, Trade & Consumer Protection
Secretary Phyllis Dubé - Department of Health and Family Services
Secretary Darrell Bazzell - Department of Natural Resources
President Katharine Lyall - University of Wisconsin System
State Geologist James Robertson - Geological and Natural History Survey

This is the 2001 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 the 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.

This report summarizes agency activities related to groundwater protection and management in FY 01 and provides an overview of the condition of the groundwater resource. See the Executive Summary for highlights and the GCC's recommendations for Directions for Future Groundwater Protection.

With this report, we would like to announce an exciting initiative being planned for fall of 2001 entitled the Wisconsin Groundwater Summit. The purpose of the Summit is to bring together a broad representation of groundwater users and stakeholders to discuss current issues facing groundwater protection and management and to develop ideas and solutions to better protect Wisconsin's groundwater quality and quantity. The Summit is planned for October 30, 2001, at the Country Inn Hotel in Waukesha, WI.

The discussion and materials developed as a result of the Summit will assist and guide State agencies, the UW System, and the GCC in carrying out groundwater protection programs. Solutions could encompass educational efforts, research needs, data management, institutional needs, as well as policy recommendations. The GCC's role is to facilitate the Summit as an exchange of ideas regarding the future of groundwater management in the state. Specific recommendations that arise from the Summit will be directed to the appropriate State agency or other entity for consideration.

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

The GCC is an interagency group that is directed by law to assist State agencies in the coordination and exchange of information related to groundwater programs. See the GCC web site for more information (http://www.dnr.state.wi.us/org/water/dwg/GCC/).

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LIST OF ABBREVIATIONS AND ACRONYMS

AAA ..... Arsenic Advisory Area
ACCP ..... Agricultural Chemical Cleanup Program
ASR ..... Aquifer Storage and Recovery
BMP ..... Best Management Practices
BRRTS ..... Bureau of Remediation and Redevelopment Tracking System
CERCLA ..... Comprehensive Environmental Response Compensation Liability Act
COD ..... chemical oxygen demand
COMM ..... Department of Commerce (formerly DILHR)
CWGC ..... Central Wisconsin Groundwater Center
DATCP ..... Department of Agriculture, Trade and Consumer Protection
DHFS ..... Department of Health and Family Services
DILHR ..... Department of Industry, Labor and Human Relations
DIN ..... decision item narrative
DNR ..... Department of Natural Resources
DOT ..... Department of Transportation
EPA ..... U. S. Environmental Protection Agency
ERC ..... Environmental Resources Center
ERS ..... Division of Environmental and Regulatory Services
ES ..... Enforcement Standard
ESA ..... ethane sulfonic acid
FHWA ..... Federal Highway Administration
FSA ..... (USDA) Farm Service Agency
FSTRAC ..... Federal/State Toxicology and Risk Analysis Committee
FY ..... Fiscal Year
GCC ..... Groundwater Coordinating Council
GEMS ..... Groundwater and Environmental Monitoring System
GIS ..... Geographic Information System
GMU ..... Geographic Management Unit
GPS ..... Global Positioning System
GS ..... Groundwater Section
GRAC ..... Groundwater Research Advisory Council
GRN ..... Groundwater Retrieval Network
IPM ..... Integrated Pest Management
LUST ..... Leaking Underground Storage Tank
LWRV ..... Lower Wisconsin River Valley
mg/L ..... milligrams per liter
MOU ..... Memorandum of Understanding
NPM ..... Nutrient and Pest Management
NRCS ..... (USDA) Natural Resource Conservation Service
PAL ..... Preventive Action Limit
PCB ..... polychlorinated biphenyl
PCR ..... polymerase chain reaction
PECFA ..... Petroleum Environmental Clean-up Fund Act
PMP ..... Pesticide Management Plan
ppb ..... parts per billion
ppm ..... parts per million
RR ..... Bureau for Remediation and Redevelopment
SEWRPC ..... Southeast Wisconsin Regional Planning Commission
SMP ..... State Management Plan
SWAMP ..... System for Wastewater Applications, Monitoring, and Permits

SWAP..... Source Water Assessment Program
TDS ..... total dissolved solids
µg/L ..... micrograms per liter
UIC..... Underground Injection Control
USDA..... U.S. Department of Agriculture
UW ..... University of Wisconsin
UWEX..... University of Wisconsin Extension
UWS..... University of Wisconsin System
USGS ..... U.S. Geological Survey
VOC ..... volatile organic compound
VPLE..... Voluntary Party Liability Exemption
WGNHS ..... Wisconsin Geological and Natural History Survey
WHP..... Wellhead Protection
WPDES ..... Wisconsin Pollution Discharge Elimination System
WRI..... Water Resources Institute
WSLH ..... Wisconsin State Laboratory of Hygiene
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) 2001.

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 non-regulatory 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; 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. Agency designees 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) In May of 2000, the GCC initiated an effort to assess the current status of groundwater management in the state and to provide future direction for the GCC and its member agencies. This effort will culminate in an event called "The Wisconsin Groundwater Summit" to be held on October 30, 2001 in Waukesha, WI. The Summit will bring together a broad spectrum of groundwater users and stakeholders to discuss issues facing groundwater protection and management and develop solutions to better protect Wisconsin's groundwater. Invitations were mailed to over 80 organizations, agencies, and key individuals with a stake in safe and adequate groundwater supplies. These include environmental, conservation, and agricultural groups, industrial users, water utilities, local and tribal government, planning agencies, state and federal agencies, and university researchers and educators. The format for the Summit will be a set of keynote presentations and a panel discussion, followed by breakout sessions where participants will be asked to address specific issues and suggest solutions. A core group of groundwater professionals will meet the following day to synthesize the discussion and formulate a set of findings and recommendations to be distributed after the Summit. A document summarizing the Summit will be distributed in 2002.
   The discussion and materials developed as a result of the Summit will assist and guide State agencies, the UW System, and the GCC in carrying out groundwater protection programs. Solutions will encompass educational efforts, research needs, data management, institutional needs, as well as policy recommendations. The GCC's role is to facilitate the exchange of ideas with respect to the future of groundwater management in the state. Specific recommendations will be directed to the appropriate State agency or other entity for consideration.

2) The GCC, through its Planning and Mapping Subcommittee, finalized the *Wisconsin Interagency Karst Feature Reporting Form* and distributed it to member agencies, local agencies, professional groups and other interested entities in November 2000. The purpose of the initiative is to provide a means for collecting information on karst features within the state and to develop a central repository for the completed forms. The GCC subcommittee also coordinated development of a karst web site in conjunction with the Wisconsin Geological and Natural History Survey and organized the *Karst Data Workgroup*, comprised of karst data experts from across the state. Eventually, the GCC hopes that a database will be created for use by agencies and researchers to 1) protect Wisconsin’s groundwater resources and

endangered species, 2) provide information for various land use planning activities, and 3) facilitate construction, agriculture, and resource planning and management activities. Copies of the Wisconsin Interagency Karst Feature Reporting Form and the accompanying cover letter are included in the Appendix.

3) The GCC and the UWS GRAC continued coordination of the annual solicitation for groundwater research and monitoring proposals among state agencies. Twenty-seven projects were funded in FY 01 by one or more of the following agencies: UWS, DATCP, DNR and Commerce. The projects funded are listed in Table 1. The GCC approved the FY 02 joint solicitation package for groundwater research and monitoring to meet state needs. The package was sent out in September 2000 and is included in the Appendix. A total of 30 project proposals were received. A comprehensive review process resulted in the selection of 21 new projects for funding for FY 02. The new projects selected by the UWS, DNR, and DATCP for funding in FY 02 are in addition to 11 projects that were carried over from FY 01. At their February 23, 2001, meeting the GCC unanimously approved the proposed UWS groundwater research plan as required by s. 160.50(1m), Wis. Stats. The UWS will fund 4 continuing and 10 new projects in FY 02. The FY 02 groundwater monitoring and research projects are listed by funding agency in Table 2.

4) Through the Monitoring & Data Management Subcommittee, the GCC continued to address important data management issues in FY 01. Highlights included:
   - Completion of a project making 375,000 scanned images of well construction reports completed prior to 1988 available to agency staff and the general public;
   - Improved access to the Groundwater Retrieval Network (GRN) by other state agencies and the public, now available on the internet;
   - Evaluation of minimum data elements needed for groundwater databases.
   - Making two additional forms available digitally for electronic submission though the DNR's Well Forms Program and web site: First Water Quality Test and Drinking Water Well Construction Report.

5) The GCC continued to address and coordinate educational activities related to groundwater. Specifically, the Education Subcommittee:
   - Developed a public education strategy on groundwater quantity. A press release and teacher materials have already been produced to accompany the groundwater quantity program "Water Rich, Water Poor" produced by Wisconsin Public Television. Future plans include a water conservation display at Farm Progress Days and a web page linked to the GCC web site on water quantity information and resources.
   - Coordinated agency activities for Farm Progress Days and Drinking Water Week, increasing the effectiveness of the messages by reinforcing them in various formats, and avoiding duplicative efforts.

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) and the U. S. Geological Survey (USGS) attend GCC meetings and serve as *ex officio* subcommittee members. The groundwater activities of the USGS and NRCS are summarized in the Appendix.

DIRECTIONS FOR FUTURE GROUNDWATER PROTECTION

PRIORITY ISSUES

- **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.

- **Investigation of recently discovered groundwater contaminants:** Recent research conducted in Europe and the U.S. indicates that traces of pharmaceuticals (including antibiotics and hormones) and pesticide breakdown products are common contaminants found in groundwater and surface water. Current testing methods do not allow adequate detection of these possible contaminants. Research is needed to determine whether these substances pose a threat to Wisconsin's groundwater resource. There is also a need to evaluate the sources, fate, transport, and chemistry of p-Isopropylbenzene (cumene), aluminum, molybdenum and strontium (non-radioactive form) in groundwater; evaluate existing databases; and sample at-risk potable wells for these contaminants.

- **Investigation of naturally occurring substances in groundwater:** Continued problems of elevated arsenic, low pH, and other water quality problems in domestic wells exist over large areas of northeast Wisconsin. DNR needs more information about the extent and causes of these problems in order to give advice to homeowners and well drilling contractors. Additionally elevated sulfate and total dissolved solids have been found in some new deep municipal wells in the Lower Fox River Valley making the wells unusable. In some other existing deep wells as far south as Milwaukee the total dissolved solids have been steadily increasing over the years. These sulfate and TDS levels pose a problem for local water managers, and the origin of the dissolved solids is not completely understood.

- **Provide resources to local governments for Smart Growth/Comprehensive Planning activities**. Recent legislation has required local units of government to develop a comprehensive plan by 2010 in order to undertake land use activities. This plan must address 9 elements, including natural and agricultural resources, housing, utilities, and land use. This planning process presents a unique opportunity to address and implement groundwater protection at the local level. The GCC will seek ways to assist local communities in their planning efforts to encourage groundwater protection.

- **Promote consistency between the agencies on data management issues:** Through updates to the DNR's groundwater data system and the Directory of Groundwater Databases, state and local government agencies now have more convenient access to groundwater data. This effort must be maintained by continuing to identify what data needs exist and ways to make data easily accessible. 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.

- **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 that 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. Priorities for the future include promoting water stewardship, awareness of water quantity issues, and

providing materials for local communities to assist in their comprehensive planning activities.

- **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. More than 90 of these summaries are now available on the UW-WRI web site maintained by UW-WRI. The rate of response to the web site posting of research findings has been very encouraging so far. To maintain and enhance this 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. 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. The GCC's Planning & Mapping and Monitoring & Data Management Subcommittees have prioritized, promoted, and helped facilitate the development of data layers as part of a larger data integration initiative. Through the DNR's Source Water Assessment Program, which will be implemented by 2003, this work will continue and will result in improved predictive capabilities.

- **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.

- **Continued evaluation of alternatives to onsite sewage systems:** Although the DNR and Commerce have 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 and protect groundwater resources.

- **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. 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.

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 01.

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, we have included a copy of the *Wisconsin Interagency Karst Feature Reporting Form* and information on the Wisconsin Groundwater Summit in the Appendix.

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, wetlands and water supply); the Department of Commerce (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 today and in the future.

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, DNR and Commerce participated in a joint solicitation for groundwater-related research and monitoring proposals for funding during FY 02. 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 four Bureaus:

1. Bureau of Drinking Water and Groundwater – Regulates public water systems and private drinking water supply wells. The Groundwater Section assists in coordinating groundwater activities of the DNR, as well as other state agencies.

2. Bureau of Waste Management - Regulates and monitors groundwater at proposed, active, and inactive solid waste facilities and landfills.

3. Bureau for Remediation and Redevelopment - Oversees clean-up actions at spills, hazardous substance release sites, abandoned containers, state funded responses, Brownfields, " high priority" leaking underground storage tanks, closed wastewater and solid waste facilities, hazardous waste corrective action and generator closures, sediment clean-up actions and helps run the Brownfield Site Assessment Grant program. A significant amount of the RR program's work relates to groundwater contamination.

4. Bureau of Watershed Management - Regulates the discharge of municipal and industrial wastewater, by-product solids and sludge disposal from wastewater treatment systems and wastewater land treatment/disposal systems. The Bureau also issues WPDES permits for discharges associated with clean-up sites regulated under the authority of the Bureau for Remediation and Redevelopment. The Bureau also has primary responsibility for regulating stormwater and agricultural runoff as well as managing waste from large animal feeding operations.

Bureau of Drinking Water and Groundwater

Groundwater Section Activities

The Groundwater Section 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 and source water assessment activities, and maintenance of a data management system for groundwater data.

Groundwater Standards. 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

April 1, 2000, revision of the existing standards for toluene and xylene went into effect in ch. NR 140, Wis. Adm. Code. To date, 120 health-based groundwater standards have been set.

In mid-2000, the DNR sent a request to the Department of Health and Family Services (DHFS) asking them for groundwater standard recommendations for alachlor ethane sulfonic acid (ESA) and molybdenum and review the existing standards for naphthalene, butylate and dacthal. The DNR anticipates receiving recommendations from DHFS in summer 2001.

In February 2001, on behalf of the Board of Agriculture, Trade and Consumer Protection (DATCP), the DNR sent a request to DHFS asking them to review the existing groundwater standards for atrazine and its metabolites and propose revised standards if appropriate. The DNR anticipates receiving a determination from DHFS in late 2001.

Groundwater Section staff serve on the Bureau for Remediation and Redevelopment 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.

Section staff also serve on the NR 700 Implementation Team (formerly the Consistency Team) which evaluates and makes recommendations promoting consistency for statewide issues affecting the DNR's Bureau for Remediation and Redevelopment. These issues include, in part, site investigations, soil and groundwater remediation, and general case closure decisions. This team's function is critical in obtaining statewide consistency in how the Bureau for Remediation and Redevelopment evaluates, addresses and closes soil and groundwater contamination sites.

Section staff serve on the Federal/State Toxicology and Risk Analysis Committee (FSTRAC). This group, comprised of representatives from several states and EPA, provides a valuable format to exchange information and promote solutions to water quality, public health and drinking water issues.

In September 1996, the Groundwater Section published revisions to the DNR's Groundwater Sampling Desk Reference and Field Manual. The documents go into great detail on how to consistently collect high quality, representative groundwater samples and measurements. During FY 01 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 and are amongst the top most downloaded documents from the Bureau's web site.

Groundwater Monitoring and Data Management. DNR continues its groundwater monitoring program, composed of problem assessment monitoring, at-risk monitoring, management practice monitoring, regulatory monitoring, and monitoring planning. During FY 01, $340,750 was awarded to 10 projects selected during the joint solicitation process described under "Groundwater Monitoring and Research" in this report. During FY 02, $436,285 was awarded to 14 projects for management practice monitoring. Nine projects are new studies selected during this year's joint solicitation process (see Tables 1 and 2).

In FY 01, two projects were funded outside of the Joint Solicitation to address specific DNR needs (problem assessment monitoring). These were:

- Improved hydrogeologic model of the Token Creek watershed. J. Bahr (UW-Madison)
- Assessment of the Ability of Mound Sand (ASTM C-33) to Remove Microorganisms in Column Experiments. J. Standridge (Wisconsin State Laboratory of Hygiene)

Final reports will be available later in 2001.

Under direction of the GCC, the UW Water Resources Institute (WRI) and the Groundwater Section continued to distribute the findings of groundwater monitoring and research funded through the joint solicitation process. Final reports and 2-page research summaries are available for most projects. Almost 100 summaries are available electronically on the WRI World Wide Web site.

The DNR's Well Forms Program continues to expand with the addition of two new forms. The First Water Quality Report Form (3300-77) and the Drinking Water Well Construction Report Form (3300-77A) were added to the existing 6 forms, bring the number up to eight Department well related forms covered by the software. Several upgrades were also completed to several of the existing forms to add additional capabilities. The program forms allow users to electronically capture, print, export, and import all well-related information. The original 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 program was originally introduced in conjunction with special Wisconsin Unique Well Number (WUWN) tags specifically designed for monitoring wells.

Groundwater Section staff inspected a number of monitoring well drilling operations in FY 01. 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.

Section staff continue to review the application and effectiveness of new technologies for remediation. Horizontal drilling, direct push technologies and different sampling protocols are among the major items reviewed. Staff have also advised Remediation and Redevelopment, Waste Management, Watershed Management and Department of Commerce staff on well design and monitoring plans. Staff also worked with Remediation and Redevelopment to publish a FAQ on temporary monitoring wells.

Wellhead Protection. 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 groundwater pollution prevention in public water supply wellhead areas consistent with the state's overall goal of 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 that was approved by the USEPA in 1993. A WHP plan must be developed for any new municipal water supply well constructed since May 1, 1992. The plan must be approved by the DNR's Public Water Systems Section. A WHP Plan is voluntary for any public water supply well approved prior to May 1, 1992; the DNR promotes and encourages but does not require wellhead protection planning for existing wells.

The DNR continues a statewide public information effort aimed at encouraging water utilities to protect their water supplies from potential sources of contamination through wellhead protection planning. Wellhead protection activities are coordinated through a Wellhead Protection Standing Team created in January of 1998. Among the activities undertaken this past year were:

- *Teacher training*. Department staff worked with the Central Wisconsin Groundwater Center (CWGC) and the Wisconsin Geological and Natural History Survey to sponsor three groundwater workshops for teachers in January. Teachers from 25 school districts were given training in the use of the groundwater sand tank model and given the models to take back to their schools. Sixty teachers took part in the workshops held in Stevens Point, Tomahawk and Wisconsin Dells. In addition to the models, teachers were given a variety of educational materials and an assignment to report how they used the model in their classroom. The intent is to provide information for teachers to educate students –and their parents – to protect groundwater in their own communities.

- *Working with local communities on WHP planning*. Three Groundwater Section staff have split up the state for purposes of assisting communities requesting assistance with wellhead protection plans. The staff meet with communities, provide information, and make presentations to promote the WHP program. The DNR also works with the Wisconsin Rural Water Association in providing assistance. Information is shared with local communities through a spring and fall wellhead protection newsletter.

- *WHP publications*. The DNR makes publications available to assist communities in their wellhead protection efforts. Work has begun on a document to provide guidance to communities in deciding how best to manage their wellhead protection area once it has been delineated.

- *Upgrading the DNR's WHP web site*. The Department continues to update its WHP web site as new information becomes available. It currently includes general information on WHP, an annotated bibliography, a list of contacts for more information, a list of available publications, example WHP ordinances, and past and present issues of the Wisconsin Wellhead Protection News. Several DNR WHP publications have been added to the web site in viewable and downloadable formats. In 2000, the example ordinances were updated and a PowerPoint presentation was placed on the web site.

- *Keeping track of wellhead protection activity*. The Department has developed a database to keep track of communities working on wellhead protection planning, whether required or voluntary. The Department is working to incorporate into the Department's Public Water System database a tracking system for both wellhead protection and source water assessment activities.

- *Promoting the Groundwater Guardian Program*. The Department worked with the CWGC to organize a meeting of communities actively involved in the Groundwater Guardian program in the state. This meeting provided an opportunity for the communities to describe their local activities to promote groundwater protection and make suggestions for how the Department and CWGC could assist the Groundwater Guardian program in Wisconsin. The CWGC is planning to hire a person to promote the Groundwater Guardian program using funds from the Department.

- *Coordinating efforts with the Source Water Assessment Program.* The WHP Team continues to work closely with the Source Water Protection Team to provide consistency and continuity between the two programs. One area where the teams are working together is promoting advanced WHP Area delineations. In order to provide the most accurate information available to assist in WHP planning, the DNR has funded or is funding regional groundwater modeling projects in about 19 counties (see Source Water Assessment discussion below). In addition to providing a valuable planning tool for communities in these counties, the projects will provide delineations of the 5, 50 and 100-year capture zones for each of the municipal wells in these areas. These delineations can be used by communities in their WHP planning process.

Source Water Assessments. The DNR received USEPA approval of Wisconsin's Source Water Assessment Program (SWAP) Plan in November 1999. The plan was submitted to meet the requirements of the 1996 Safe Drinking Water Act Amendments. By May 2003 the 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 within those areas; 3) perform an analysis of susceptibility for each system; and 4) make the results of the assessments available to the public.

Source water areas for municipal groundwater systems are being delineated through regional groundwater flow modeling studies. These studies are being completed for the Lower Fox Valley, Central Sands Area, and the following counties: Dane, Eau Claire, Fond du Lac, Kenosha, La Crosse, Milwaukee, Ozaukee, Pierce, Racine, Rock, Sauk, St. Croix, Walworth, Washington, and Waukesha. For the other municipal systems and smaller systems, simpler radius delineations are being used.

In coordination with the State's Vulnerability Assessment Program, maps of source water areas are being sent to each system with a request for system operators to identify potential contaminant sources within the delineated areas. Additionally, through SWAP, the DNR is collecting potential contaminant source location data from existing databases and from field projects by the Remediation and Redevelopment, Waste Management, and Watershed Management programs.

The types and locations of potential sources of contamination will be used with well construction, hydrologic, geologic, and other information to determine each system's susceptibility to contamination. The results of the assessments will be sent to drinking water systems and made available on the Internet. The goal of Wisconsin's SWAP is to provide information that will assist communities in preparing WHP plans.

Coordination of groundwater components of basin plans and of nonpoint source priority watershed projects. Groundwater Section staff work with basin teams to develop specific groundwater priorities for State of the Basin Reports. Priorities are based on GRN data, land cover information and information provided by regional DG program staff. Staff also participate on the Rock River Coalition Groundwater Issues Team. The Team has focused on cataloging data and resources, contaminant sources and karst features and promoted 6 well abandonment demonstrations.

During FY 01, Geographic Management Units (GMU) around the state began the process of developing State of the Basin reports with direction from Water Division and Land Division guidance on integrated planning. These reports replace Water Quality Management (WQM) plans required under Section 208 of the Clean Water Act and NR 121, Wis. Adm. Code and will help meet strategic planning requirements for Fish and Wildlife Service grant funds. State of the Basin Reports have been completed for the following Basins: Wolf River, Lower Fox River, Grant-Platte, Lower Chippewa River, Green Bay, Lakeshore, Milwaukee River and Upper Chippewa River.

State of the Basin (or GMU) reports provide baseline information on surface water, groundwater and land resources. Their main focus is on priority issues that are identified by the respective GMU team, made up of department staff and partnership groups. The plans identify geographic priorities for the nonpoint source program and will be used to help rank projects eligible for nonpoint source grant funds. The Groundwater Section is involved in integrated planning by providing basic data on groundwater for each GMU and more detailed information as is needed. The Section is uniquely suited to highlight areas in need of management based on groundwater issues and nonpoint source priority areas related to groundwater.

New Runoff Management rules with performance standards for stormwater infiltration will be promulgated in FY 01. Groundwater Section staff are working with Runoff Management staff to make sure the rules comply with chapter NR 140, Wis. Adm. Code. The Section is also participating on a team writing guidance for developers, land use planners and government agencies regarding stormwater practices that will meet the performance standards while preserving groundwater quality.

Other Bureau Activities

Arsenic. In 1999 the Bureau of Drinking Water & Groundwater established a statewide Arsenic Study Group. This Group was established because of the increased incidence of arsenic in wells, primarily in NE Wisconsin; the effects of a potential federal drinking water standard change; and unresolved drilling method and construction specification issues. The Arsenic Study Group includes DNR Drinking Water & Groundwater staff, representatives from other State agencies, EPA, the United States and the Wisconsin Geological Surveys, UW System, UW Extensions, Local County Health Departments, the National Institute of Health, and the Wisconsin Water Well Association. The group's purpose was to assist the state in its effort to proactively understand and develop solutions for the arsenic issue and its related health impacts.

After several meetings the Arsenic Study Group provided approximately 20 recommendations. These recommendations included gathering existing data, analyzing for voids in data, beginning new research activities, and developing information/education materials for the citizens of the state. Recommendations acted upon to date include:

- Production of a brochure entitled "Arsenic in Drinking Water" which is available on the Bureau of Drinking Water & Groundwater web site.
- Making funds available to perform raw water sampling of 3,300 Municipal, Other Than Municipal, and Non Transient Noncommunity wells. Results from the samples returned indicate that approximately 80 systems in Wisconsin could be affected by an arsenic standard of 10 µg/L.

- Soliciting research proposals through the Joint Solicitation process related to arsenic. Approximately $270,000 has been allocated during FY 01-02 for 5 research projects related to the arsenic issue.
- Developing a web page devoted to the arsenic issue. The web page is being designed by the DNR with assistance of the DFHS and other partners and will be available later in 2001.

Underground Injection Control (UIC) Program. Public water utilities in Oak Creek and Green Bay are continuing to work with the Bureau of Drinking Water and Groundwater to evaluate the use of aquifer storage recovery (ASR)[1] techniques in Wisconsin:

- The Oak Creek ASR pilot study has been approved to proceed with an additional injection-storage-recovery cycle in order to gather additional water quality information. A final report on the portion of the research that was funded by the American Water Works Association Research Foundation (AWWARF) should be available toward the end of 2001.
- The Green Bay ASR pilot system is still expected to become operational in the latter part of the year. DNR staff remain concerned about the potential for adverse geochemical reactions that would result in the mobilization of arsenic found in the regional bedrock. The Department has conditioned its approval of the proposed demonstration test plan to ensure that these potential interactions are more precisely monitored.

The Bureau of Drinking Water and Groundwater continues to work with the United States Environmental Protection Agency (EPA) to revise the primacy agreement that gives the DNR primary enforcement for Wisconsin's Underground Injection Control (UIC) program. The Department must submit a final revised UIC primacy application to EPA by April 1, 2002. As part of this process, the bureau will also be asking the Natural Resources Board to create and adopt Chapter NR 815, Wis. Admin. Code, as it pertains to the regulation of underground injection wells.

High Capacity Wells. Groundwater quantity and water withdrawal issues have received more than usual attention in recent years, prompted by the interest of a major water bottling company in locating a high capacity well near two spring sites. The Department of Natural Resources is continuing to address the potential impacts of the proposed wells through the permitting process. This project highlighted the limited authority that the state has in regulating groundwater withdrawals that may affect surface water resources.

Drinking Water and Groundwater web site. The Bureau continues to operate its Drinking Water and Groundwater web site. The site provides information on Public Water Supplies in Wisconsin, consumer confidence reports, frequently asked questions, wellhead protection, community water systems, well abandonment, capacity development, drinking water systems, homeowner information, groundwater information, staff listings, and well driller and pump installer information. Access to several new systems is available through a web interface. Information and data from the Public Drinking Water System, Well Construction System, High Capacity Wells and the Groundwater Retrieval Network System is available online. The Groundwater Information section of the site has been greatly expanded to include extensive sections on wellhead protection and source water protection. All new publications developed in the Groundwater Section are posted online for downloading, viewing or both.

Bureau of Waste Management

Over the past few years increasing numbers of residential developments have been located close to old, closed landfills. Further, it has been recently discovered that several of these landfills are impacting groundwater. In 1998 and 1999 the DHFS sampled private wells down-gradient of 19 small, closed landfills in one county. Several of the

1 ASR systems involve the injection of treated drinking water via a well into a suitable bedrock aquifer. The injected water is stored underground until the time it is needed to meet the needs of a utility's customers. During a high demand event the stored drinking water is pumped back up the same injection well and recovered into the water distribution system with little need for additional treatment to remove potential drinking water contaminants.

private wells had results above maximum contaminant levels. The results of this sampling showed that there might be more landfills with serious problems that have not yet been identified.

The DNR Bureaus of Waste Management, Remediation and Redevelopment, and Drinking Water and Groundwater in cooperation with the DHFS, responded to this issue in early 1999 by choosing 16 old, closed landfills – at least three from each of the five regions across the state - that have private wells nearby and may be impacting groundwater. Private wells around each of the landfills were sampled in 1999 and significant levels of contamination were found. Of the 113 wells that were tested, 31 had detects of volatile organic compounds (VOCs). Fourteen of the homes had levels exceeding drinking water standards and have been given health advisories not to drink their water.

To recommend ways to ensure integration and communication within the DNR when addressing the problem of private wells near old, closed landfills, an ad hoc team, the Landfill Encroachment Work Group, was formed with members from the Bureaus listed above. The work group's goal was to work together to prevent people from drinking contaminated groundwater from private wells near landfills and locating homes where this may already be occurring. There are also plans to coordinate with other state agencies, local agencies and the private sector.

The work group presented its recommendations to the three different Bureau Directors in June 1999. The work group made the following recommendations to help avoid old, closed landfills from impacting private wells:

1. improve our database of the location and characteristics of active, inactive and abandoned landfills across the state;
2. provide easy access to that list through the Internet and other more traditional media for developers, realtors, planners and potential homeowners;
3. work with these external groups to determine what information would be the most valuable to them; and
4. rank unmonitored old, closed landfills to determine which of these sites should be investigated to determine if there are private wells nearby that should be sampled.

More information regarding residential encroachment and the issues faced by the different Bureaus involved can be found in the paper, "Can Wisconsin's One-of-a-Kind Environmental Monitoring System Adequately Evaluate Its Old, Closed Landfills?" by Jack Connelly and Diane Stocks, dated July 1999. Contact the Bureau of Waste Management for a copy.

The three bureaus involved in the workgroup have taken several steps to implement the recommendations listed above. Information is being collected for a GIS layer of locations for all the sites listed on the Registry of Waste Disposal Sites using Global Positioning System (GPS) and digitizing from blueprint plan sheets. Over the past year we have digitized the location of 230 landfills with plan sheets and have just begun GPS locating smaller landfills that do not have plan sheets. Landfill characteristics are also being collected for all the Registry Sites. In the future, we hope to link the two databases and provide this information to potential homeowners, planners, realtors, etc. using a mapping interface.

The Bureau of Waste Management was also concerned staff was not aware of some old, closed landfills that are impacting groundwater. Program staff used several reports from the Groundwater and Environmental Monitoring System to do a rough screening of old, closed town, city and village landfills with monitoring wells. Fifty-five landfills were identified as needing further attention and each of the regions is currently doing a more detailed evaluation of these landfills.

Over the past year the bureau has under taken a study of 31 landfills accepting municipal solid waste, to try to determine whether VOC contamination in groundwater at these landfills is increasing, decreasing or remaining stable. We chose sites with 10 years of data and summarized the trends over this period of time. One purpose of this study is to determine whether natural attenuation is occurring in groundwater near leaking landfills. The findings of this study will be available in September 2001.

The Bureau of Waste Management and the UW Stevens Point received funding from July 1999 to July 2001 to evaluate the effectiveness of chemical oxygen demand (COD) as an indicator parameter at landfills. One reason for evaluating COD is that mercury waste is generated when COD is analyzed in the laboratory. The Department's overall goal is to reduce amount of mercury that gets into the environment so eliminating COD sampling at the 400+ landfills that currently sample for it would help us meet that goal. Preliminary findings from the first year of the study indicate that there may be potential to eliminate COD monitoring. The second year of the study is evaluating alternatives to sampling for COD and the findings will be available in September 2001.

Bureau for Remediation and Redevelopment

The Bureau for Remediation and Redevelopment (RR) program implemented several actions that have influenced responses to contaminated groundwater.

Cleanup of groundwater contamination - The program used the Environmental Fund to initiate or continue environmental cleanup actions at approximately 45 locations where groundwater contamination is known or suspected. The Environmental Fund is used when contamination is significant but private parties do not undertake the cleanup because no one has legal responsibility for the contamination, the person(s) legally responsible do not have the financial ability to proceed, or the responsible person simply refuses to proceed. Private contractors conduct these cleanups with oversight by Department staff. The program spends an average of $5 million per year from the fund to address contamination at new and continuing project sites. Whenever feasible, the RR program and legal staff attempt to recover costs from responsible persons after the cleanups are undertaken.

Brownfields program - In FY 01, the RR program implemented a new program called the Brownfields Site Assessment Grant (SAG) program. This program provides for up to 80% reimbursement for eligible activities to local governmental units. Eligible activities include: site assessment and investigation, demolition, asbestos abatement, removal of petroleum and hazardous substance storage tanks and removal of abandoned containers. The significance of the SAG program for contaminated groundwater is as a funding source for (1) removal of potential sources of groundwater contamination, and (2) site investigations to determine whether groundwater is contaminated, including the determination of the extent and degree of contamination. The SAG program does not fund remediation activities but funds preliminary activities to determine whether remediation is necessary.

The Natural Resources Board approved emergency and permanent versions of NR 168 used to select eligible sites for funding. Grant awards were made on the basis of scores of the applications submitted by local governmental units for specific eligible sites. Eligible sites are abandoned, idle or under used industrial or commercial facility or site whose expansion or development is adversely affected by actual or perceived environmental contamination. Sites are eligible for funding only if the persons responsible for the contamination are unknown, cannot be located, or cannot pay for the activities for which grant funding is requested.

The total amount requested was more than twice as much as the amount available for grant awards. DNR awarded $1.45 million to 35 different local governmental units at 49 sites selected from a total of 111 applications. Communities of less than 30,000 people received 30 grants with the remaining 19 grants going to larger communities. The SAG awards will fund the investigation of the extent and degree of groundwater contamination at fifteen sites and the removal of nearly 60 underground storage tanks, which are potential sources of groundwater contamination.

The RR program continues to provide redevelopment assistance at brownfield sites with groundwater contamination. RR staff assist local governments and private businesses with the cleanup and redevelopment of abandoned or under-used properties where redevelopment is hindered by contamination. In many cases these properties have groundwater contamination or contamination that poses a threat to groundwater. Staff provide technical and financial assistance. Also, the RR program continues to provide number of different assurance letters related to properties with groundwater contamination. General Liability Clarification Letters provide assurances to parties involved with voluntary cleanup sites so that they can buy or redevelop brownfield properties without

concern about liability. "Off site" letters are provided to owners of property who demonstrate that the contamination under their properties did not originate on the property. These letters facilitate development of the property while the Department provides oversight of the cleanup being conducted by the person responsible for the contamination. In addition, lease letters are provided to lessees who rent properties overlying contaminated groundwater. These letters clarify the activities that lessees may undertake in order to remain free of liability for the contamination. Other assurance letters are also provided to lenders and local governments.

The RR program also continues to assist parties with voluntary investigations and cleanups of Brownfield properties through the Voluntary Party Liability Exemption (VPLE) process. After a person has conducted an environmental investigation of the property, and cleaned up soil and groundwater contamination, the Department will issue a "Certificate of Completion" which provides a release from future liability for any contamination that occurred on the property prior to issuance of the certificate. In March of 2001, the RR program began allowing parties to obtain a Certificate of Completion for sites that have not met groundwater standards if they could demonstrate that natural attenuation is effective (see the section below for further discussion of natural attenuation closure) and they paid for environmental insurance coverage. The state has entered into this insurance policy to cover the cost to cleanup contaminated groundwater if natural attenuation fails at VPLE sites.

Dry Cleaner Environmental Response Program - The rule to implement the new Dry Cleaner Environmental Response Program, NR 169, became effective in February 2000. The program reimburses eligible costs associated with the cleanup of soil and groundwater at sites contaminated by dry cleaning solvents. Fees paid by the dry cleaning industry provide program funding. Environmental cleanup at dry cleaner sites will be conducted following the NR 700 rule series.

Site closure rules - NR 746 (and its counterpart, Comm 46) was promulgated in February 2001. The bulk of the rule establishes risk and closure criteria to determine whether petroleum contaminated sites can be closed using natural attenuation as a final remedy for groundwater contamination. NR 746 also defines which petroleum-contaminated sites DNR and Department of Commerce have authority to administer; summarizes site investigation requirements, and delineates other administrative requirements such as when remediation and remediation funding is terminated, tracking and transfer of sites, staff training and dispute resolution. The rule provides that sites with contamination in low permeability (clay) materials can close after a site investigation if all risk criteria are met and the groundwater contamination is stable or receding. For contamination in permeable materials, sites must meet all risk criteria and demonstrate through monitoring that groundwater contaminants are declining. A groundwater use restriction must be recorded for sites closed with groundwater contamination above NR 140 enforcement standards. Depending on the extent of soil contamination remaining at a contaminated site, a deed restriction may also be required.

GIS Registry - The NR 746 rules also implement a GIS registry of closed remediation sites to replace the requirement to record groundwater use restrictions at the County Register of Deeds Office. This database will be available on the internet for public access and use by the end of 2001. (Another database, the Bureau of Remediation and Redevelopment Tracking System (BRRTS), has been available on the internet for public access for the past year. These two databases are linked for greater ease of information access). The GIS registry will include locational information on sites closed with residual groundwater contamination above the NR 140 enforcement standards, as well as site specific information pertaining to where the contamination is on the property in question and at what concentration it was found at the time the closure decision was made. This database is to be used with well construction requirements for private wells, and with a setback distance for new municipal wells. The Department is providing the information from the database to Diggers Hotline. When well drillers contact Diggers Hotline before drilling, Diggers Hotline will then inform the Department that a well is proposed for a property listed on the Registry. The Department will then contact the driller and advise them that special well construction features may be necessary, and that they must contact the Bureau of Drinking Water and Groundwater prior to any well construction activities. BRRTS is also available for locating potential contamination sites when evaluating new municipal well placement. These databases make site specific information on open and closed remediation sites much more available and accessible to the public and specific interested groups, particularly those wanting to install or replace a potable well on an affected property, as well as those buying properties. Sites

regulated by the Department of Commerce are also included in the GIS Registry of Closed Remediation Sites and BRRTS.

Bureau of Watershed Management

Wastewater Discharges - The Bureau of Watershed Management continued to issue WPDES permits to all communities and industrial facilities which discharge treated domestic or industrial wastewater to groundwater through land treatment/disposal systems. These systems are primarily spray irrigation, seepage cell and ridge & furrow treatment systems. WPDES permits, issued to these facilities, contain groundwater monitoring and data submittal requirements which are used to evaluate facility compliance with ch. NR 140, Wis. Adm. Code, groundwater quality standards. Permits issued to new municipal discharges to groundwater via seepage cell systems reflect the more stringent effluent limits for total nitrogen and chloride contained in ch. NR 206, Wis. Adm. Code. Groundwater monitoring systems at existing facilities are evaluated and upgraded, as necessary, at permit re-issuance.

A study of elevated iron and manganese concentrations in groundwater at industrial wastewater land treatment/disposal sites, conducted by the Mid-West Food Producer's Association (in conjunction with the University of Wisconsin - Madison), was submitted to the Department in May of 2001. Watershed Management Program staff is currently reviewing this study.

The Bureau of Watershed Management continues to assist unsewered communities, served by failing or inadequate individual on-site treatment systems in their efforts to construct centralized wastewater treatment facilities. Rules have been adopted to establish the Department's authority for permitting systems with flows greater than 12,000 gallons per day. A Memorandum of Understanding (MOU) between the Department of Natural Resources and the Department of Commerce has been created to establish respective regulatory authority for subsurface systems. The MOU indicates that DNR has permitting and design approval authority for large-scale systems (flows greater than 12,000 gallons per day) and joint authority for systems that dispose of mixed domestic and industrial wastewater to the subsurface.

Septage and Sludge Management - The Bureau of Watershed Management implements the regulations in chapters NR 113, NR 204 and NR 214, Wis. Adm. NR 113 relates to septage management and NR 204 governs the treatment quality, use, and disposition of municipal wastewater treatment plant sludge. NR 113 and NR 204 incorporate federal septage and sludge standards. The Bureau regulates the land application of industrial sludge, liquid wastes and by-product solids through NR 214. Chapters NR 113, NR 204 and NR 214 contain treatment quality standards and land application site requirements and restrictions that are designed to prevent runoff to surface water or leaching of nutrients and pollutants to groundwater.

The Bureau continues to develop and implement a new statewide computer system that records and monitors treatment and disposal of municipal sludge, septage, and industrial land applied wastes. This system includes an inventory and a history of all sites used for land application. Wisconsin became the fourth state delegated authority by EPA to implement municipal sludge regulations, through it's delegated NPDES (WPDES) permit program, in July of 2000.

Agricultural Runoff - NR 243 permitting is ongoing for 116 operations (66% dairy; 23% poultry; 11% swine & beef). Of the 116 operations, there are 107 existing permittees and 9 operations are seeking permits for the first time. Regional and central office staff are continuing efforts to maintain the permit backlog at less than 10%. The trend of growing numbers of permit applications for operations with 1,000 or more animal units is expected to continue. The development of performance standards and prohibitions as part of the Nonpoint Redesign Initiative is intended to further address impacts from animal feeding operations with less than 1,000 animal units.

A team of DNR staff has been reviewing U.S. EPA's proposed revisions to regulations for Concentrated Animal Feeding Operations (CAFOs). The proposed revisions include proposals to reduce the threshold at which an operation is considered to be a CAFO from 1,000 animal units to 750, 500 or 300 animal units. The proposed

revisions include an attempt to address discharges to groundwater with a direct hydrologic connection to surface waters. The team recently completed its review and submitted formal comments to the U.S. EPA on the proposed revisions.

Storm Water – DNR has designated approximately 70 municipalities to receive a municipal storm water permit under ch. NR 216. Municipality designations include those around Madison, Eau Claire, Milwaukee, Racine, Waukesha, West Allis and Sheboygan that were identified to be significant contributors of storm water pollutants to waters of the state. The storm water industrial program is currently putting significant energy toward the non-metallic mining industry to get quarries under permit coverage and also on compliance issues related to the auto and scrap recycling industry. The Department is developing performance standards (i.e. 80% sediment control, infiltration, peak flow, buffer requirements, etc.) that may become promulgated in fall of 2001. These standards will affect storm water permits, especially for new development. EPA phase II storm water regulations will require construction sites down to 1 acre, and many other smaller urbanized municipalities, to obtain permits by March 2003. The storm water program will be working on revised rules for performance standards and phase II rules over the next couple years.

Nutrient Management Plans – One of the performance standards included as part of the Redesign effort was a nutrient management standard, NRCS Standard 590. The Department is currently reviewing comments received as part of the second round of public hearings on the proposed Redesign rules.

For more information, contact Susan Sylvester at 608-266-1099 or *sylves@dnr.state.wi.us*, or Mike Lemcke at 608-266-2104 or *lemckm@dnr.state.wi.us*, DNR, P.O. Box 7921, Madison, WI 53707-7921.

DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION

Protecting Wisconsin's groundwater is a 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 pesticide management plans (PMPs - previously known as 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 PMP describing how the state will manage the pesticide to protect groundwater. The generic PMP presents a comprehensive review of Wisconsin's regulatory and non-regulatory efforts to prevent groundwater contamination due to pesticides. This generic plan will serve as a framework for pesticide-specific PMPs that will be required by the EPA for four 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 2001 growing season increased the number of atrazine use prohibition areas, based on groundwater sample results available as of September 2000. A set of 103 maps of new or existing prohibition areas is available from the Water Quality Section covering 1.2 million acres that have been incorporated into the rule. 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 re-sampling 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, FY 98, FY 99, and FY 00 with similar results. DATCP hopes to conduct this survey annually to analyze contamination trends in prohibition areas. In 2000, approximately 50 private wells that have historically exceeded groundwater standards were sampled.

In 1985 the Department of Agriculture Trade and Consumer Protection began a 2-year study funded by the Wisconsin Department of Natural Resources (DNR) to evaluate the potential impact of agriculture on groundwater quality. The study focused on areas of the state with high groundwater contamination potential. In 2000, this study entered its 15th program year. DATCP's Water Quality Section maintains a network of monitoring wells that are primarily used as an early warning system for pesticides new to the marketplace. In 2000, 37 samples from monitoring wells near 22 agricultural fields were sampled. A total of eight compounds were detected in groundwater. Two of these (nitrate and atrazine + metabolites) were found at levels above an existing enforcement standard. Other compounds detected include alachlor ESA, metribuzin, metolachlor, cyanazine amide and simazine.

In FY 98, DATCP began sampling monitoring wells in 17 selected fields across the state. These fields are located in prohibition areas in which atrazine has not been used since 1993. Ch. ATCP 31, Wis. Adm. Code requires DATCP to collect scientific data to show if renewed use of atrazine in prohibition areas will cause further groundwater contamination. Quarterly sampling for this project will continue for five years. Although it is too early in the project to make recommendations, 1998, 1999 and 2000 summary data showed that atrazine concentrations increased at all but one site. One or more wells at 59% of sites exceeded the enforcement standard for atrazine (3.0 parts per billion) at some time during the first 2 years of the project. The nitrate enforcement standard was exceeded at 100% of these sites over the same sampling period.

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. During FY 00, DATCP conducted a third survey to compare current groundwater quality to 1994 and 1996 results. In 2000 Water Quality Section staff sampled 336 private wells across the state that included 122 of the same wells sampled in 1996. Results of the 2000 survey are not yet available. 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. The program may also handle point source contamination on farms. To date, 757 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 funded four pesticide research projects during FY 01 with a total commitment of $160,000 over two years. Two-year projects were funded to 1) evaluate pesticide and nitrate leaching on soils receiving manure, 2) evaluate the remediation of soil and groundwater using alfalfa, 3) to screen pesticides for developmental toxicity, and 4) study the effectiveness of phytoremediation of groundwater using aspen trees. 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 01 approximately $200,000 was provided to promote the adoption of nutrient management plans on farms to maximize profitability and to minimize excessive runoff of nutrients to surface and groundwater.

Since 1990, the Agricultural Clean Sweep program has helped farmers dispose of unwanted pesticides, farm chemicals, and empty pesticide containers. Beginning in 1996, the program extended collection services to small agricultural businesses. In FY 01 DATCP provided $371,733 to fund Clean Sweep projects in 36 counties for collection and disposal of waste pesticides and containers. Approximately 254,053 pounds of waste were reducing the potential for inadvertent environmental damage. Approximately $560,400 will be available during FY 02 for these projects.

For further information, visit the web site or contact Mr. Nicholas Neher, DATCP, 2811 Agriculture Drive, P.O. Box 8911, Madison, Wisconsin, 53708-8911; phone: 608-224-4567; e-mail: *nicholas.neher@datcp.state.wi.us*.

DEPARTMENT OF COMMERCE

Private sewage systems - A revised private onsite wastewater treatment systems (POWTS) code, Comm 83, was implemented on July 01, 2000. The vast majority of counties chose not to delay use of some of the new (to Wisconsin) technologies the revised code permits. Even with the availability of additional onsite treatment options, based on plan review and permit activities, it is apparent that most property owners are choosing to install the same

types of onsite systems that were available under the previous code. Nine manuals for standard system designs are referenced in the code. The majority of the designs are being selected from the conventional, mound, pressure distribution, at-grade, and holding tank component manuals. A significant addition to the plan review and permitting process is the requirement for written management and contingency plans for each onsite system design. These plans are intended to alert the owners of onsite systems to the need for regular inspection, servicing and/or maintenance. These plans provide for mandatory system maintenance schedules and reporting of maintenance events over the life of the system. To help insure that the maintenance is properly performed, training classes and workshops for "POWTS Maintainers" have been held by private vendors and the University of Wisconsin – Extension.

Petroleum Product and Hazardous Substance Storage Tanks - The State Administrative Code Chapter Comm 10 regulates flammable and combustible liquids and hazardous substance liquids on the CERCLA list. The regulatory authority for the storage tank program is within the Division of Environmental and Regulatory Services (ERS) in the Department of Commerce. The ERS Division has three bureaus: Bureau of Storage Tank Regulation, Bureau of Retail Petroleum Services, and the Bureau of PECFA.

The ERS division continues to maintain regulatory oversight of the Federal EPA Underground Storage Tank (UST) upgrade compliance deadline that was December 22, 1998. Systems that did not meet the upgrade requirements after the deadline were "red-tagged" and taken out of service. Some facilities were placed in a "temporary-out-of-service" status and given one additional year to upgrade or be permanently closed. Prior to October 1999 Wisconsin State Statute did not designate or authorize the department regulatory authority for the non-flammable/combustible hazardous substance tanks included in the federal rule. Hazardous substance tanks have been brought into regulatory authority by 1999 Wisconsin Act 9, but, have not at this time been implemented through administrative rule, which is currently under revision.

Since 1991 the database inventory of petroleum product tanks regulated under Comm 10 has increased from 143,681 to 174,725 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 June 28, 2001 the database reflects 78, 399 federally regulated tanks with only 12,980 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, spill and overfill protection, and record keeping. Permit renewal administrative review includes compliance assessment of the owner's financial responsibility.

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 storage tanks 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). Aboveground bulk storage facilities are being evaluated for compliance with release prevention upgrade requirements due in 2001.

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.

Petroleum environmental cleanup fund act (PECFA) - The PECFA program from August 1989 through May 2001 has reimbursed petroleum storage tank system owners approximately $1.05 Billion to remediate petroleum contamination both in the soil and groundwater. The program, in addition to auditing owner invoices and

authorizing payments, performs technical reviews of site investigations, remedial options, and grants closures for 65% of the State's LUST sites.

The 1999-2000 Budget Bill passed in late October authorized a $270 M bond to "pay down" the backlog of audited claims awaiting payment. This bond and annual spending authority ($94 M) has resulted in the payment of over 5,000 claims in Fiscal Year 2000. In anticipation of the bond the PECFA Claims Section reduced the time that a regular claim is in house before a review decision is completed from approximately 11 months to 3 months. The petroleum inspection fee supports PECFA's spending authority.

The department continues to use competitive bidding to establish a reimbursement cap for cleanup activities at contaminated sites. All sites which will cost the PECFA program more than $60,000 must be competitively bid (exemptions available) through case closure. Competitive bidding allows environmental consulting firms to review the site investigation report and in compliance with the bid specifications, submit a cost through case closure. This bidding process establishes the lowest cost cleanup and a cost cap through case closure. Additionally, the site owners understand more clearly what remedial efforts are necessary to obtain closure. The DNR and Comm have completed the bidding process for 160 sites. The department currently reviewing existing sites that have been reimbursed >$200,000 and early results indicate that upon contact many of these sites will be requesting closure hereby halting the continued exhaustion of PECFA resources.

For more information, contact Mr. Ron Buchholz, Acting Administrator, P. O. Box 7839, Madison, Wisconsin 53707-7839, phone: 608-266-7605, fax: 608-267-0592; e-mail *rbuchholz@commerce.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 and are submitted through the rule-making process as amendments to ch. NR 140, Wis. Adm. Code. DHFS staff are completing work on recommendations for two additional groundwater enforcement standards and revisions of three existing enforcement standards.

DHFS staff are the primary resource for information about the health risks posed by drinking water contaminants, and are charged with investigating suspected cases of water-borne illness. Toxicologists, public health educators, and epidemiologists employed in the Department's Division 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(s) 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.

DHFS staff have been active in research and outreach activities relating to naturally-occurring arsenic in groundwater in Winnebago, Outagamie and Brown Counties. Long-term exposure to arsenic in drinking water has been shown to contribute to increased risk of skin, lung and bladder cancers, as well as a number of cardiovascular and dermatological problems. Other conditions that may be related to arsenic exposure include diabetes and adverse reproductive outcomes. DHFS staff received a grant from the GCC to conduct a follow-up investigation on the relationship between exposure to inorganic arsenic in water and health outcomes. As part of this research effort, local health departments, DNR and DHFS staff, town clerks and others have carried out well sampling campaigns in 15 townships in Winnebago and Outagamie counties. To date, nearly 2000 families have completed questionnaires aimed at assessing arsenic-related health outcomes. Three more township campaigns are planned for the summer of 2001. It is hoped that this sampling will continue to increase awareness of arsenic in well water as a potential health concern.

Recent groundwater-related publications and presentations by DHFS staff:

Knobeloch, L., B. Salna, A. Hogan, J. Postle and H. Anderson. Blue babies and nitrate-contaminated well water. Environmental Health Perspectives, vol. 108, no. 7, July 2000.

Knobeloch, L., and C. Warzecha. Cancer Incidence among Consumers of Arsenic-Contaminated Groundwater. Poster presented at the 4th International Conference on Arsenic Exposure and Health Effects, June 2000.

For more information, contact Henry Anderson, Lynda Knobeloch or Mark Werner, 1 W. Wilson St., Rm. 150, Madison, Wisconsin, 53701; phone: 608-266-1253 (Henry), 608-266-0923 (Lynda), or 608-266-7480 (Mark).

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

The Wisconsin Geological and Natural History Survey (WGNHS) performs basic and applied groundwater research and provides technical assistance, maps, and other information and education to aid in the management of groundwater resources. The WGNHS groundwater program is complemented by geology and soils programs that provide maps and research-based information essential to the understanding of groundwater recharge, occurrence, quality, and movement.

In FY 01, 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 more complex questions about groundwater flow, contaminant transport, 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 and USGS cooperate in measuring monthly groundwater levels in a monitoring network of 145 wells. WGNHS researchers collect and describe geologic samples from 250 wells per year.

The WGNHS serves as the repository for Well Constructor's Reports, one- to two-page reports that are usually submitted to the DNR by a well driller within a few years of a well's completion. In cooperation with the DNR, the WGNHS continues to review, sort, and catalog approximately 18,000 well construction reports per year. Approximately 400,000 of these reports are on file at the Survey. The 1999 initiative to carry out computer scanning and basic database entry for all well construction reports in the WGNHS files to support DNR's source-water assessment program has been completed. We are now moving forward to make the database and scanned images available to state agencies, consulting firms, and private well owners. The computerization of these records will allow WGNHS to streamline our record keeping and provide better, more usable information to the public. Wells continue to be added to the database during our county and regional studies. The development of a separate statewide database for approximately 36,000 geologic logs and drillholes that have complete lithologic information will be continued.

Geologic and groundwater studies at the county scale continue to be an important part of WGNHS programs. During FY 01 the Survey published a report about the Dane County groundwater flow model, which was developed by WGNHS and USGS hydrogeologists. The groundwater model is being widely used for evaluating future pumping, well placement, and wellhead protection scenarios in Dane County. The model is also being used as a framework for the additional study of important springs in several parts of the county (Token Creek, Pheasant Branch Creek, and Nine Springs). During FY 02 the WGNHS will continue to assist with these spring investigations in cooperation with UW-Madison and USGS personnel.

In response to the DNR's request for assistance with source-water assessment studies, the WGNHS initiated, with cooperation from the USGS, new county groundwater studies in Sauk, Rock, and La Crosse Counties during FY

00; these studies will be completed during FY 02. Each of these studies will develop a countywide groundwater model and will delineate zones of contribution for municipal wells in the counties. In addition, a similar study for Fond du Lac County will be initiated in FY 02.

The WGNHS is also undertaking major studies of the hydrogeology of southeastern Wisconsin in cooperation with the Southeastern Wisconsin Regional Planning Commission (SEWRPC) 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. During FY 02 the WGNHS will continue to investigate the Maquoketa, and is conducting detailed hydraulic tests of the properties of the shale.

For the past two years the WGNHS has cooperated with the DNR, USGS, and SEWRPC in the construction of a regional groundwater model of the seven-county SEWRPC region in southeast Wisconsin. This model is scheduled for completion in mid-2001; it represents a state-of-the-art analysis of groundwater flow in this largely urban area. With assistance from the DNR and UW-Milwaukee personnel, the model will be used to delineate contributing areas for more than 200 municipal supply wells in the region.

Carbonate rocks (limestone and dolomite) underlie much of Wisconsin and form important aquifers over large parts of the state. Groundwater in carbonate rocks often moves through fractures and solution features. Groundwater velocities in such rocks can be unusually high, and the rocks usually have very low ability to attenuate contaminants. Consequently, carbonate rocks are very vulnerable to groundwater contamination. Predicting groundwater flow in fractured carbonate rocks is challenging because these aquifers tend to develop two-component flow systems: rapid flow through small, discrete fractures and slower flow, but significant storage, in the matrix blocks. Work by the WGNHS on carbonate aquifers in eastern Wisconsin suggests that detailed stratigraphic analysis, coupled with geophysical and hydrogeologic data, may help predict the hydraulic properties of these complex and vulnerable aquifers.

Groundwater recharge is critical to maintaining the supply of Wisconsin's groundwater, but mapping and quantifying recharge areas and rates can be a difficult process. In cooperation with UW-Madison, the WGNHS has developed a computerized technique for rapidly delineating recharge areas for use in regional groundwater models. This method couples GIS techniques with basic landscape data and rainfall-runoff modeling and is being tested in Dane County.

Rural land use has become an important topic affecting groundwater resources. During FY 02 the WGNHS will initiate a new project, with DNR funding, to study the effects of rural subdivisions in Dane County on groundwater quality. This project will be carried out with the cooperation of the Dane County Executive and local builders' organizations.

The WGNHS is engaged in a multi-year mapping effort to develop a new map of the buried bedrock surface in southeastern Wisconsin. The complex geologic relationships are being studied to support the ongoing groundwater modeling efforts in that rapidly urbanizing part of Wisconsin.

Over the past few years, the WGNHS has developed a program of research and public education on groundwater movement in carbonate rocks, and has provided assistance to various agencies facing carbonate-rock problems. Examples of recent work include completion of a wellhead protection project for the City of Sturgeon Bay, completion of a project characterizing the hydrostratigraphy of the Sinnipee dolomite, assistance to the DNR in

selected regulatory issues, including aquifer storage and recovery project in Green Bay and advice to local committees developing wellhead-protection guidelines in Door County.

In October 2001 the WGNHS will co-host the Midwest Groundwater Conference, a technical conference that will draw participants from across the Midwest.

In the past few years, arsenic and other trace metal contaminants have been detected in numerous private wells in northeastern Wisconsin. Beginning in early 1999 and continuing in 2000, Survey personnel have assisted DNR and other officials regarding the problems of elevated trace metals in these wells and also elevated dissolved solids, particularly sulfate and chloride, in deep municipal wells in eastern Wisconsin. During FY 02 the WGNHS will continue to devote appropriate staff time to these problems, with the goals of compiling existing geologic, hydrogeologic, and geochemical information, developing investigative priorities for focusing further study, and identifying possible solutions or mitigation strategies. In addition, the Survey will carry out geophysical logging of problem wells at the DNR's request.

The WGNHS, with DNR support, is carrying out research on the source(s) and geochemical characteristics of arsenic contamination in water-supply wells in northeastern and southeastern Wisconsin. In FY 00 the WGNHS collected rock and groundwater samples in the Lake Geneva area. During FY 02 the WGNHS will present the results of this work and begin a field experiment in the Fox River Valley.

The WGNHS has also been actively assisting the DNR in its review of the proposed massive sulfide mine near Crandon, Wisconsin. This review includes development and testing of groundwater flow and contaminant transport models being used to evaluate the potential effects of the mine on local groundwater and surface-water features.

Research projects completed this year or in progress include:

1. Hydrogeology of Sauk County
2. Hydrogeology of Rock County
3. Hydrogeology of La Crosse County
4. Field verification of well capture zones for the City of Sturgeon Bay
5. Hydrogeologic properties of the Maquoketa shale
6. Hydrostratigraphy of southeast Wisconsin
7. Regional groundwater flow model of Southeast Wisconsin
8. Hydrogeology of Dane County
9. Investigation of arsenic contamination of groundwater in northeastern Wisconsin
10. Development of new methods for determining groundwater recharge rates
11. Review of material submitted regarding proposed mine near Crandon, Wisconsin
12. Investigation of the effects of rural subdivisions on groundwater quality.
13. Source-water protection for Fond du Lac County

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

Recent WGNHS Publications

Bulletin 99: Pleistocene geologic map and cross sections of Waukesha County, Wisconsin. 2001. L. Clayton. Two full-color plates (scale 1:100,000).

Miscellaneous Map 49: Water-table elevation of Buffalo County, Wisconsin. 2000. W.G. Batten and A. Zaporozec (scale 1:100,000).

Miscellaneous Map 51: Groundwater quality investigation maps of Price County, Wisconsin. 2000. Compiled by P.D. Roffers and K.J. Cates. Plate 1: Nitrate as nitrogen. Plate 2: Chloride. Plate 3: Alkalinity. Plate 4: Total hardness. Plate 5: Electrical conductivity. Plate 6: Ferrous iron. (Scale 1:100,000.)

Open-File Report 2000-01: Hydraulic conductivity and specific storage of the Maquoketa shale. 2000. T.T. Eaton, D.J. Hart, K.R. Bradbury, and H.F. Wang, 31 p.

Open-File Report 2001-01: Field verification of capture zones for municipal wells at Sturgeon Bay, Wisconsin. 2001. K.R. Bradbury, T.W. Rayne, and M.A. Muldoon, 29 p.

Web site: Information about karst. 2000.

DEPARTMENT OF TRANSPORTATION

The DOT regulates the storage of highway salt (ss. 85.17 and 85.18, Wis. Stats.) to protect the waters of the state from harm due to contamination by dissolved chloride. DOT is also responsible for potable well sampling at 29 rest areas and 113 waysides. Other DOT groundwater related activities include: road salt research; hazardous material and waste investigation or remediation; wetland compensation and research; and storm water management and research. Various divisions and sections in DOT are involved with these activities:

- Salt Storage - Bureau of Highway Operations and District 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. A pilot project for a consultant to perform storage facility inspections was completed in 1999/2000. A full season of storage facilities inspections was performed by the consultant in 2000/2001 and will continue in 2001/2002.

All salt must be covered and stored on an impermeable base. The base for stockpiles is required to function as a holding basin and to prevent runoff. The covers must consist of impermeable materials or structures to prevent contact with precipitation. State funded facilities are being added to the DOT salt storage program so that more indoor storage is available. This will improve groundwater protection and it creates greater flexibility for scheduling salt purchase at optimal prices.

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 tested to record and verify application rates and coverage effectiveness. New technology equipment (e.g., zero-velocity spreaders, ground speed controllers, and onboard liquid pre-wetting 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. This system consists of temperature sensors and remote processing units, which determine and record temperatures of road pavements at 54 separate statewide locations along major highway routes. The pavement temperature information helps determine the sand and salt application rates. Annual training for proper

snowplowing and salt spreading techniques is provided for county snowplow operators, and the counties provide weekly reports of salt usage.

During the 1997-98 winter season several counties began using alternative anti-icing and deicing chemicals on test sections in an effort to reduce the amount of chlorides applied to pavement and impacts on groundwater. Use of pro-active anti-icing techniques should result in lower chemical usage and reduce total winter maintenance costs.

During the 1998-99 winter season: 7 counties used liquid $MgCl_2$ for pre-wetting or anti-icing as direct spray on pavements and bridge decks for anti-icing; 2 counties used Ice Ban M-50 (50% corn based by-product and 50% $MgCl_2$) as direct spray on bridge decks; 13 counties used Ice Ban M-50 as a pre-wetting solution for road salt applications; and 6 counties used $MgCl_2$ as a pre-wetting solution for road salt applications.

During the 1999-00 winter season: 22 counties used liquid $MgCl_2$ for pre-wetting or anti-icing; 8 counties used Ice Ban M-50 for pre-wetting or anti-icing; 9 counties used M50 Road Deicer (50% sugar based by-product and 50% $MgCl_2$) for pre-wetting or anti-icing; and 10 counties used salt brine for pre-wetting. The result of these changes was a decline in statewide salt use for highways. Salt use for the winter of 1999-2000 (state trunk highway system only) was approximately 376,000 tons compared to the previous 5-year average of 395,000 tons.

During the 2000-01 winter season: 30 counties used liquid $MgCl_2$ for pre-wetting or anti-icing activities; 16 counties used either Ice Ban M-50 or M-80 or M-50 road deicer (50% corn-based byproduct and 50% $MgCl_2$) for pre-wetting or anti-icing; and 21 counties used salt brine for pre-wetting or anti-icing. Salt use for the winter of 2000-2001 (state trunk highway system only) was approximately 521,000 tons due to the above normal snowfall and winter weather conditions.

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). The next progress report is due in 2002.

Hazardous Materials (Petroleum) and Hazardous Waste - As part of the highway improvement program, DOT performs an estimated 25 to 75 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, 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 15 to 25 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). DOT manages about 7,500 to 15,000 tons of contaminated soil per year and about 5 million gallons of contaminated water per year.

Wetlands - Compensatory wetland mitigation is required under section 404 of the Clean Water Act for transportation projects. DOT completed a cooperative study with the U.S. Geological Survey on groundwater of three wetland compensation projects. The final report on this study, *Hydrogeological, Geomorphological, and Vegetative Investigations of Select Wetland Creation and Restoration*, was completed February 1999, and is available. 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 an interagency approved wetland mitigation banking program. Currently wetland loss due to highway, bridge and airport may be compensated through the bank system. As of December 31, 2000, there have been 1,719 wetland acres lost to 958 DOT construction projects throughout the state since 1990. This loss was compensated by 2,434 acres of wetland restoration and creation. Thirty wetland bank sites have been planned and constructed. There are 17 constructed bank sites containing 1,574 available wetland acres. Six bank sites containing 391 acres have been closed. The percent acres compensated through the bank is currently 61%, while remaining compensation is done on or near specific transportation projects. During calendar year 2000 there were 143 construction projects that caused 46 acres of wetland loss, which compensated at bank sites (53 ac.), on-site (7 ac.) or near-site (4 ac.).

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. 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 to verify the effectiveness of various storm water treatment devices.

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, or e-mail *carol.cutshall@dot.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 01 the UWS directed a wide-ranging program of priority groundwater research consisting of 14 projects. The projects included short-term and long-term studies, and may be either of a fundamental or applied nature. They provide a balanced program of laboratory, field, and computer modeling studies and applications aimed at preserving or improving groundwater quality. The groundwater problems investigated include:

- Investigation of denitrification as a basin-scale control of nitrate concentration and export in Wisconsin aquifers;

- Identification of ecologically important effects of polluted groundwater in a sensitive, efficient, cost-effective invertebrate whole animal assay;

- Determination of factors responsible for the formation and transport of methyl mercury in groundwaters of forested and wetland systems;

- Development, testing, and exploration of new strategies to better model contaminant fate and transport in heterogeneous aquifers with complex reaction networks;

- Application and comparison of techniques for calculating site estimates of groundwater recharge and development of methods for quantifying recharge for groundwater modeling and water resource planning;

- Investigating the use of alfalfa for bioremediation of nutrients in groundwater.

- Development of thin-film microporous absorbents to remove arsenic from contaminated groundwater;

- Assessing macropore flow as means for enhancing groundwater recharge or as a potential source of groundwater contamination;

- Investigating the use of waste foundry sands in reactive walls for remediating groundwater;

- Identifying the hydrologic factors which have caused historical changes in groundwater recharge rates in southeastern Wisconsin;

- Investigating the degradation of chlorinated contaminants by zero valent iron (ZVI) under the catalysis of sorbed surfactant admicelles;

- Assessing the compatibility of lining system materials and mine waste liquids with the intent of determining if materials used for lining systems will function as intended in the presence of mine waste liquids;

- Integrating an artificial neural network (ANN) model in combination with a geographic information system (GIS) and a groundwater quality database to assess nitrate contamination from nonpoint sources at a watershed scale; and

- Evaluation of two agricultural management and fertilization practices on nitrogen levels in groundwater.

The 14 funded projects provided training in several disciplines for post-doctoral research associates, graduate student research assistants, and undergraduate students at UW-Madison, UW-Milwaukee, UW-Stevens Point, and UW-Parkside.

The UWS selected ten new groundwater research projects from this year's Joint solicitation for support during FY 01 (July 1, 2001 – June 30, 2002) (see Table 2). Four projects, selected from the previous year Joint Solicitation, will receive continuation support during FY 02. New projects are centered at UW-Madison, UW-Extension, UW-Stevens Point and UW-Parkside.

Teaching

The UWS institutions continue to offer courses and programs at the undergraduate and graduate levels that focus 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. Specifically, the WRI views education as an important component of its total program. The importance of K-12 education is also recognized as a basic component of the WRI's training program. To address this issue, the WRI distributes its two publications--*Local Watershed Problem Studies-Elementary Activities* and *Local Watershed Problem Studies-Middle and High School Curricula Guide*--on request. These two curricula guides were produced to assist educators in the development and dissemination of curricula concerning soil and water resources. In addition, the WRI Library has purchased several other guides with diverse approaches to teaching water-related issues in K-12 curricula.

Information Transfer

Results of WRI-supported research are published in a variety of forums. Much of the WRI research ultimately appears in refereed professional journals, although results of WRI research can also be accessed as technical reports, conference proceedings and abstracts, book chapters, or as dissertations and theses. During the past fiscal year, a list of all publications resulting from WRI-supported research was added to the WRI Web Site. Copies of the publications housed at the WRI are distributed upon request. Library staff has also begun to add the collection to the UW-Madison Circulation System so that anyone at any UW campus can check out WRIL books online and have the book sent to them through a statewide delivery system.

Water Resources Institute Web Site. The WRI has maintained a Web site since 1995 to provide an efficient means for the transfer of water-related information. The site provides information about WRI programs and staff, funding opportunities, conference information, project summaries, links to other water-related information sources, and an extensive WRI Library Site.

During the past year, WRI staff added the following to the Site:

> The Wisconsin Groundwater Research and Monitoring Project database was added to the Web. This Site presents summaries of groundwater research/monitoring projects completed since 1989. It can be browsed by title or broad subject classifications. Copies of the full reports are available from the Library.
>
> WRI Publications is a listing of publications based on research supported by the Wisconsin Water Resources Institute from 1966-2001. Copies of publications can be obtained from the Library.
>
> The WRI Water Links were updated to include links to Wisconsin water research, groundwater, State Government, and graduate education programs.
>
> The Water Education Place
> a guide to printed water curricula and Web Sites for teachers and kids, was added to the Library Site.

Use of the WRI Web Site has steadily increased from May 2000 through April 2001. In June 2000, 2557 people visited the Site or an average of 85 people per day. By April 2001, the number of visits had increased to 4812 or 160 visitors per day. Visitors also spent more time on average. Initially, the average visit was about 21 minutes long. By April 2000, the average visit was 27 minutes long.

Conferences, Meetings and Presentations. The Wisconsin Water Resources Institute co-sponsored the American Water Resources Association -- Wisconsin Section Annual Meeting on March 29 and 30, 2001 in Green Lake, Wisconsin. The title of this year's meeting was "Water Rich or Water Poor? Water Quantity Issues in Wisconsin". Invited speakers explored the threat to water quantity and quality resulting from increased urbanization, agricultural expansion, climate change, and population growth. Over 35 contributed papers or posters covered a wide range of current research regarding Wisconsin's water resources. This meeting is unique because it especially encourages students to present papers or posters describing their original research. Students funded by the Joint Solicitation are asked to present results of their research at this forum.

The WRI is also co-sponsoring the 2001 annual meeting of the Midwest Groundwater Conference. The WRI web site serves as the home for information on the conference and contains links for on-line registration and abstract submission. The institute is also responsible for all promotion and publication activities of the conference, to be held in Madison in late October 2001.

Water Resources Institute Library. The Water Resources Institute Library (WRIL) maintains a specialized collection of over 21,000 water-related publications and more than 35 journals and 135 newsletters. The collection covers all major topics in water resources, including the water cycle, water conservation, water management, water quality and quantity, point and nonpoint water pollution sources, water law, and aquatic life. The collection is particularly strong in Wisconsin and Great Lakes water resources issues, groundwater protection, wetlands issues, and the impacts of agricultural chemicals. Access to additional water-related indices, databases, full-text journals and eBooks is gained through the University of Wisconsin Electronic Library, Dialog, and the Internet. The Library also maintains a Web Site which serves both as a portal to water-related information on the Web and a guide to the library. The Library also produces "Recent Acquisitions and Web Sites of Interest" monthly and distributes it to approximately 300 university personnel, state agency staff, researchers, consultants, libraries, private organizations and interested citizens.

Since August 1990, the Library has circulated and served as a depository for the reports resulting from the Joint Solicitation of the Groundwater Coordinating Council for research/monitoring proposals. The Library has added these reports to Madcat, listed them in "Recent Acquisitions", and during the past year provided staff to put project summaries on the Web.

The Library's primary clientele are Wisconsin citizens – particularly University of Wisconsin faculty, staff, and students, state government employees, and business and industry. The Library lends documents to non-Wisconsin residents, but only provides other services as time and resources permit. The Library is staffed and open to the public 9 a.m. to 4:30 p.m., Monday through Friday. The entire collection is included in Madcat, the University of Wisconsin online catalog. Anyone with access to the Web can easily search the collection by author, title, or subject.

The WRI Library is one of only two libraries established under the State Water Resources Research Institutes Program. The Library collection, electronic resources and services are built upon long-term cooperation and coordination with other University of Wisconsin and area libraries. Library staff participates in campus library groups, the Special Libraries Association, the Wisconsin Library Association, and other library organizations. Through this coordination, the librarian has built a unique collection and specialized services that do not duplicate the collections or services of other area libraries.

Use of the WRI Library by faculty, students, federal agencies, private consulting firms, and others interested in water continues to increase. Although book circulation statistics for most libraries are declining due to greater use of the Web for information, WRIL circulation remained about constant. During the period 7/00 – 6/01, library staff responded to approximately 1200 requests for individual titles and subject searches. More than 600 UW-Madison faculty, staff, and students, WDNR staff, private consulting firms, and members of the public contacted the WRIL last year.

Library circulation and use statistics only tell part of the story. Web Sites are becoming an important part of library services. Usage of the WRIL Web Site has also grown steadily over the reporting period. In June 2000, 655 people visited the Site or an average of 21 people per day. By April 2001, the number of visits had increased to 1439 or 47 visitors per day. Visitors also spent more time on average. Initially, the average visit was about 10 minutes long. By April 2001, the average was over 15 minutes long.

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 is available statewide and has been integrated into a number of Wisconsin Watershed projects. It is being used as an educational tool for Environmental Quality Incentive Programs and county conservation planning. Commodity organizations are increasingly using Farm*A*Syst as a basis for developing voluntary environmental management assessment systems. For example, the Wisconsin Milk Marketing Board is working to develop a dairy environmental assessment system based on Farm*A*Syst. In Wisconsin, at least 3 Native American nations are using elements of these programs to assist with their efforts to protect and manage natural resources.

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.

This Farm*A*Syst project is being expanded through a $2,500,000 grant to support development and pilot testing of livestock environmental management systems for dairy, beef and poultry. Resulting materials will be pilot-tested in nine states. The Home*A*Syst project is being expanded into a healthy home project which assists users in identifying health risks around the home and taking actions to reduce those risks.

The UW Environmental Resources Center (ERC) provides development and national coordination of a number of youth leader water education materials related to groundwater education. The ERC also provides a national database of youth water education materials, allowing individuals to choose a curriculum appropriate to education goals by searching on approximately 100 water topics and 100 youth education and water education topics. The ERC continues to provide national coordination for a service learning curriculum, Give Water a Hand. The goals of this curriculum 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. New projects include a gap analysis of youth water curricula for source water education and riparian education resources, to help meet goals of the Clean Water Action Plan. We also developed a Leader Institute and Guide for Latino water education and completed an evaluation of USGS water education materials to assist with USGS education program development decisions. Many of these items have been posted on the ERC website in PDF format.

The UW Nutrient and Pest Management (NPM) program mainly serves Wisconsin farmers and the other agricultural professionals who assist them in making management decisions. The primary focus of NPM programs is to improve nutrient management practices to save money and reduce the potential for nonpoint source pollution. The program continues its focused neighborhood approach that works one-on-one with farmers in priority watershed or other critical areas. A parallel NPM focus is increasing educational programs on integrated pest management to assist farmers moving beyond pesticide-dependent cropping systems. Activities include hands-on IPM training for farmers, publications, and field research and demonstration projects.

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. In 1999, two additional positions were added providing educational assistance to approximately 13 basins. The Basin Educators 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 Center publishes a bimonthly newsletter, Keeping Current, which brings information about water issues to more than 1,500 agency staff throughout the state.

UW-Extension coordinates the Multi-Agency Land and Water Education Grant Program which funded ten groundwater-focused projects between July 1, 1999, and June 30, 2001. These projects, which totaled over $150,000 in educational assistance funds, examined the effects of intensive rotational grazing on groundwater quality, provided well testing for rural landowners, and conducted Farm*A*Syst assessments to help farmers identify and address groundwater contamination on their property. Altogether, between July 1, 1999 and June 30, 2001, 60 water quality protection projects totaling $1.1 million have been funded.

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 to helping communities with wellhead protection planning, describing the extent and causes of groundwater nonpoint pollution in Wisconsin, and examining groundwater quantity issues. The Center frequently works through county Extension faculty in program delivery.

In 2000, the Center assisted nearly 3400 households in having their water tested in conjunction with county Extension offices and the UW - Stevens Point Environmental Task Force Program. Of these, 7% exceeded drinking water standards for nitrate-nitrogen. Seventeen percent were unsafe because of coliform bacteria. Twenty percent had moderate to severe corrosivity indexes. Fourteen education programs helped nearly 1200 well users in 7 counties understand potential remedies for these problems and the relationship of land use practices to groundwater quality.

In the last year the Center has provided statewide leadership in evaluating groundwater data related to the possible impacts of the proposed Perrier water bottling plant in south central Wisconsin, as well as education on other aspects of groundwater quantity. The Center has been active in the nonpoint source pollution program redesign, and a leader in education and research into nonpoint problems. It has provided assistance in many of the projects undertaken by the Education Subcommittee in the last year, such as groundwater education at Farm Progress Days.

Center staff are highly involved with agencies and private organizations. These include the Wisconsin Potato and Vegetable Growers Association Nonpoint Pollution subgroup; DATCP Atrazine Technical Advisory Committee; Golden Sands Resource Conservation and Development Area Water Resources Committee; and Extension Nutrient Management Self-Directed Team. Involvement with local watershed based groups includes the Wolf River Basin Partnership and Pigeon River Partnership. The Center has also provided technical assistance to the Portage County Citizens Groundwater Advisory Committee and its subcommittees.

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

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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 nitrate. Each is discussed below, in addition to sections on biological hazards, natural groundwater quality, and arsenic.

Volatile Organic Compounds

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 in Wisconsin's groundwater 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.

Wisconsin has 90 active, licensed solid waste landfills, all of which are required to monitor groundwater. In addition, the DNR currently tracks more than 9,400 LUST sites, 4,000 waste disposal facilities, and about 1,400 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.

Landfills. Two studies conducted over a four-year period revealed that out of 45 unlined municipal and industrial landfills, 27 (60%) had VOC contamination in groundwater. All of these landfills are currently closed. Six landfills with liner and leachate collection systems were also sampled and no confirmed VOCs were detected. VOCs contaminated groundwater at 21 (81%) of the 26 unlined 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 July 1994, the DNR reviewed historical data and sampled groundwater at 11 closed, unlined landfills and at six older, lined landfills. VOC levels have decreased after closure at all but two of the unlined 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, lined landfills.

Over the past few years increasing numbers of residential developments have been located close to old, closed landfills. Further, it has been recently discovered that several of these landfills are impacting groundwater. In 1998 and 1999 the DHFS sampled private wells down-gradient of 19 small, closed landfills in one county. Several of the private wells had results above maximum contaminant levels. The results of this sampling showed that there may be more landfills with serious problems that have not yet been identified.

The DNR Bureaus of Waste Management, Remediation and Redevelopment, and Drinking Water and Groundwater in cooperation with the DHFS, responded to this issue in early 1999 by choosing 16 old, closed landfills – at least three from each of the five regions across the state - that have private wells nearby and may be impacting groundwater. Private wells around each of the landfills were sampled in 1999 and significant levels of contamination were found. Of the 113 wells that were tested, 31 had detects of VOCs. Fourteen of the homes had levels exceeding drinking water standards and have been given health advisories not to drink their water.

Underground storage tanks. Wisconsin requires underground storage tanks with a capacity of 60 gallons or greater to be registered with Commerce. This registration program has identified a total of 174,725 tanks as of June 28, 2001 of which 78,399 tanks are regulated by the federal underground storage tank program. Only 12,980 regulated tanks are currently in use. 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 1, 2001, DNR records indicate there are 4,100 active underground storage tank contamination cleanups and approximately 5,300 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 600 households has been contaminated by leaks from underground storage tanks.

Hazardous substance spills. 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 800 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. The spills program develops outreach materials to help reduce the number and magnitude of spills and provide guidance for responding to spills. Topics addressed include spills from home fuel oil tanks, responses to illegal methamphetamine labs, and mercury spills, all of which can lead to significant environmental impacts, if not properly addressed.

Pesticides

Pesticide contamination in groundwater results from field applications, pesticide spills, misuse, or improper storage and disposal. Serious concerns about pesticide contamination in Wisconsin were first raised in 1980 when aldicarb, a pesticide used on potatoes, 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.

The DNR and DATCP expanded their sampling programs in 1983 to include analysis of pesticides commonly used

in Wisconsin. The most commonly detected pesticides in Wisconsin groundwater are:

- Metabolites of alachlor (Lasso) and metolachlor (Dual)
- Atrazine and its metabolites
- Metribuzin (Sencor)
- A breakdown product of Cyanazine (Bladex). Cyanazine is no longer manufactured.

Federal and state groundwater quality standards for many of these compounds were also adopted. To date, standards for over 30 pesticides are included in ch. NR 140, Wis. Adm. Code.

Chloroacetanilide herbicide metabolites are increasingly being detected in Wisconsin groundwater. In a study completed in 2000, 27 monitoring wells, 22 private drinking water wells, and 23 municipal wells in Wisconsin were sampled for alachlor, metolachlor, acetochlor, and their ethane sulfonic acid (ESA) and oxanillic acid (OA) metabolites. Wells were selected based on previous detections of pesticides or proximity to agricultural fields. Alachlor, metolachlor, and acetochlor are chloroacetanilide herbicides that are commonly used on corn and other crops in Wisconsin. With the exception of alachlor ESA, no historical data exists for these metabolites in Wisconsin groundwater because laboratory methods were not previously available. Over 80 percent of the monitoring wells and drinking water wells contained the ESA and OA metabolites of alachlor and metolachlor. The metabolites of acetochlor showed a lower frequency of detection. Metabolite concentrations ranged from near the level of detection to 42 µg/L. Monitoring wells and private drinking water wells showed higher detection frequencies and concentrations than the deeper municipal wells, but the municipal wells did show significant impacts. Fifty-two percent of the municipal wells had at least one detection. No municipal well had pesticide levels that exceeded an enforcement standard.

Beginning in October 2000, DATCP collected 336 samples from private drinking water supplies to determine the statewide impact of pesticides on groundwater resources. DATCP analyzed the samples for commonly used herbicides including the chloroacetanilide herbicides and their metabolites. While data analysis is not complete at this time it appears that the metabolites of alachlor and metolachlor are more frequently detected than atrazine and its metabolites.

In 1991, the Wisconsin State Laboratory of Hygiene (WSLH) began a public testing program using an immunoassay screening test for triazine-based compounds. The triazine immunoassay screen uses specific antibodies designed to selectively bind to target compounds that are present at low concentrations. This screening test is available to the public at a low cost via an 800 telephone number. DNR funds a part time staff position to assist in the quality control process for data collection and well location verification.

In a recent survey of DNR groundwater databases, more than 14,000 triazine screen results have been recorded. 42% of the samples had a detection for a triazine compound; 13% exceeded the PAL for atrazine of 0.3 ppb; and 1.6% exceeded the ES for atrazine of 3.0 ppb.

The immunoassay triazine analysis detects atrazine and certain similar compounds, but does not detect two of the three atrazine metabolites included in the groundwater standard. While there is no ES for the triazine screen, comparing the triazine results to the ES and PAL for atrazine provides a reference point for the severity of contamination. Atrazine has been used heavily in Wisconsin and there have been relatively few detects of other triazine compounds in groundwater.

In 1997, DATCP investigated differences between the triazine screen and gas chromatography results for atrazine. DATCP, with support from DNR, collected 49 split samples for analysis by the WSLH and DATCP laboratories. Results of this study showed that 33% of the wells that were below the 3 ppb ES for atrazine based on a triazine screen were above the ES level when analyzed by gas chromatography. This is because the triazine screen does not detect all the atrazine metabolites and therefore underestimates the total atrazine concentration. Based on this information, the WSLH now advises homeowners that the triazine screen results should be used for initial screening purposes only. Higher triazine detects often receive a followed-up gas chromatography test.

The following are other DATCP pesticide related studies conducted recently or as part of ongoing research.

Monitoring Reuse of Atrazine in Prohibition Areas - In FY 98, DATCP began monitoring the limited reuse of the herbicide atrazine in selected areas where atrazine use has been prohibited. DATCP is gathering data to see if renewed atrazine use at current restricted use rates will cause groundwater contamination. DATCP is monitoring groundwater quarterly at 17 fields, 10-40 acres in size, for 5 years. In 2000, 238 samples were collected in this program. Preliminary results show an increasing trend of atrazine contamination at coarse textured sites but not at medium textured sites. The atrazine enforcement standard was exceeded at least one time in 9 of the sites.

Pesticide and Groundwater Impacts Study - In 1985, DATCP began a study to determine if normal field application and use of pesticides and fertilizer was causing groundwater contamination at highly susceptible sites (sandy soils, less than 25 ft. to groundwater). As many as 50 different field sites have been sampled. Currently 25 sites are being monitored across the state.

In 2000, a total of eight compounds were detected in groundwater. Two of these compounds (total atrazine and nitrate) were found at levels above an ES. Alachlor ESA, a break down product of alachlor, was detected at 41 percent of the samples. Cyanazine amide, a metabolite of cyanazine first detected in 1997, was found at 9 percent of the sites in 2000.

Atrazine Rule Evaluation Survey - In 1994 and 1996 DATCP conducted sampling programs in private wells to evaluate the restrictions on the use of atrazine in Wisconsin. These surveys were designed to determine how levels of atrazine and its metabolites in groundwater were changing three and five years after the atrazine restrictions went into effect.

A similar survey was conducted in 2000/2001 and the results will be statistically comparable to the first two surveys. Results from this survey will be available in August 2001. A total of seven common herbicides, ten metabolites and nitrate were included in the latest survey. Highlights from this overall study show:

- A significant decline in atrazine concentrations between 1994 and 1996;
- Average atrazine plus metabolite concentration in wells with detections declined from 0.96 to 0.54 parts per billion (ppb) in the two year period, a 44% decrease;
- The frequency of detection of contaminated wells did not show a significant decline from 1994 to 1996.

Surveys of groundwater quality at pesticide storage and handling facilities- The Agricultural Chemical Cleanup Program (ACCP), administered by DATCP, was created primarily to address point source contamination at handling facilities and in nearby wells. Point source contamination on farms is also handled by the ACCP. To date, approximately 300 cases involving soil or groundwater remediation related to spills, misuse, improper storage and other point sources have been identified at facilities and farms. Monitoring groundwater from adjacent private wells and/or installation of monitoring wells is often part of these cases.

Exceedence Survey - From 1995-2000 DATCP has conducted an annual sampling program called the *Exceedence Survey.* This program samples wells that have previously exceeded a pesticide enforcement standard. 148 wells have been re-sampled in this program for common pesticides and nitrate. Most of the wells are in atrazine prohibition areas. About 2/3 of the wells have had a decrease in atrazine concentration from 1995 to 2000.

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). A 1994 study by WGNHS and DHFS estimated that 9 to 14% of private water wells in Wisconsin exceed the nitrate standard. As part of an analysis to provide baseline groundwater data for the State of the Basin Reports, the most recent nitrate sample from each well in the GRN data base was extracted. Of 10,105 well samples, 2016 (20%) equaled or exceeded the enforcement standard of 10 parts per million. In the same data set, 5113 (50%) were equal to or exceeded the PAL. 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. DHFS staff completed a summary of two cases from southern Wisconsin in which infants developed methemoglobinemia after being fed formula that was prepared with well water (Knobeloch et al. 2000). One of these infants required emergency air transport and life-saving therapy. The nitrate levels involved in these cases ranged from 22.9 to 28 mg/L (as N).

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 found that residents who consumed water that was high in nitrate had higher levels of cancer-causing nitroso compounds in their urine (Van Maanen et al., 1996). These researchers also found that genes in the blood cells of these individuals had higher numbers of mutations. Two years earlier, these same researchers had reported a link between consumption of high-nitrate water and the incidence of thyroid disorders (Van Maanen et al., 1994). In 1996, a study conducted jointly by the National Cancer Institute, the University of Nebraska, and Johns Hopkins University found an association between nitrate-contaminated water and Non-Hodgkin's lymphoma (Ward et al., 1996). A large cohort study conducted jointly by the University of Iowa, Mayo Clinic and the University of Minnesota found a positive association between nitrate levels in municipal water supplies and the incidence of bladder and ovarian cancer among adult women (Weyer et al. 2001).

Private water supply wells should be tested for nitrate at the time of installation and at least every five years during their use. In 1989, the GCC endorsed a resolution recommending that newly constructed water supply wells be sampled for nitrate in addition to coliform bacteria. Testing is also recommended for wells used by pregnant women and is essential for wells that serve infants less than 6 months of age.

Nitrate can enter groundwater and surface water from a variety of sources including farm fields, septic tanks, animal feedlots, decaying vegetation, and urban storm water. Contamination is difficult to prevent. Although the Department of Commerce continues to evaluate state-of-the-art septic system designs for nitrate removal, septic tanks continue to be a significant source of nitrate in heavily populated, unsewered areas. DATCP proposed regulatory authority for fertilizer use in the FY 96-97 budget but the proposal was not approved. In 1997, Wisconsin Act 27 required the development of performance standards for a number of agricultural and non-agricultural practices to reduce non-point sources of pollution of surface and groundwater. These performance standards include nutrients applied to cropland and DATCP was directed to develop a nutrient management program. During 2000, DATCP and DNR conducted public hearings and have proposed changes to their non-point pollution control rules to include nutrient management standards and practices. Adoption and implementation of nutrient management standards, based on UW recommendations, would reduce the over-application of nitrogen that occurs on some farms. This would dramatically reduce the amount of nitrate that would be available to leach to groundwater.

Owners of nitrate-contaminated water supplies have few options. They do not qualify for well-compensation funding unless the nitrate level in their well exceeds 40 mg/L (as N) and a dairy herd uses the well. In order to establish a safe water supply, they may opt to replace an existing well with a deeper, better cased well or to connect to a nearby public water supply. Alternatively, they may choose to install a water treatment system or to use bottled water. A 1997 study by DHFS examined this issue. Their survey of 1500 families found that few took any action to reduce nitrate exposure. Of those who did, most purchased bottled water for use by an infant or pregnant woman.

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Biological Hazards

Biological contamination often occurs in areas where there is little natural attenuation potential. This is common in areas where the depth to groundwater or the depth of soil cover is shallow, or in areas of fractured bedrock. 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 (Warzecha et al 1995). 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.

In an effort to address concerns arising from possible airborne bacteriological contamination of wells, the WSLH completed a study investigating the role of air-borne particulates as the cause of unexplained coliform contamination in drilled wells (Trest et al. 1998). Samples were collected from 165 well sites located throughout Wisconsin. 96 of these recently experienced a total coliform positive. Of the 165 wells, 51% contained viable coliform organisms. Of the wells that had previous coliform positive, 61.5% of the air samples tested coliform positive. Of the wells that had no recent coliform positive, 36% of the air samples tested total coliform positive. Wells adjacent to positive air coliform samples were 1.7 times more likely to contain coliform bacteria than wells where the air coliform samples were negative. Wells located near vegetation, barnyards, pets, or fecal material; and samples collected within three hours of a rainfall event or where the grass had been recently mowed had relatively high percentages of air coliform positive samples. The study also determined that coliform bio-aerosols experimentally created near a wellhead are capable of artificially infecting a well.

Researchers at the Marshfield Medical Research and Education Foundation have investigated the association of pathogenic viruses and bacteria in private wells with incidences of infectious diarrhea and indicators of well water contamination in a series of studies from 1997-2000 (Borchardt et al. 2000). In general, infectious diarrhea was not associated with drinking from private wells, nor was it associated with drinking from wells positive for total coliform. However, wells positive for enterococci were associated with children having diarrhea of unknown etiology (origin), which was likely caused by calciviruses. Preliminary results indicate that the incidence of virus contamination in private wells is similar to or lower than that of community wells.

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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 (see discussion of arsenic below).

Naturally-occurring radioactivity in groundwater, including uranium, radium, radon, and gross alpha is becoming an increasing concern. Sampling has identified radionuclides in groundwater in north-central Wisconsin, high levels of radium in water supplies in eastern Wisconsin, and gross alpha problems in northeastern and southeastern parts of the state. Nearly 70 public water systems either exceed or are nearing the drinking water standard of 15 pCi/L for gross alpha activity.

Two studies have been initiated by the DNR to address concerns about radioactive compounds in groundwater. The first titled "Identification and Quantitation of Alpha Emitting Radiochemicals in Drinking Water", began in FY 00. DNR staff collected samples from about 100 community and nontransient noncommunity public water wells. Each sample will be analyzed for several alpha emitting radiochemicals in an attempt to identify and quantify the relative contribution of each chemical to the total gross alpha activity in the samples. WSLH will analyze for total Uranium (U-238, U-234, U-235) alpha activity, total Thorium (Th-228, Th-230, Th-232) alpha activity, Radium 226, and Polonium 210 alpha activities. Preliminary results indicate total uranium is the major contributor to high gross alpha activities. Small quantities of polonium and thorium have also been detected but they do not appear to be major contributors to the total gross alpha activity in public water system wells.

A second study is looking at radon in drinking water supplies. Staff from the DNR will sample about 340 noncommunity, nontransient and other than municipal water systems per year. Project results will help determine the impact of expected new EPA standards for radon in drinking water. To date, approximately 250 samples have been collected from nontransient, noncommunity wells. Preliminary results tend to support findings from earlier community water system monitoring which indicated that approximately 50% of the public water systems monitored in Wisconsin exceed the proposed radon standard of 300 pCi/L.

Arsenic

Naturally occurring arsenic has been detected in wells throughout the State of Wisconsin. Department of Natural Resources historic data show that 3,386 public wells and 1,821 private wells have detectable levels of arsenic. These samples were taken randomly over the years with more public well water being tested for arsenic than private well water. Arsenic has been detected in public well water samples in every county in Wisconsin. However, the problem is especially prevalent in northeastern Wisconsin where increased water use has likely mobilized arsenic into the groundwater. In a portion of Outagamie, Shawano, Winnebago, and Brown Counties approximately one out of three private drinking water wells sampled have arsenic detects. The highest concentration of arsenic detected in a private well in Wisconsin is 15,000 µg/L.

Arsenic bearing geologic units exist across the state. It is found in the igneous rocks of the Precambrian shield, the Paleozoic sedimentary rock, and within glacial deposits. The highest concentrations are present in the sedimentary bedrock. Results from several DNR studies indicate the geochemical phenomena causing the elevated levels of

arsenic in groundwater are associated with oxidation of sulfide-mineralized zones within the bedrock aquifers. The main zone of mineralization extends some ten feet below the base of the Platteville Dolomite, which is part of the main upper bedrock formation of this region. If the St. Peter Sandstone is present within the geologic sequence, it lies directly below the Platteville Dolomite and the arsenic-rich mineralized zone then extends about ten feet into this sandstone. Although it is certain that this is the main mineralized zone, experts believe that there are other lateral and vertical occurrences of arsenic-rich strata.

Arsenic Advisory Area - Studies conducted by DNR led to the delineation of the extent of the arsenic contaminated area. This delineation led to the establishment of an "Arsenic Advisory Area" in the early 1990s. This area includes the strip of land five miles either side of the bedrock subcrop of the St. Peter Sandstone, extending in a northeasterly trend, from a location just southwest of Oshkosh, to a location just west of Green Bay. For this area, DNR developed special well construction specifications, more stringent than the minimum Private Well Code requirements. DNR guidance recommends the installation of 80 feet of casing through the sandstone contact for drinking water wells in the AAA. These specifications were recommended, but not required, for new wells constructed within the "Arsenic Advisory Area". The specifications, when followed, will increase the likelihood of installing a well free of arsenic.

Ongoing research indicates that casing off the upper parts of the St. Peter Sandstone is usually effective in eliminating or reducing the presence of arsenic in drinking water. However, over the last several years some wells that were not constructed according to guidance have exhibited increasing arsenic concentrations and have required replacement or reconstruction. In addition, follow-up testing on 50 replacement wells found that arsenic levels are exceeding standards in at least 5 cases where initially they had been below the ES. Additional sampling of replacement wells will occur in FY 02 to test whether current guidelines are adequate at lowering arsenic concentrations.

Recent information has raised questions about the St. Peter Sandstone – Sinnipee Dolomite contact being the only location where high arsenic concentrations are found. A renewed effort is currently underway to reexamine this problem. In addition, there is evidence to suggest that increased levels of arsenic in this region may be related to increased groundwater consumption[2]. In many areas, increasing concentrations of arsenic may be a result of the water table dropping to levels at or just below the sulfide rich mineralized zone and then fluctuating up and down across this layer. This fluctuation can allow oxygen in the air to come in contact with and oxidize the sulfide minerals in this layer. This initial oxidation can then trigger a complex set of geochemical reactions that can eventually release arsenic into the groundwater. Once this reaction has been initiated it is likely to continue.

Health Effects – National health experts agree that consuming water containing arsenic has many adverse health effects. Wisconsin Department of Health and Family Services' toxicologists have reviewed the existing toxicological information and have produced an "Arsenic in Drinking Water" brochure documenting the potential health problems linked to consuming water containing arsenic. The brochure informs the public that drinking arsenic contaminated water has been associated with skin cancer; internal cancers (bladder, prostate, lung and other sites); thick rough skin on hands and feet; unusual skin pigmentation; numbness in the hands and feet; circulatory disorders; tremors; and stomach pain, nausea, and diarrhea.

The current Federal Drinking Water Standard, for public water supply wells, is 50 micrograms/liter (µg/L). At that level the risk of cancer is 1 to 1.5 in 1,000, higher than normally allowed for substances in drinking water. The Environmental Protection Agency (EPA) was required by the 1996 revisions to the Safe Drinking Water Act to propose a revision to that standard. In June 2000 EPA proposed a standard of 5 micrograms per liter. Public comments were taken on the proposed standard, as well as standards at the 3, 10 and 20 µg/L levels. On January

2 Since the 1950s, groundwater consumption in northeastern Wisconsin has risen significantly due to an increase in population and per capita water use. Thousands of new private wells have been constructed in this region. Municipal and industrial groundwater use has increased. As a result, regional groundwater levels in the sedimentary bedrock aquifers of northeastern Wisconsin have shown a steady long-term decline. The decline has averaged as much as three to four feet per year in the Green Bay area and as much as two to three feet per year in the Fox Cities area surrounding the City of Appleton.

22, 2001 EPA promulgated an arsenic standard of 10 micrograms/liter. Community, as well as, Non-Transient Non-Community water systems would have been affected. On March 23, 2001 EPA felt that the science and cost associated with the arsenic standard needed more review and withdrew the pending arsenic standard and proposed to move the effective date of the rule from May 2001 to February 2002.

During the 9 month delay the EPA is reviewing a range of 3-20 micrograms/liter for the establishment of a new drinking water standard, looking at new studies regarding health effects that were received after the previous comment period had closed, and reviewing EPA's risk analysis of arsenic. EPA has been asked to pay close attention to economic issues associated with arsenic especially costs to small systems.

A sampling effort of 3,300 public water supply systems (Municipal, Other than Municipal, and Non-transient Non-community wells) was undertaken in the summer of 2000. Results from the samples returned indicate that approximately 80 systems in Wisconsin could be affected by an arsenic standard of 10 µg/L.

The proposed standard also raises questions for private water supplies, particularly in regards to health risks associated with drinking water with moderate levels of arsenic (between the old and new standards). In FY 01, the DHFS received funding to conduct a follow-up investigation on the relationship between exposure to inorganic arsenic in water and health outcomes. As part of this research effort, local health departments, DNR staff, town clerks and others have conducted well sampling campaigns in 15 townships in the affected counties. Several other towns have offered similar well testing programs. Over 4350 households have submitted samples and returned health surveys, providing health and exposure information for about 1800 individuals. Historical data indicates that 37% of the wells in the 4-county area affected by arsenic exceed the 5 µg/L standard. In two of the townships, almost 50% of the samples tested in the current campaign exceed 5 µg/L while 21.8% exceed 10 µg/L.

CONDITION OF THE RESOURCE - GROUNDWATER QUANTITY

Groundwater is plentiful in Wisconsin, but concern is growing about its limits. Natural shortages of groundwater have occurred due to weather conditions and geologic setting. Human activities also cause quantity problems. A dripping faucet, for example, can waste 20 or more gallons of water each day. Groundwater withdrawals in the Lower Fox River Valley, southeastern Wisconsin, and Dane County have caused substantial declines in groundwater levels.

Recently, attention has focused on the state's limited authority to protect groundwater quantity. In August of 2000, the UW-Madison Department of Urban and Regional Planning issued a report reviewing Wisconsin's high capacity well law and making recommendations for its improvement. The report discusses the potential impacts of high capacity wells on the environment, summarizes the existing law for managing groundwater in Wisconsin, reviews programs in selected states, and discusses issues and strategies for improving groundwater quantity management in Wisconsin. Some of the key recommendations include:

- Expand the public trust doctrine to groundwater
- Enforce existing statutory language regarding groundwater
- Explicitly recognize hydraulic continuity between groundwater and surface water in legislation
- Expand criteria for review and permitting of high capacity wells to consider effects on interconnected surface waters and ecological resources (springs, wetlands, rivers and streams, lakes, fish and wildlife)
- Enforce monitoring and reporting requirements for high capacity well permits
- Encourage voluntary reporting of water use information from other groundwater users
- Address cumulative impacts of wells by ensuring consistency with local or regional water management plans

The report is entitled "Modernizing Wisconsin Groundwater Management: Reforming the High Capacity Well Laws" and is available from the Department of Urban and Regional Planning, UW-Madison/Cooperative Extension, 112-A Old Music Hall, 925 Bascom Mall, Madison, WI 53706 for $7.00 per copy.

The GCC anticipated some of these issues in a report entitled "Status of Groundwater Quantity in Wisconsin"

published in April 1997. The full report is available from the DNR and may be downloaded. The Executive Summary is printed here.

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. The Groundwater Section of the DNR's Bureau of Drinking Water and Groundwater prepared this report 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 effects 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 up to $750,000 available each year for groundwater-related monitoring or research. Approximately $10.5 million has been spent through FY 01 on 270 different projects dealing with groundwater or related topics (see Table 3 in Appendix). The sources of money and purposes of monitoring or research include:

1. DNR Management Practice Monitoring - The DNR has had approximately $300,000 available each year since FY 86 to support groundwater monitoring studies evaluating existing design and/or management practices associated with potential sources of groundwater contamination. The intent of these studies is to reduce the impacts of potential sources of contamination by changing the way land activities that may impact groundwater are conducted. The money comes from the Groundwater Account of the Environmental Fund (which is funded by various fees). Through FY 01, the DNR has spent approximately $5.0 million on 151 monitoring projects. Several of these projects have been co-funded with DATCP, Commerce and/or UWS.

2. UWS Groundwater Research - The UWS, through its UW-Madison Water Resources Institute (WRI), has received funding since FY 90 for groundwater research. Through FY 01, the UWS has spent $3.5 million on 97 groundwater research projects. Several projects have been co-funded with DNR, Commerce and/or DATCP and five were co-funded with WRI through the US Geological Survey.

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 01, DATCP has spent about $1.5 million on 39 pesticide projects. Several of these projects have been co-funded with DNR and/or UWS.

4. DILHR/Commerce Private Sewage System Research - The Division of Safety & Buildings (formerly in the Department of Industry, Labor, and Human Relations) received a special GPR appropriation of $50,000 from 1990 to 1993 to fund research on alternatives to current private sewage system technology. In 1994, when the appropriation expired, $75,000 generated through plan review and licensing fees became available each year for research on private sewage systems. Through FY 01, DILHR/Commerce has spent approximately $600,000 on eight projects. Two projects were co-funded with DNR and UWS.

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.

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.

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 01 Joint Solicitation

The joint solicitation for FY 01 was distributed in October 1999. A total of 30 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 2000 to review and rank the projects that were submitted for funding. As a result of the subcommittee meeting, the GRAC meeting in March, and review of the proposals by agency staff, 19 new projects were selected for funding in FY 01. Eight on-going projects were carried over into FY 01. A total of 27 projects were funded through the joint solicitation at a cost of approximately $826,000 (see Table 1).

FY 02 Joint Solicitation

A joint solicitation for project proposals by the UW System, DNR, DATCP and Commerce was distributed in September 2000 for funding in FY 02. The deadline for proposals was November 13, 2000. The joint solicitation package contains a listing of the priorities for each of the agencies (see Appendix). The Monitoring & Data Management and Research Subcommittees of the GCC and DNR staff reviewed the priority needs for the DNR's management-practice monitoring program for FY 02. The two subcommittees met in December to rank the 30 proposals submitted. In addition, the GRAC met in February to select projects to recommend to the GCC for UWS funding. Twenty-one of the 30 proposals received will be funded in full or in part through the joint solicitation process. The projects to be funded in FY 02 are listed in Table 2.

The GCC attempts to compile information about other groundwater research programs within and outside of Wisconsin. To this end, groundwater-related research projects funded through the Fertilizer Research Council in FY 00 and 01 are listed in the Appendix. In addition, the GCC continues to contact other states with groundwater research programs to prevent research duplication and to make efficient use of limited research funds. The strategy for interstate coordination of groundwater research 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.

Table 1: Groundwater Projects Funded through the Joint Solicitation for FY 01

(Map numbers identify projects on the State map in Figure 1. * denotes continued project)

DNR Projects

***Evaluating options for changing groundwater and leachate monitoring requirements for landfills to reduce mercury used by laboratories.** J. Connelly, Wisconsin Department of Natural Resources, and R. Stephens and B. Shaw, University of Wisconsin Stevens Point. ($31,823)

Geologic and geochemical controls on arsenic in groundwater in northeastern Wisconsin. M. Gotkowitz, Wisconsin Geological and Natural History Survey, T. Simo, University of Wisconsin –Madison, D. Krabbenhoft and R. Hunt, US Geological Survey, M. Schreiber, Virginia Tech. ($68,133) – Map #2

VOC trend analysis of WI solid waste landfill monitoring data: A preliminary analysis of the natural attenuation process. J. Connelly, J. Battista, and T. Hegeman. Wisconsin Department of Natural Resources. ($21,845) – Map #3

Development of analytical methods for comprehensive chemical and physical speciation of arsenicals in groundwater. J. Aldstadt. University of Wisconsin –Milwaukee. ($29,989)

New approaches to the assessment of microbes in groundwater: application to monitoring bioremediation and detection of pathogens. M. Collins. University of Wisconsin –Milwaukee. ($33,244)

An analysis of arsenic replacement wells to determine validity of current DNR well construction guidance. K. O'Connor and K. Lauridsen. Wisconsin Department of Natural Resources. ($21,276) – Map #6

Verification and characterization of a fracture network within the Maquoketa shale confining unit, SE Wisconsin. T. Eaton, K. Bradbury, Wisconsin Geological and Natural History Survey, and H. Wang, University of Wisconsin - Madison. ($20,117) – Map #7

Public health impacts of arsenic contaminated drinking water. L. Knobeloch, L. Hanrahan, H. Anderson, and M. Weisskopf. Wisconsin Department of Health and Family Services. ($32,244) – Map #8

A study of microbiological testing of well water quality in Door County and incidence of illness in humans. L. Braatz, Wisconsin Department of Natural Resources, and D. Battigelli, Wisconsin State Laboratory of Hygiene. ($52,739) – Map #9

The total cost for all projects funded by the DNR in FY 01 including the co-funded project below is $340,750.

DNR/UWS Co-funded Project

***Remediating groundwater using reactive walls containing waste foundry sands**. C. Benson and G. Eykholt. University of Wisconsin – Madison. (DNR $29,340, UWS $6,100)

UWS Projects

***Field monitoring of drainage and nitrate leaching from managed and unmanaged ecosystems.** J.N. Norman. University of Wisconsin-Madison. ($15,050; co-funded by U.S.G.S. base funding of WRI) – Map #11

***Macropore flow: A means for enhancing groundwater recharge or a potential source of groundwater contamination.** K.W. Potter. University of Wisconsin-Madison. ($9,370; co-funded by U.S.G.S. base funding of WRI)

***Causes of historical changes in ground-water recharge rates in southeastern Wisconsin.** D.S. Cherkauer. University of Wisconsin-Milwaukee. ($34,140)

***Admicelle-catalyzed reductive dechlorination of PCE by zero valent iron.** Z. Li University of Wisconsin –Parkside. ($16,839)

*__Development of neural network models for predicting nitrate concentration in well water in the Tomorrow-Waupaca watershed.__ H. Lin. University of Wisconsin -Stevens Point. ($28,044)

*__Compatibility of containment systems with mine waste liquids.__ T. Edil. University of Wisconsin-Madison. ($9,275)

__The spatial and temporal variability of ground water recharge.__ M.P. Anderson. University of Wisconsin -Madison. ($20,564)

__Groundwater modeling: Semi-analytical approaches for heterogeneity and reaction networks.__ G. Eykholt. University of Wisconsin -Madison. ($23,289)

__Removal of As(III) and As(V) in contaminated ground water with thin-film microporous oxide adsorbents.__ M. A. Anderson University of Wisconsin -Madison. ($25,499)

__Effect of clean and polluted groundwater on *Daphnia* reproduction and development.__ S. Dodson. University of Wisconsin -Madison. ($28,923)

__Importance of groundwater in production and transport of methyl mercury in Lake Superior tributaries.__ D. Armstrong. University of Wisconsin -Madison. ($25,234) – Map #21

__A basin-scale denitrification budget for a nitrate contaminated Wisconsin aquifer: A study at the groundwater/surface water interface.__ B. Browne. University of Wisconsin -Stevens Point. ($28,890) – Map #22

The total cost for all projects funded by the UWS in FY 01 including the co-funded project below is $302,742 (including fringe benefits and 6% administration costs).

UWS/DATCP Co-funded Project

__Remediation of soil and groundwater using effectively and ineffectively nodulated alfalfa.__ N. Turyk. University of Wisconsin -Stevens Point. (UWS $13,525; DATCP $4,080) – Map #23

DATCP Projects

__Pesticide and nitrate leaching in soils receiving manure.__ B. Lowery, F. Arriaga, and D. Stoltenberg. University of Wisconsin – Madison. ($16,695) – Map #24

__Screening of agricultural and lawn care pesticides for developmental toxicity using the mouse embryo assay.__ A. Greenlee. Marshfield Medical Research Foundation. ($36,381)

__Effectiveness of phytoremediation and hydrogeologic response at an agricultural chemical facility in Bancroft, WI__ W. DeVita and M. Dawson. University of Wisconsin – Stevens Point. ($21,725) – Map #26

The total cost for all projects funded by DATCP in FY 01, including the co-funded project above is $78,881.

Commerce Project

__Evaluation of pathogen and nitrogen movement beneath on-site systems receiving domestic effluent from single pass sand filters.__ J. Converse. University of Wisconsin – Madison. ($58,000) – Map #27

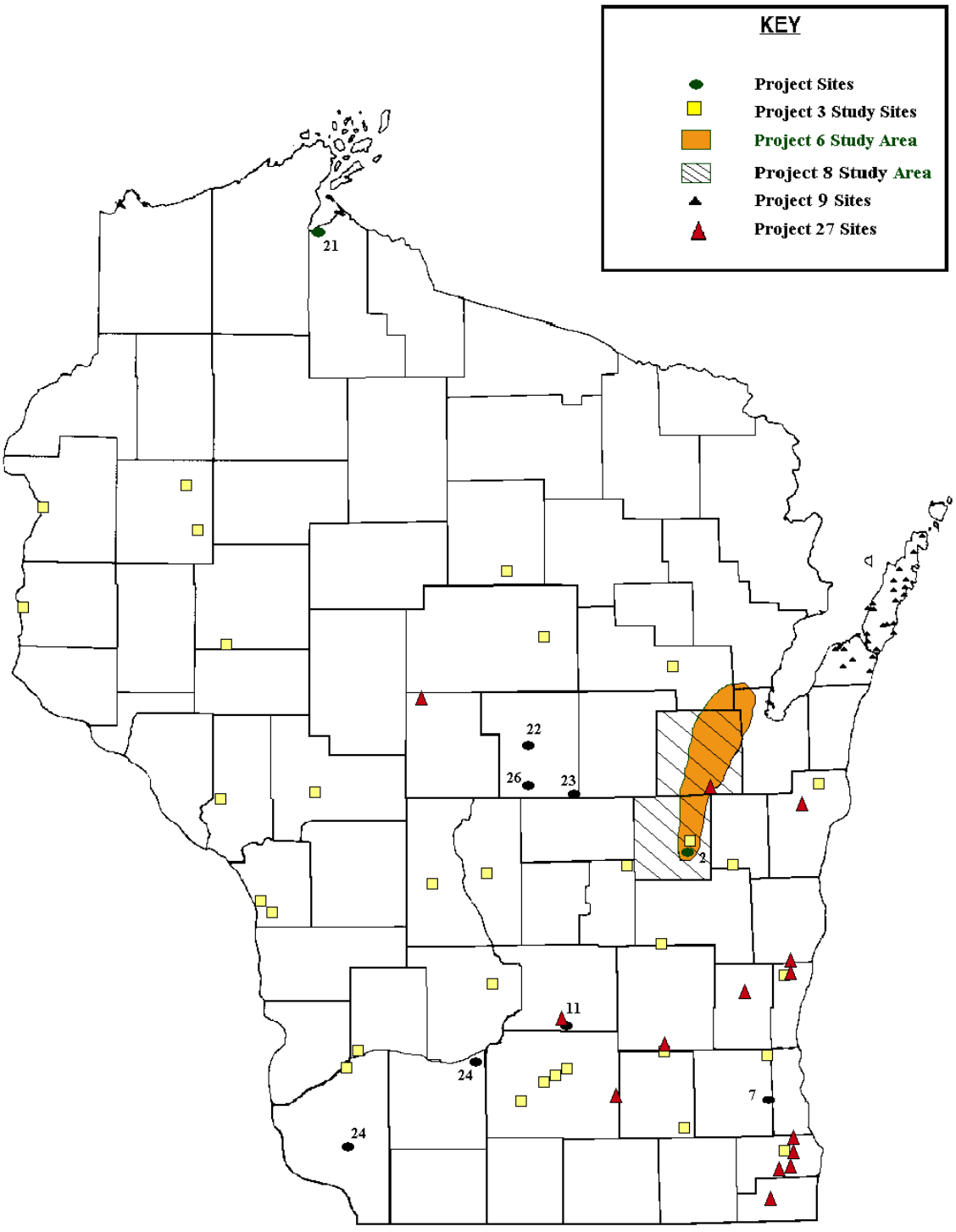

Figure 1 - Location of Groundwater Project Field Sites Funded Through the Joint Solicitation for FY 2001

Table 2: Groundwater Projects to be Funded through the Joint Solicitation for FY 02

Agency	*Title*	*Author(s)*	*Affiliation*	*FY 02 Budget*
DATCP				
	*Pesticide and nitrate leaching in soils receiving manure	B. Lowery, F. Arriaga, and D. Stoltenberg	UW-Madison	$18,380
	*Effectiveness of phytoremediation and hydrogeologic response at an agricultural chemical facility in Bancroft, WI	W. DeVita and M. Dawson	UW-Stevens Point	$16,400
	Chloroacetanilide and Atrazine Residue Penetration and Accumulation in Two Wisconsin Groundwater Basins	W. DeVita, P. McGinley, and G. Kraft	UW-Stevens Point	$32,349
	Agrochemical Leaching from Sub-optimal, Optimal, and Excessive Manure-N Fertilization of Corn	J. Norman and K. Brye	UW-Madison	$43,187

The total cost for all new projects funded by DATCP through the FY 02 joint solicitation process, including the co-funded project below is $92,190

The total cost for all projects funded by DATCP in FY 02, including the co-funded projects below is $135,000

DNR				
	*Geologic and geochemical controls on arsenic in groundwater in northeastern Wisconsin	M. Gotkowitz, T. Simo D. Krabbenhoft, M. Schreiber, & R. Hunt	WGNHS, UW-Madison & USGS	$35,478
	*Development of analytical methods for comprehensive chemical and physical speciation of arsenicals in groundwater	J. Aldstadt	UW-Milwaukee	$31,450
	*New approaches to the assessment of microbes in groundwater: application to monitoring bioremediation and detection of pathogens.	M. Collins	UW-Milwaukee	$37,910
	*An analysis of arsenic replacement wells to determine validity of current DNR well construction guidance	K. O'Connor and K. Lauridsen	DNR	$21,276
	*Public health impacts of arsenic contaminated drinking water	L. Knobeloch, L. Hanrahan, H. Anderson, and M. Weisskopf	DFHS	$28,912
	Nitrate Loading History, Fate, and Origin for Two Wisconsin Groundwater Basins	G. Kraft	UW-Stevens Point	$32,754
	Susceptibility of La Crosse Municipal Wells to Enteric Virus Contamination from Surface Water Contributions	R. Hunt and M. Borchardt	USGS & UW-LaCrosse	$49,704x
	Monitoring Contaminant Flux from a Stormwater Infiltration Facility to Groundwater	C. Dunning and R. Bannerman	USGS & DNR	$22,600x
	Preservation and Survival of *E. coli* in Well Water Samples Submitted for Routine Analyses	W. Sonzogni, J. Standridge, and M. Bussen	WSLH	$24,990x
	Development of a Culture Method for Detection of *Helicobacter pylori* in Groundwater	W. Sonzogni, J. Standridge, and M. Hamacher	WSLH	$24,851x
	Time Domain Electromagnetic Induction Survey of the Sandstone Aquifer in the Lake Winnebago Area	R. Taylor and J. Jansen	UW-Milwaukee	$33,530
	Delineation of High Salinity Conditions in the Cambro-Ordovician Aquifer of Eastern Wisconsin	T. Grundl and R. Taylor	UW-Milwaukee	$28,779
	Importance of Disinfection on Arsenic Release from Wells	W. Sonzogni, G. Bowman, J. Standridge, and A. Clary	WSLH	$34,846
DNR/DATCP				
	Occurrence of Antibiotics in Wastewater Effluents and their Mobility in Soils: A Case Study from Wisconsin	K. G. Karthikeyan and W. Bleam	UW-Madison	DNR $29,205 DATCP $16,654

The total cost for all new projects funded by DNR through the FY 02 joint solicitation process, including the co-

funded project above is $281,259

The total cost for all projects funded by DNR in FY 02, including the co-funded project above is $436,285

UWS

*Removal of As(III) and As(V) in Contaminated Groundwater with Thin-film Microporous Oxide Adsorbents	M. A. Anderson	UW-Madison	$4,500#
*Importance of Groundwater in Production and Transport of Methyl Mercury in Lake Superior Tributaries	D. Armstrong, D. Krabbenhoft, and K. Rolfhus	UW-Madison & USGS	$3,260#
*A Basin-scale Denitrification Budget for a Nitrate-contaminated Wisconsin Aquifer: A Study at the Ground-water/Surface Water Interface	B. Browne, G. Kraft D. Saad	UW- Stevens Point & USGS	$18,532#
Co-occurrence and Removal of Arsenic and Iron in Groundwater	P. McGinley	UW-Stevens Point	$11,120
Field Evaluation of Raingardens as a Method for Enhancing Groundwater Recharge	K. Potter	UW-Madison	$19,039
Impacts of Land Use and Groundwater Flow on the Temperature of Wisconsin Trout Streams	S. Gaffield and L. Wang	WGNHS	$33,696
Impacts of Privately-Sewered Subdivisions on Groundwater Quality in Dane County, WI	K. Bradbury	WGNHS	$39,415
Monitoring and Scaling of Water Quality in the Tomorrow-Waupaca Watershed	H. Lin and B. Browne	UW-Stevens Point	$35,445
Removal of Heavy Metals and Radionuclides from Soils Using Cationic Surfactant Flushing	C. Evans and Z. Li	UW-Parkside	$20,849
Investigation of Changing Hydrologic Conditions of the Coon Creek Watershed in the Driftless Area of	R. Hunt	UW-Madison	$21,619
Effect of Clean and Polluted Groundwater on Reproduction and Development	S. Dodson	UW-Madison	$22,148
Removal of Arsenic in Groundwater Using Novel Mesoporous Sorbent	J. Park	UW-Madison	$28,299
Groundwater-Lake Interaction: Response to Climate Change, Vilas County, Wisconsin	M. P. Anderson	UW-Madison	$20,989

UWS/DATCP

*Remediation of soil and groundwater using effectively and ineffectively nodulated alfalfa.	N. Turyk, B. Shaw M. Russelle	UW-Stevens Point	UWS $10,785 DATCP $8,030

The total cost for all new projects funded by the UWS through the FY 02 joint solicitation process is $252,619.

The total cost for all projects funded by the UWS in FY 02 including the co-funded project above is $306,311 (including fringe benefits and 6% administration costs).

X partially funded in FY 01
co-funded by U.S.G.S. base funding of WRI
* denotes continuing project from FY 01

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 that have funded projects are the DNR, DATCP, DILHR/Commerce, and the UW System. There are 270 projects listed. One hundred sixty-eight of these projects have been funded through the joint solicitation process that 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 results to improve the management of the state's groundwater resources. Citations refer to the projects listed in Table 3.

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 was first detected in monitoring wells and private drinking water wells in Wisconsin. The first systematic well sampling program to characterize atrazine contamination on a statewide basis was the 1988 DATCP Grade A Dairy Farm Well Water Quality Survey (LeMasters, 1989). This state-funded well survey estimated that atrazine was present in 12% of the Grade A Dairy Farm Wells in the State.

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

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

State-funded research was essential in showing that atrazine contamination did not follow simplistic notions of groundwater contamination susceptibility. One of the most important findings was that the Central Sands and the Lower Wisconsin River Valley (LWRV), two areas that appear similar in soils and agricultural practices, had significantly different susceptibility to contamination. These differences were pointed out in several research projects conducted by the UW Soil Science Department (Daniel, 1991; Lowery, 1991; McSweeney, 1991; Lowery, 1992-3). This information had a direct influence on the atrazine rule in that there is now a use prohibition in the LWRV and managed use in the Central Sands.

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

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

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

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

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

Groundwater Monitoring at Solid Waste Disposal Sites - The 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 unlined 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 unlined 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 that 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 that 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 that 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 that, in contrast to what some were claiming, 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 (e.g. Arsenic) - 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. In FY 01, DHFS staff received additional funding to conduct a follow-up investigation on the relationship between exposure to inorganic arsenic in water and health outcomes. As part of this research effort, local health departments, DNR staff, town clerks and others have conducted well sampling campaigns in townships in the affected counties.

Ongoing research indicates that casing off the upper parts of the St. Peter Sandstone is usually 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 contact for drinking water wells in the AAA. A current study appears to indicate that shorter casing lengths (~40 feet) may also be effective in reducing the risk of arsenic exposure. However, in an effort to save costs, the majority of wells constructed are not following the recommendations. 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. In addition, follow-up testing on 50 replacement wells found that arsenic levels are exceeding standards in at least 5 cases where initially they had been below. Additional sampling of replacement wells is occurring in FY 01 - 02 to test whether current guidelines are adequate at lowering arsenic concentrations.

Including the two studies mentioned above, a total of 7 GCC-funded projects are addressing issues related to arsenic in FY 02. Additional studies include an analysis of the geologic and geochemical controls on arsenic in groundwater, a study refining analytical methods for detection of arsenic compounds, a study of the role of chlorination in releasing arsenic, and two projects investigating treatment methodologies for both private and public water supplies. These studies will help provide needed information about the occurrence, health risks, and remediation of arsenic in drinking water supplies.

Groundwater Movement in Fractured Dolomite - Door County has been the site of four 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.

During 1999, Bradbury and others began a follow-up project to attempt to verify the results of the Sturgeon Bay wellhead protection project using natural groundwater tracers. This research is measuring the natural seasonal variations in temperature, electrical conductivity, and oxygen and hydrogen isotopes of groundwater and

precipitation in order to verify the sources and velocities of groundwater moving toward Sturgeon Bay's wells. The use of such tracers is attractive because they are naturally present in the environment.

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 DNR's Northeast Region (NER) 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.

Geographic information management in DNR's Northeast Region. An environmental inventory utilizing GIS was created in the DNR's former 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.

A subsequent project gathered relevant geologic and hydrogeologic data from case files and entered them into one single relational database (Stoll, 1996-97). This database is joined in a GIS with the previously located site information. This combination provides an easily accessible wealth of information that can be used for queries and analysis. In addition, a program was developed utilizing Environmental Systems Research Institute (ESRI) Avenue for ArcView language to query data the DNR Region has gathered. For instance well driller construction logs which are in a File Maker Pro software database are linked in an ArcView Project to be readily viewed by selecting an area on screen. Also, summary reports can be prepared of local conditions prior to investigating contamination sites in the field by selecting an area on screen.

GIS work conducted in NER has provided the seed for the growth of GIS and GPS source and receptor locational work statewide. In 1998, NER mapped the location of over 2000 public water supply wells utilizing GPS methods with differential correction. From that work, wellhead vulnerability radii are assigned to each well to provide the basis for Wellhead Vulnerability determinations relative to that well and its local potential contaminant sources.

Dane County model. Previous support of county-wide groundwater inventory studies and of modeling methodologies (Potter, 1992-93; Anderson, 1997) 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 wells in Dane County (Bradbury 1996).

The Dane County model, which provides a modern hydrogeologic framework for groundwater movement in Dane County, has stimulated a number of significant research projects by other investigators (Mickelson 1994-95; Bradbury et al., 2000). These investigators are using the model as a starting point for more detailed flow models of specific problems or areas of the county. One of the most significant of these is the award of a multi-year USEPA STAR grant to a team of DNR, UW-Madison, USGS, and WGNHS investigators who are investigating the water-resources impact of different land-use strategies on Madison's urban fringe. This research will support several graduate students and is will provide an integrated assessment of the hydrological, ecological, and institutional impacts of urbanization and land-use change. This research is focused on the Pheasant Branch watershed just west of Madison. Other research projects are investigating the

sources of groundwater supplying important springs in the Nine Springs and Token Creek watersheds, with the goal of determining how nearby development and groundwater use could affect the springs.

The Dane County model has now become a prototype for regional groundwater models in other parts of Wisconsin. In FY 00 the WGNHS, USGS, and SEWRPC began a cooperative project to develop a similar model for the entire seven-county SEWRPC area of southeast Wisconsin. Other modeling projects are taking place in Sauk, Rock, and La Crosse Counties. Such models are critical tools in the planning process, and allow water managers to evaluate the impacts of various future water management and land use alternatives in order to make well-informed land-use decisions.

Prevention and Remediation of Groundwater Contamination – Twenty-four 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 Institute. Many of these projects have been completed. Final technical reports are published or in press. The reports and studies in progress provide information or products that 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 (Li, 2000), (Benson and Eykholt, 2000), (Benson, 1997-2000), (Hoopes, 1997-99), (Park, 1997-98), (Collins, 1997-98), (Bahr, 1996-98), (Hickey, 1994-96), (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 and mine waste contaminants to groundwater (Edil and Benson, 2000), (Edil 1997), (Benson, 1995-96), (Edil and Park, 1992-93);
- 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, 1997-98), (Shinners, 1995-96), (Newenhouse, 1995), (Harrison, 1992-93), (Bahr, 1991-92); and
- Development of new technologies for evaluating the integrity of water supply well and exploration borehole seals (Edil, 1996, 1998-99), (Edil and Benson, 1997-98).

Biological Effects of Groundwater Contaminants – The GCC has solicited research projects during the last several years that deal with biological aspects of groundwater contamination.

Two projects dealt 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 disrupters (PCBs, phthalates, etc.) and a common groundwater contaminant (nitrate). Gordon Chesters and Harry Read of the UW-Madison Water Resources Center (now WRI) 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.

Several projects have focused on developing new techniques for detecting, quantifying, and monitoring microorganisms in groundwater and soils. William Hickey, of the UW-Madison Soil Science Department, developed a rapid molecular method using the polymerase chain reaction (PCR) to assay soils for the presence of specific sewage-borne pathogens. PCR-based methods eliminate the need to culture organisms for detection, and remedy shortcomings of traditional techniques by allowing rapid, sensitive, and specific identification of the pathogens of concern rather than indicator organisms. The PCR protocol he developed was designed to detect DNA originating from *Escherichia coli,* which is one of the major species of bacteria associated with human waste. With this method he could distinguish *E. coli* DNA from that of its closest relative, *Shigella*. The method allowed the

detection of DNA equivalent to about 20 cells. Currently, he is testing the PCR method for tracking of *E. coli* in the environment.

Because they have the capacity to co-metabolize a wide variety of organic chemicals, including halogenated compounds, methanotrophic bacteria have significant potential for bioremediation. Mary Lynne Perille Collins of the UW-Milwaukee Department of Biological Sciences has completed a 2-year project in FY 00 that developed methods for quantification of methanotrophs in groundwater. These methods, that include competitive PCR and direct PCR, will provide approaches to monitoring bioremediation and natural attenuation. In addition, this work has provided the basis of a new study initiated in July 2000 that will apply direct PCR to the detection of pathogens in groundwater.

Mark Borchardt, of the Marshfield Medical Research Foundation, has investigated the association of pathogenic viruses and bacteria in private wells with incidences of infectious diarrhea and indicators of well water contamination in a series of studies from 1997-2000. In general, infectious diarrhea was not associated with drinking from private wells, nor was it associated with drinking from wells positive for total coliform. However, wells positive for enterococci were associated with children having diarrhea of unknown etiology, which was likely caused by calciviruses. Preliminary results indicate that the incidence of virus contamination in private wells is similar or lower than that of community wells.

Finally, two projects have assessed the toxicity of agricultural chemicals on biota in surface waters:

William Karasov of the UW-Madison Department of Wildlife Ecology recently completed a study of the possible relationship between common agricultural chemicals and Wisconsin's declining and endangered amphibian population. The researchers tested the effects of atrazine and nitrate on northern leopard frog (*Rana pipiens*) larvae in the laboratory. Neither atrazine, nor nitrate, nor their interaction had a significant effect on development rate, percent metamorphosis, time to metamorphosis, percent survival, mass at metamorphosis, or hematocrit. Nitrate slowed growth of larvae; however, this growth inhibition was not thought to be biologically important when compared to natural variation in the environment. Thus, the authors concluded that concentrations of atrazine and nitrate commonly found in the environment do not appear to pose a significant threat to *R. pipiens* larvae through direct toxicity.

Ron Crunkilton, of the UW-Stevens Point College of Natural Resources, received funding in FY 99-00 for a study of the acute and chronic toxicity of nitrate to brook trout embryos and larvae. Exposure to nitrate at environmentally realistic concentrations increased mortality in brook trout embryos and reduced growth or biomass in long-term exposures. The lowest observable effect concentration was 6.25 mg/L NO_3-N for both mortality and growth of feral brook trout. Mortality was greater in soft water compared to hard water and the effect was independent of nitrate concentration. These findings suggest that high nitrate concentrations may increase mortality of brook trout embryos in coldwater streams with significant groundwater baseflow in agricultural areas.

GROUNDWATER DATA MANAGEMENT

Department of Natural Resources

Collection and coordination of groundwater data exchange within the DNR and with outside agencies continues to be a high priority. The Department continues its focus on the collection and retrieval of groundwater data to meet inter-agency responsibilities and cooperative agreements.

The Department's groundwater data retrieval system, the Groundwater Retrieval Network (GRN), continues to provide access through its web interface. GRN currently accesses information from over 255,000 wells. These wells represent public and private water supply, piezometers,

monitoring wells, non-potable wells, and groundwater extraction wells from three program systems in the bureaus of Waste Management and Drinking Water and Groundwater. Enhancements to the GRN system, suggested by regional and central office staff as well as external partners, are implemented through a yearly process allocating available groundwater related programming hours. These programming hours are used to improve system functionality and ease of use. A new program is being finalized that maintains an updated GRN locational coordinate and updates a statewide Geographic Information System (GIS) coverage of well locations, maintained through a link with GRN. GRN allows users to extract well and sample information in Microsoft Excel format, comma or tab delimited text format. Using ArcView (a desktop GIS software package) GRN data can imported to create a well GIS "layer" on a personal computer for viewing and querying purposes.

In 1998, the Department launched an initiative to begin labeling monitoring wells with the Wisconsin Unique Well Number. Peel and stick labels, similar to the existing drinking water well label, are available to well drillers and consultants for their wells. In the past year, staff have updated the Department-developed computer program allowing entry, editing, printing, and data sharing from eight well-related forms. Additional forms were added and capabilities within existing screens were enhanced. Work began last fiscal year to upload data from drinking water supply and monitoring wells derived from electronic submittals into existing program databases.

The Bureau of Remediation and Redevelopment (RR) program has undertaken development of a GIS registry system that will identify on a web-based map all closed remediation sites having restrictions on the use of groundwater. The purpose of this system is to assist well drillers and other interested parties in locating sites to prevent drilling in contaminated areas. Additionally, it will provide realtors and bankers with information on contaminated sites that will assist them in making informed decisions when lending money or assisting with the sale of a property. It will also assist anyone looking for redevelopment potential and will assist the general public in identifying contaminated property.

As part of a larger effort the RR program is also working toward locating and mapping all sites that the program works with. That system will be modeled after the registry application.

The Bureau of Waste Management continues to accept electronic submittal of environmental monitoring data via diskette from landfill owners, labs and consultants. Establishment of electronic signature standards from DOA continues to delay progress implementing a pilot program allowing facilities to submit environmental monitoring data via e-mail. The Bureau is continuing to look at options to provide a web interface to some of their Groundwater and Environmental Monitoring System (GEMS) data.

The Bureau of Watershed Management has implemented a database, designated the System for Wastewater Applications, Monitoring, and Permits (SWAMP). This database system stores facility specific information such as address, contacts, location, permit requirements, monitoring results, and violations of permit requirements for private and municipal wastewater treatment facilities. Data for holders of specific Wisconsin Pollutant Discharge Elimination System (WPDES) and general permits is stored. The system contains current information on groundwater, wastewater, and biosolids treatment/management. Historical sampling data from groundwater monitoring wells is available through the system and current sample results are added on a monthly basis. Sampling results and site loading information are also available for land application of municipal sludge, septage and industrial sludge, by-product solids and wastewater.

The State's Source Water Assessment Program made progress on several groundwater-related data initiatives in FY 01. The DNR's Drinking Water and Groundwater program coordinated efforts to improve the Department’s data on public water supply wells and significant potential sources of contamination that may threaten these wells. Cooperative projects with the Remediation and Redevelopment, Waste Management, and Watershed Management programs are improving and collecting site locations of known groundwater contamination sites, large landfills, large confined animal feedlot operations and other potential threats. Locational data for these sites are being gathered from existing files and from on-site visits. Additionally the WGNHS and DNR have produced a searchable index of scanned images of more than 350,000 well construction reports available at the WGNHS. DNR staff will use these reports to help determine the susceptibility of public water systems to contamination.

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, DATCP's laboratory, and other sources. This scrutiny is important, because DATCP uses 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 maintains two groundwater sample databases: the *Drinking Water Well System* and the *Monitoring Well System*. The *Drinking Water Well System* contains contact and location information, well characteristics, and pesticide and nitrate sample results for private and public drinking water wells. The *Monitoring Well System* contains similar information for monitoring wells, and also tracks specific pesticide use history, soils, crop history, well construction, and precipitation and irrigation at monitored sites.

DATCP's *Drinking Water Well System* currently contains information for over 37,000 wells and over 217,000 pesticide and nitrate-N results. These data represent samples analyzed by DATCP, SLOH, and other public and private laboratories. The *Drinking Water Well System* was converted from a Paradox to Access97/SQL Server application in FY 99 to: (1) meet state database and operating system (Windows NT) standards, (2) improve compatibility of data with other established database systems, and (3) begin improving links between these databases and our geographic information system (GIS) tools. The *Monitoring Well System* will be converted to Access97/SQL Server in FY 02. Members of DATCP's Groundwater Protection Unit and its Containment and Remediation Unit access the database.

DATCP uses geographic information system (GIS) tools to analyze groundwater data and prepare maps for public hearings, DATCP board meetings, presentations, and other uses. DATCP prepares and maintains ArcInfo and ArcView data layers of well locations, 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 chapter ATCP 30, Wis. Adm. Code (the "Atrazine Rule"). Other GIS analyses involve identifying groundwater wells that may be impacted by point sources of pesticide and nitrate-N contamination. DATCP also uses global positioning system (GPS) receivers 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 the 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 result in 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, including geographic information systems (GIS) data, continue to be developed at the Survey, usually on a project basis to assist with on-going research. The effort to integrate, standardize, and document our data holdings continues to be a priority at the WGNHS. Another high priority is to make our digital data readily available to state agencies and the public.

Department of Commerce

Commerce is continuing its data integration information technology initiative. With regard to groundwater protection, Commerce maintains databases of underground petroleum storage tank systems and properties with petroleum contamination either in the past or currently. The database also stores information on activities associated with onsite sewage system design, installation and maintenance. Sanitary Permit information may be combined with information on onsite system maintenance and inspection when the database system is enhanced in the future

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 over 325,000 individual test results for approximately 46,800 samples covering the state. Chemistry data includes pH, conductivity, alkalinity, total hardness, nitrate-nitrite, chloride, saturation index, and coliform bacteria. In 1998, a new sampling program for iron, sodium, potassium, copper, lead, calcium, magnesium, manganese, zinc, and triazine was also initiated. Arsenic and sulfate were added late in 1999. 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-nine counties are represented by 100 or more samples in the databases, and 23 counties are represented by 500 or more samples.

Department of Transportation

The DOT has entered salt storage facility records into a new database. There are currently 1,209 salt storage "sites" listed in the database and 2,171 "sub-sites" or storage facilities including salt storage sheds, liquid storage containers, and salt storage piles at docks. Detailed inventories of salt use are kept by each county and updated monthly. A record of facility inventories, inspections, repairs and improvements is included in the database.

The DOT maintains records of hazardous material investigation and remediation for highway projects. These records include information regarding groundwater contamination and groundwater use restrictions.

Groundwater monitoring is also performed for several DOT wetland mitigation projects. These records contain information on groundwater elevation and gradients as it relates to a wetland restoration or creation project (surface water and groundwater interaction).

The Wetland Mitigation Bank Accounting System is maintained by DOT on Wetland Bank activity. This system provides information on wetland loss and compensation by acres and wetland type and by project and location.

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.

COORDINATION ACTIVITIES

GROUNDWATER COORDINATING COUNCIL

The Groundwater Law, 1983 Wisconsin Act 410, established the GCC to advise and assist state agencies in coordinating non-regulatory 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 with groundwater responsibilities to sit on the Council. The state agencies include the DNR, Commerce, DHFS, DATCP, DOT, WGNHS, and the UWS. The GCC has created five subcommittees to assist in its work. The subcommittees are composed of approximately 60 people including members of the GCC, employees of state and federal agencies, university researchers and educators, representatives of counties and municipalities and public members. 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.

Wisconsin Groundwater Summit. In May of 2000, the GCC initiated an effort to assess the current status of groundwater management in the state and to provide future direction for the GCC and its member agencies. This effort will culminate in an event called "The Wisconsin Groundwater Summit" to be held on October 30, 2001 in Waukesha, WI. The Summit will bring together a broad spectrum of groundwater users and stakeholders to discuss issues facing groundwater protection and management and develop solutions to better protect Wisconsin's groundwater. Invitations were mailed to over 80 organizations, agencies, and key individuals with a stake in safe and adequate groundwater supplies. These include environmental, conservation, and agricultural groups, industrial users, water utilities, local and tribal government, planning agencies, state and federal agencies, and university researchers and educators. The format for the Summit will be a set of keynote presentations and a panel discussion, followed by breakout sessions where participants will be asked to address specific issues and suggest solutions. A core group of groundwater professionals will meet the following day to synthesize the discussion and formulate a set of findings and recommendations to be distributed after the Summit. A document summarizing the Summit will be distributed in 2002.

The discussion and materials developed as a result of the Summit will assist and guide State agencies, the UW System, and the GCC in carrying out groundwater protection programs. Solutions will encompass educational efforts, research needs, data management, institutional needs, as well as policy recommendations. The GCC's role is to facilitate the exchange of ideas with respect to the future of groundwater management in the state. Specific recommendations will be directed to the appropriate State agency or other entity for consideration.

Inventory of Karst Features. The GCC, through its Planning and Mapping Subcommittee, finalized the *Wisconsin Interagency Karst Feature Reporting Form* and distributed it to member agencies, local agencies, professional groups, and other interested entities in November 2000. The purpose of the initiative is to provide a means for collecting information on *karst*[3] features within the state and to develop a central repository for the completed forms. The GCC subcommittee also coordinated development of a karst web site in conjunction with the Wisconsin Geological and Natural History Survey and organized the *Karst Data Workgroup*, comprised of karst data experts from across the state. Eventually, the GCC hopes that a database will be created for use by agencies and researchers to 1) protect Wisconsin's groundwater resources and endangered species, 2) provide information for various land use planning activities, and 3) facilitate construction, agriculture,

3 **"Karst"** is the term used by geologists to describe areas where the bedrock, usually limestone or dolomite, has been (or has the potential to be) easily dissolved by surface water or groundwater. Karst landscapes may have deep bedrock fractures, caves, disappearing streams, springs, or sinkholes. These features can be isolated or occur in clusters, and may be open, covered, buried, or partially filled with soil, field stones, vegetation, water or other miscellaneous debris.

and resource planning and management activities. A copy of the *Wisconsin Interagency Karst Feature Reporting Form* and the accompanying cover letter are included in the Appendix.

Joint Solicitation. The GCC and the UWS GRAC continued coordination of the annual solicitation for groundwater research and monitoring proposals among state agencies. Twenty-seven projects were funded in FY 01 by one or more of the following agencies: UWS, DATCP, DNR and Commerce. The projects funded are listed in Table 1. The GCC approved the FY 02 joint solicitation package for groundwater research and monitoring to meet state needs. The package was sent out in September 2000 and is contained in the Appendix. A total of 30 project proposals were received. A comprehensive review process resulted in the selection of 21 new projects for funding for FY 02. The new projects selected by the UWS, DNR, and DATCP for funding in FY 02 are in addition to 11 projects that were carried over from FY 01. At their February 23, 2001, meeting the GCC unanimously approved the proposed UWS groundwater research plan as required by s. 160.50(1m), Wis. Stats. The UWS will fund 4 continuing and 10 new projects in FY 02. The FY 02 groundwater monitoring and research projects are listed by funding agency in Table 2.

Other coordination activities. 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)
- FY 02 Joint Solicitation
- FY 00 GCC Report to the Legislature
- UWS FY 02 Groundwater Research Plan
- Proposal writing workshop for FY 02 Joint Solicitation
- Ideas for improving FY 03 Joint Solicitation
- Staffing and program changes at the Central Wisconsin Groundwater Center
- Arsenic in groundwater in the Fox River Valley
- Pesticide metabolites in groundwater
- New (Cycle 8) NR140 Groundwater Standards
- Improving Wisconsin's high capacity well legislation
- The Perrier proposal for Big Springs, WI
- Planning for the Wisconsin Groundwater Summit
- Wisconsin's Comprehensive Planning/Smart Growth legislation
- Groundwater modeling in the Nine Springs Watershed in Dane County
- Monitoring baseflow and predicting nitrate concentrations in the Tomorrow-Waupaca River Watershed
- 2001 Midwest Groundwater Conference

WWW site. Several updates to the World Wide Web site for the GCC have been made in the past year. The site provides information on the activities of the council, a list of members on the council and members of the subcommittees, information on the annual Joint Solicitation for groundwater research proposals, documents in web viewable and downloadable format, and links to other relevant groundwater or related web sites including research summaries at the Water Resources Institute and a Karst information page at the WGNHS.

SUBCOMMITTEE ACTIVITY SUMMARIES

Research Subcommittee

The purpose of the Research Subcommittee is to assist the GCC in establishing priorities for groundwater research and monitoring activities and to review proposals submitted through the joint solicitation process. To this end, the subcommittee met in September 2000 to review and revise the priorities for the DNR's groundwater management

practice monitoring program for FY 02. The revised priorities were included in the joint solicitation distributed by the UWS, DNR, Commerce, and DATCP in October 2000.

The subcommittee met with the Monitoring and Data Management Subcommittee in December 2000 to review the 30 proposals that were received as a result of the joint solicitation. Subcommittee members made recommendations that were used by the three agencies and the UWS in deciding which groundwater-related proposals to fund for FY 02. The projects to be funded in FY 02 are listed in Table 2.

Monitoring & Data Management Subcommittee (MDMS)

The MDMS's goal is to coordinate groundwater monitoring and data management activities of state agencies to maximize value and efficiency. In FY 01 the MDMS reviewed the priorities for the DNR's groundwater management practice monitoring program for FY 02. The subcommittee met with the Research Subcommittee in September 2000 to revise the priorities to be included in the joint solicitation distributed by the UWS, DNR, Commerce, and DATCP in October 2000. The subcommittee met with the Research Subcommittee in December to review the research and monitoring proposals that had been received in response to the joint solicitation. Subcommittee members made recommendations that were used by the three agencies and the UWS in deciding which groundwater-related proposals to fund for FY 02. The projects to be funded in FY 02 are listed in Table 2.

MDMS members continued to work individually or in small groups on action items targeted by the subcommittee in FY 01. Progress was made on the following issues:

- Work on producing a list of Minimum Data Elements was influenced by two documents released during the year: the DNR's Locational Data Standards guidance and the National Water Quality Monitoring Council's draft Data Elements for Reporting Water Quality Results of Chemical and Microbiological Analytes. In light of the later document the subcommittee's efforts will include producing guidance for Wisconsin data managers on how to use the new national data elements.
- The DNR's Groundwater Retrieval Network (GRN) was made available on the DNR Bureau of Drinking Water and Groundwater web site. Staff from any agency can now access well sample data and use a variety of search and download tools.
- The DNR and WGNHS effort to electronically scan all well construction reports on file at the WGNHS was completed. The scanned images are available electronically to DNR staff for source water assessment work.
- The FY 01 Groundwater Monitoring Plan was published.
- Two additional forms were made available digitally for electronic submission though the DNR's Well Forms Program and web site. The Forms Program now includes forms for First Water Quality Test, Drinking Water Well Construction, Monitoring Well Construction, Monitoring Well Development, Well/Drillhole/Borehole Abandonment, Soil Boring Log Information, Groundwater Monitoring Well Information, and Groundwater Monitoring Well Inventory.
- The subcommittee continued to track the new confidentiality requirements of 1999 Wisconsin Act 88. The Act created uncertainty for DNR and DOT regarding which data shared from well construction reports and laboratory results.
- Two MDMS members took part in the Wisconsin Karst Data Workgroup meeting (see Planning and Mapping Subcommittee summary)

A continuing goal for the MDMS is for members to communicate on each program's monitoring programs and goals to prevent duplication and increase the utility of monitoring results.

Planning and Mapping Subcommittee (PMS)

The Planning and Mapping Subcommittee met five times during FY 01 (7/17/00, 9/6/00, 11/28/00, 2/14/01, and 6/11/01). PMS members continued to address four major groundwater planning and mapping issues: (1) inventory of Wisconsin's karst features and landscapes; (2) identification of groundwater quantity and quality issues important for comprehensive planning (i.e., Smart Growth); (3) discussion of a follow-up to the 1991 *Working*

Together to Manage Wisconsin Groundwater - Next Steps conference; and (4) update of member agency groundwater planning and mapping activities.

Inventory of Wisconsin's Karst Features and Landscapes**.** The PMS finalized the *Wisconsin Interagency Karst Feature Reporting Form* and distributed it to member agencies, local agencies, professional groups, and other interested entities. The subcommittee also coordinated development of the Karst Information web site, housed on the Wisconsin Geological and Natural History Survey site. This web site allows users to access the karst reporting form, contains pictures and descriptions of Wisconsin karst features/landscapes, and provides links to related karst research, datasets, and web sites. The PMS also organized the *Karst Data Workgroup*, comprised of karst data experts from across the state. The purpose of this workgroup is to help the PMS develop a plan for coordinating the statewide integration of new and existing karst datasets into one automated inventory and mapping system. The Karst Data Workgroup intends to propose activities, timelines, and funding for Phase 1 of this plan by Fall 2001. One member of the subcommittee also presented these karst activities at the *Eighth Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst*.

Identification of Groundwater Quantity and Quality Issues Important for Comprehensive Planning. The PMS discussed ways to help counties and local units of government identify groundwater quantity and quality issues during their comprehensive planning activities. The PMS reviewed guidance developed by Brian Ohm for the Natural Resource component of these plans. In FY 02, the PMS intends to develop a list of groundwater quality and quantity considerations relevant to other comprehensive plan components.

Follow-up to 1991 Working Together to Manage Wisconsin Groundwater - Next Steps Conference**.** The subcommittee also discussed whether the GCC should "redo" the 1991 *Working Together to Manage Wisconsin Groundwater - Next Steps* conference. Information from this 1991 conference was used assess and guide groundwater related activities of various state agencies. The group discussed several possible formats for a follow-up conference - and recommended that the State/Local Subcommittee become more involved in planning this conference. The follow-up Wisconsin Groundwater Summit is now scheduled for October 2001. The PMS will continue to help organize and conduct this conference, as needed, and will be primarily responsible for reviewing the report summarizing the discussions and outcomes of this conference.

Education Subcommittee

The Education Subcommittee met three times during the past year. Its mission is to review public information and education materials, coordinate educational messages among agencies, and serve as a forum to identify groundwater education needs, ideas and concerns.

The subcommittee made good progress on a public education strategy on groundwater quantity issues, which included a press release and teacher materials to accompany the groundwater quantity program “Water Rich, Water Poor” produced by Wisconsin Public Television. It also coordinated agency activities for Farm Progress Days and Drinking Water Week. It reviewed materials and strategies for communicating with physicians about arsenic in drinking water and other health risks. It provided input in revisions to the Groundwater Resource Directory, a DNR brochure on volatile organic compounds (VOCs) in drinking water, and a UW-Extension well information folder. It welcomed Amy Mager as the representative from the State Lab of Hygiene. At each meeting, representatives shared information about current agency activities related to groundwater.

Local Government Subcommittee (LGS)

The LGS was formed in 1993 to represent local units of government and organizations representing local units of government. The subcommittee was created by the GCC in response to recommendations from the 1991 conference “Working Together to Manage Wisconsin’s Groundwater – Next Steps?” The purpose of the Subcommittee is to serve as a means of communicating local government issues and concerns about groundwater protection to the state

agencies that make up the GCC, as well as to allow the GCC and its subcommittees to share information and get input about documents and publications.

The subcommittee has not met in recent years but did meet on October 10, 2000 to discuss how best to utilize the subcommittee to meet the needs of local governments. There was a consensus that the Groundwater Summit being discussed by the GCC could serve as an impetus for providing new directions for the LGS, as well as identifying new people or groups to become involved. The group also felt that the LGS had the potential to provide information to communities in their planning process, and provide help with addressing issues that may arise, such as the recent Perrier case. The group felt that the LGS could deal with regulatory issues, in sharing information about upcoming state initiatives, and giving local government groups a means of conveying their concerns to the state.

There was extensive discussion of preliminary plans for the Groundwater Summit to be held in October 2001. The intent is to model the conference after the 1991 conference that, among other things, led to the formation of the LGS. Subcommittee members provided input to help the planning effort for the meeting. The group felt that the Summit would help define the future direction for the LGS by defining specific issues to approach and providing an expanded group of people and interests to draw from. It was decided that the group would wait to meet until the results of the conference could be evaluated.

APPENDIX

Wisconsin Groundwater Coordinating Council
MEETING MINUTES – AUGUST 18, 2000

Members Present: Susan Sylvester (DNR), Jack Metcalf (Governor's Rep), James Robertson (WGNHS), Fran Garb (UWS), Nick Neher (DATCP), John Jackson for Carol Cutshall (DOT), Mark Werner for Henry Anderson (DHFS)

Others Present: Anders Andren (WRI), Jim Vanden Brook (DATCP), Ron Hennings (WGNHS), Byron Shaw, George Kraft, Victor Phillips, Steve Menzel (UW-Stevens Point), Jim Peterson, Steve Born, Marilyn Leffler, Terilynn Reese, Kurt Zeiler (UW-Madison), Tim Asplund, Lisa Morrison, and Bill Furbish (DNR), Gary Lueck (WRWA).

The meeting was held in the Board Room of the Department of Natural Resources Headquarters in Madison, beginning at noon.

1. **General Business** – Introductions were made. The minutes from the May 12th meeting were approved as written.

2. **Education Subcommittee Report** – Jim Peterson reported on the following activities:

   - Groundwater Education Resource Directory – The Subcommittee is working with Tim Asplund to revise and update this directory, last revised in 1994. The plan is to make the information available on the internet, as well as in the current "handbook" version. The subcommittee hopes to have it finalized by January 2001.
   - Drinking Water Awareness Week – The Subcommittee hopes to coordinate activities to raise awareness about drinking water issues during this week, which occurs the first week in May, 2001. The subcommittee will be seeking grants to help pay for these activities and will begin planning at its next meeting in September.
   - Farm Progress Days – Several agencies were represented at this year's Farm Progress Days held in Fond du Lac County in July. Of about 200 samples submitted for nitrate testing, 12% exceeded the 10 ppm standard, in line with current statewide estimates of nitrate contamination. Each of the agency booths handed out a magnet designed by Subcommittee members with a well testing checklist and DNR's Drinking Water and Groundwater Bureau phone number. The Wisconsin Groundwater Association sponsored the cost of the magnet production.
   - Arsenic in Drinking Water brochure – The brochure was a hot item at Farm Progress Days, and staff fielded many questions about the arsenic issue.

3. **Planning and Mapping Subcommittee Report –** Tim Asplund and Lisa Morrison reported on the following activities:

   - Next Steps II – Tim Asplund distributed a handout describing ideas that the Subcommittee developed in regards to revisiting the 1991 document "Working Together to Manage Wisconsin's Groundwater – Next Steps?" The Subcommittee suggested a phased approach, including listening sessions held around the state to gather initial input, a survey of local governments, a statewide conference, and a final report or set of recommendations. The Subcommittee felt that it would be useful to organize the listening sessions around issues of local or regional concern (arsenic, groundwater withdrawals, nitrates or pesticides), and to hold them in conjunction with other events (educational forums or hearings). Finally, with the current level of awareness and activity surrounding the Perrier issue, the Subcommittee felt that it would be a good time to talk about issues surrounding water use and water quantity, and what the state could be doing to help guide management of groundwater use. Nick Neher raised some concerns about the listening sessions, wondering if participants would be most concerned about regulatory issues, which the GCC has no direct control over. Nick also stated that the GCC needs to stake out its role in regards to any

recommendations that are made and decide what to do with the rest. Susan Sylvester suggested that specific invitations be made to a target audience, rather than the general public. Jamie Robertson asked that the Subcommittee be clear about "Who do we want to listen to? What do we want to hear? and What will we do with the information?" Also, Jamie cautioned against rushing into things, saying that the dates suggested in the handout were too optimistic. In general, there was support for following the model of the first "Next Steps" conference and further refining the format and purpose of the listening sessions. The GCC asked the Subcommittee to discuss these issues with itself and other groups and report back at the next meeting.

- Interagency Karst Reporting Form – After many months of development and revision, the subcommittee is ready to release its Karst Form to be used by agency and other staff to document karst features that they encounter during field investigations. The Subcommittee hopes to approve the final version at its next meeting on Sept. 6. The WGNHS will serve as the repository for the forms, which are currently available in paper format only. Lisa Morrison handed out the latest version, along with a list of further items to be discussed by the Subcommittee. The next task is to make plans for distributing the form among agency staff and to identify other parties that may find the form useful, or that may be able to assist in collecting the information. Future tasks will be to build an electronic database and possibly to allow electronic submittal and querying/retrieving of the data. The Subcommittee will evaluate the form's use before proceeding with further efforts.

4. **2000 Report to the Legislature –** The GCC unanimously approved the annual report as written, with one change suggested by Fran Garb to eliminate out-of-date references from the list of UWS Faculty and Staff Publications and Presentations. Tim Asplund asked the GCC whether the Benefits of Groundwater Research Projects section should reflect current research only, or could include older information as currently written. Jamie Robertson suggested that each entry should be updated with new information as needed, but that older information should be kept as long as it was still relevant.

5. **FY 02 Joint Solicitation** – Tim Asplund handed out a timeline for the next round of the joint solicitation for groundwater projects. Two significant changes from last year were an earlier deadline for proposals (13 November) and earlier GRAC and GCC review and approval dates to allow the WRI more time to seek matching funds from other sources. In addition, electronic submission of proposals will be required in addition to the traditional 3 paper copies. This will allow quicker and easier distribution of proposals for review, and may be an intermediate step along the way toward web-based submission. Susan Sylvester noted that the Proposal Writers Workshop will be held again this year (mid-October), and encouraged everyone to promote it among their research contacts.

6. **Central Wisconsin Groundwater Center (CWGC) and Environmental Task Force (ETF) Program**– Dean Victor Phillips, of UW-Stevens Point College of Natural Resources (CNR) gave an overview of CNR and discussed 2 recent vision initiatives that pertain to the CWGC and ETF programs. CNR has about 1400 students in its natural resources programs, including 120 graduate students. The CNR is one of the two largest undergraduate natural resources programs in the country. One of the vision initiatives is to develop a Watersheds Center, which would house ETF, CWGC, the Wisconsin Lakes Partnership, and Water Resources faculty within CNR. CNR is currently working with DNR to fund the Center in the next biennial budget. CNR is also seeking federal support for a Global Environmental Management Education Center and has created a new Associate Dean for Outreach and Extension position. Dean Phillips expressed his thanks to Byron Shaw for all his work with CNR and ETF over the years.

   George Kraft then gave an overview of the previous and current structure and mission of water programs at UWSP. In the past, the CWGC and ETF programs were separate, with CGWC focused on educational, planning, and policy assistance related to groundwater, and the ETF focused on water related research and analysis. Most of the ETF program was soft-money funded, while CWGC received a greater amount of GPR. With the retirement of Byron Shaw as Director of the ETF, the college began seeking ways to restructure the program, while keeping its current level of activity. The solution was to have one director for both programs, and to more fully integrate their activities with the academic programs of CNR. A second component was to

hire a non-point pollution specialist to help support the ETF laboratory. By combining the two programs, it is hoped that funds generated through the outside research and contracts of the ETF can subsidize the outreach programs coordinated primarily through CWGC. George appealed to the GCC for help in increasing the contract stream to CNR through its agency research and monitoring programs.

7. **Technical Presentation on the Tomorrow/Waupaca River Watershed Project** – Byron Shaw, of UW-Stevens Point College of Natural Resources, presented findings from a recent project that was funded partially through GCC Joint Solicitation funds. The hypothesis of the study was that baseflow samples collected from headwater streams during the winter are an indicator of average groundwater quality within the watershed. The Tomorrow/Waupaca River Watershed was used for this study because of its mix of land uses and residents concerns about groundwater quality. Sampling was done for nitrates, triazines, phosphorus, and other constituents in both wells and adjacent streams during both summer and winter time periods. Groundwater flows have been mapped, such that groundwater recharge areas, streamsheds and associated land uses could be determined for each sampling site.

   The study found a good correlation between average nitrate concentrations in wells and stream baseflow, though concentrations were higher in the wells. Percent of land in agriculture was directly correlated to nitrate concentrations; however, correlations were better in second order than in first order streams. Irrigated agriculture was not very well distinguished from non-irrigated land use. Based on these results, Byron estimated that 35% of N that is applied to agricultural lands (assuming university recommended application rates) is being leached to groundwater. Further work could be done on refining the scale of the land use information to help make better connections between surface water and groundwater. In terms of P, the study found that reactive P in baseflow was correlated to total P in high flow during spring runoff. This finding suggests that some of the TP is ending up in sediment and being released as reactive P during low flow. Thus monitoring of baseflow could be a good way to characterize groundwater quality as well as better reflect the watershed's contribution to downstream eutrophication problems.

   Susan Sylvester thanked Byron for his presentation and presented him with a Resolution of Appreciation from the GCC for his 15 years of service on the Monitoring and Data Management Subcommittee and his "hard work and dedication to the protection of Wisconsin's most valuable natural resource."

8. **DATCP Water Quality Report** – Jim Vanden Brook presented an overview of DATCP's water quality monitoring projects related to pesticides in groundwater.
   - Monitoring Well Program – This program originally had 50 sites with clusters of 3 monitoring wells located downgradient of an agricultural field. 26 sites are still being monitored. All of the sites are located in areas though to be susceptible to groundwater contamination (sandy soils, irrigated, shallow depth to groundwater), primarily in Wisconsin River Valley and Central Sands. In 1999, 8% of the sites exceeded the Enforcement Standard (ES) for atrazine (3 ppm), and 72% exceeded the ES for nitrate (10 mg/L). A variety of other pesticides were also detected in many wells.
   - Acetochlor Monitoring – EPA has conditionally registered this pesticide with a requirement that monitoring be done for 5 years in 7 states. 25 sites are located in Wisconsin, including some in silt loam soils. Acetochlor was not detected in any of the Wisconsin wells in 1999. Atrazine exceed the ES in 8% of the wells, and nitrate exceeded the ES in 64%. Several other pesticides were detected. Monitoring will continue for 2 more years.
   - Monitoring Reuse of Atrazine – Wells are sampled quarterly from fields treated with atrazine that were previously designated as atrazine prohibition areas. The monitoring sites are located in the middle of the field rather than downgradient. Most areas had not had atrazine applied for 5-6 years prior to sampling. No temporal trends have been detected yet. In 1998, and 1999, 59% of the wells exceeded the ES for atrazine. 100% exceeded the ES for nitrate. In most cases, concentrations spiked soon after atrazine was reapplied indicating relatively quick travel time, as well as recovery.
   - DATCP Exceedence Survey – 148 private wells are being sampled annually around the state which had exceeded a pesticide standard (usually atrazine) in the past. This survey is the first step in the repeal of atrazine prohibition areas. In 1999, 30% exceeded the ES for atrazine, representing a 13% decrease since

1995. 66% of the wells exceeded the ES for nitrate, representing a 6% increase. Other pesticides are showing up as well.

- Metabolite Monitoring – DATCP has completed a study sampling for ethane sulfonic acid (ESA) and oxanilic acid (OA) degradates of Acetochlor, Alachlor, and Metolachlor in 73 wells in Wisconsin. Wells included 27 monitoring wells located on fields that have had alachlor applied in the past or had detects in the well, 23 water supply wells which had detects of alachlor ESA, and 23 municipal supply wells. The latter were selected either because of pesticide detects, proximity to agricultural areas, or because they were one of 7 biggest systems in the state. Almost all of the monitoring and private wells had detects, while half of the municipalities had detects of either metolachlor or alachlor metabolites. Acetochlor metabolites were not detected in municipal wells, but this pesticide has only been in use for 5 years (compared to 20 years for the others), and may not have reached municipal wells which are deeper and further from application areas. Ron Hennings mentioned that 5-year travel times should be available for most of the municipal wells soon if not already, which may be useful for predicting if and when the metabolites may show up. DATCP will be doing a statewide survey of private wells next. The information from these studies will be useful as DNR and DHFS consider a groundwater standard for alachlor ESA.

9. **DHFS update –** Mark Werner updated everyone on several DHFS activities-
   - Alachlor ESA standard – Staff are starting to look at the available data and literature on alachlor ESA. There is some suggestion that the metabolites may be less toxic than their parent compounds because the Cl atom is cleaved.
   - Nitrate poisoning cases – Mark distributed copies of a recent article authored by Lynda Knobeloch and others on 2 recent infant nitrate poisoning cases in Wisconsin. The article appeared in the journal Environmental Health Perspectives and can be viewed on the web.
   - Arsenic Study – A GCC funded project to test private wells for arsenic in 3 townships is underway. Three meetings have been arranged to start communicating the results to well owners. Companion surveys are being distributed with the sample kits. About 100 of these have been returned so far. The intent of the study is to better understand the relationship between arsenic exposure and disease. Costs have been as low as $20 for the arsenic tests. Samples continue to produce high values – one received from the Town of Algoma on the day of the meeting was 2300 µg/L.

10. **Modernizing Wisconsin's High Capacity Well Law –** Steve Born, from the Department of Urban and Regional Planning at UW-Madison introduced the next topic, which was the outcome of a graduate-level water resources policy class this past spring. Steve iterated his support for the Next Steps II planning process, saying that it represented a good opportunity for the GCC to get out on top of water quantity and water use issues and could put Wisconsin into a good position to manage groundwater into the next century.

    Marilyn Leffler, a water resources management graduate student, presented an overview of the report, due out in mid-September. The report discusses the potential impacts of high capacity wells on the environment, summarizes the existing law for managing groundwater in Wisconsin, reviews programs in selected states, and discusses issues and strategies for improving groundwater quantity management in Wisconsin. The report is entitled "Modernizing Wisconsin Groundwater Management: Reforming the High Capacity Well Laws" and will be available from The Department of Urban and Regional Planning, UW-Madison/Cooperative Extension, 112-A Old Music Hall, 925 Bascom Mall, Madison, WI 53706 for $7.00 per copy.

    Marilyn gave an overview of four cases studies that are documented in the report and discussed some approaches that other states have taken. For example, Florida requires consideration of groundwater and surface water quality, wildlife, recreation, and wetlands in permits for high capacity wells. Minnesota takes an adaptive management approach, allowing conditional permits that can be adjusted based on monitoring reports. Marilyn identified existing laws that could be invoked to expand the state's authority to regulate high capacity wells, including public trust doctrine, nuisance common law, and statutory and discretionary rules. In addition, she listed several recommendations for new legislation, including explicit recognition of the connection

between surface and groundwater, expanded permit review, monitoring and reporting requirements, limiting exemptions, and allowing for consideration of cumulative impacts and future resources.

Nick Neher asked whether any projections were made in the report regarding increased demands or uses by agriculture. Steve responded that the report did not make projections, but that he hoped agencies will begin doing so, based on the information that is presented. Steve also mentioned that Smart Growth planning at the local level should be sure to take groundwater issues into consideration. Steve also outlined the strategy for publicizing and making use of the report, saying that possible directions include legislative hearings, a legislative council study, presentations to interest groups, media educational components, and plugging into land use planning and other initiatives.

The meeting adjourned at 3:05. The next meeting is scheduled for 12 noon on November 10th at the WGNHS on Mineral Point Road in Madison.

Respectfully submitted,

Tim Asplund, Water Resources Specialist
Department of Natural Resources

Wisconsin Groundwater Coordinating Council
REVISED MEETING MINUTES – NOVEMBER 10, 2000

Members Present: Susan Sylvester (DNR), Jack Metcalf (Governor's Rep), James Robertson (WGNHS), Fran Garb (UWS), Nick Neher (DATCP), Carol Cutshall (DOT), Henry Anderson (DHFS)

Others Present: Jim Hurley (WRI), Sue Swanson (UW-Madison), Tim Asplund, Mike Lemcke, and Bill Furbish (DNR), Bob Pearson (DOT).

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

1. **General Business** – Introductions were made. Tim Asplund mentioned that minor modifications were made to the draft minutes from the August 18th meeting that he distributed earlier. The minutes were approved as amended. Tim informed everyone that he had updated the GCC website and was interested in making minutes available there. Susan Sylvester suggested waiting until the minutes had been approved at the subsequent meeting before posting. Several members mentioned that they appreciated receiving subcommittee minutes with the agenda for the meeting rather than separately. Tim will be sure to schedule subcommittee meetings enough in advance of the GCC meetings so that minutes can be included.

2. **Planning and Mapping Subcommittee Report** - Bob Pearson reported that the Subcommittee approved the final version of the *Wisconsin Interagency Karst Reporting Form* at its meeting on Sept. 6. Bob, Tim Asplund, and Mindy James of WGNHS developed a web site to house the form in electronic format and to provide background information on karst with links to maps, photos, and other websites pertaining to karst. The "karst page" can be accessed online. In the next few weeks, Tim and the Subcommittee will focus on getting the word out among agency staff as well as external partners. Tim passed around a draft of the cover letter that will be [was] distributed with the form in November. The letter was endorsed by the GCC with a couple of modifications. Tim asked if the language at the bottom of the letter describing the purpose of the GCC could be used on future mailings to external recipients. It reads "*The GCC is an interagency group that is directed by law to assist State agencies in the coordination and exchange of information related to groundwater programs.* " The GCC approved the language and its use in the future. Susan also suggested including a copy of the GCC brochure with any mailings.

3. **Monitoring and Data Management Subcommittee (MDMS) Report** - Mike Lemcke reported that the MDMS met on Sept. 11 to review tasks and issues that the Subcommittee had been working on in the past and to touch base with each other on current activities. Some of the items discussed were:
   - Act 88 - The implications of this act, which went into effect on Nov. 1st, are still unclear in regards to sharing information on groundwater monitoring data among state agencies and providing information on well construction data. This item will continue to be on the MDMS agenda in future meetings.
   - Minimum data elements - A work group that was formed to look at this issue decided that the DNR standards were reasonable and should be used by other agencies. The Subcommittee will suggest that other agencies at least include latitude/longitude information on forms as they are revised.
   - Databases and electronic data submittals - Discussions on making data accessible to partner agencies

     continued.
   - WUWN - The Subcommittee will continue to encourage staff to make use of Wisconsin Unique Well Numbers on monitoring wells and work on linking databases through this identifier. Susan mentioned that there was an issue with the permanence of the WUWN labels (i.e. tampering, weathering). Mike said that this issue would also continue to be addressed.
   - Other issues - The Subcommittee would continue to monitor other issues, such as the integration of groundwater data into land use initiatives such as Smart Growth.

4. **Education Subcommittee Report** – Tim Asplund reported on the following activities:

- Changes in membership - Amy Mager, of the State Laboratory of Hygiene, is the newest member of the Subcommittee and will help provide an important link to that group. Dorie Turpin will be taking the place of Bill Rock, representing the Private Water Systems Section of the DNR.
- Groundwater Education Resource Directory – The first two sections have been revised, listing agency and staff contact information. Tim is working on compiling the third section listing resources and publications. Everyone except NRCS had provided their updated list of resources to Tim by the November 1st deadline. January 2001 is still the targeted completion date.
- Groundwater Awareness Week and other "weeks" – The Subcommittee decided to offer its help to the WWWA in promoting this week, which is scheduled for sometime in January. The Subcommittee will also be sure to provide information on the GCC at agency booths during the WWWA conference. The Subcommittee agreed that it could take the role of providing press releases about the three different groundwater-related weeks during the coming year and serve as a clearinghouse for providing information about activities and resources available.
- Getting drinking water information to physicians – The Subcommittee discussed ways to get information on drinking water issues to physicians and health care providers. One idea is to provide information or make presentations during "grand rounds" at various clinics. This is the route being used to spread the word on arsenic in the Fox River Valley.
- VOC brochure - Tim passed around a draft version of this DNR brochure, due to be printed by the end of year. The Subcommittee had substantial input into the text and layout of this brochure.

5. **Local Government Subcommittee** - Tim Asplund reported that the LGS met on October 11th to review its purpose and provide input on the Next Steps II planning process (see below). It was a successful meeting, with most of its members in attendance. The general feeling among the group was that the LGS could provide a useful role in communicating information and needs from local governments and technical staff to state agencies, as well as assist the agencies with getting information out to local partners. However, the LGS needed to have some direction on specific issues to respond to or tasks to take on, rather than meet for the sake of meeting. Many good ideas were generated for the Next Steps II planning, and the group decided to use the findings from that process to provide direction and identify new members to broaden the participation for future LGS activities.

6. **FY 02 Joint Solicitation** – Tim Asplund reported that the deadline for groundwater proposals was Monday, November 13th. As of the 10th, he had only received 5 proposals, but was expecting at least 20 based upon inquiries and information from other agency staff. [A total of 30 proposals were received and are under review]. A Proposal Writing Workshop was held on October 24th. Only 6 potential researchers attended, but the participants gave positive feedback on the content and presenters. A suggestion was made to offer the workshop at different locations in the future (e.g. other UW campuses). Another alternative would be to offer the workshop every two years. Nick Neher suggested using video-conferencing to reach a wider audience. Tim and Jim Hurley will look into this possibility for the next solicitation. Henry Anderson asked that we be sure to include tribes on our mailing list and workshop invitations. The Research and Monitoring & Data Management subcommittees will meet on December 19th to review and rank the proposals.

7. **WRI proposal for pre-approval of continuing projects** - Jim Hurley handed out a proposal from the Water Resources Institute regarding GCC's approval of UWS groundwater projects for FY02. In order to maximize resources, the WRI has been partially supporting some projects submitted through the Joint Solicitation with USGS base program funds. Jim stated that the WRI would like to do the same this year with four continuing projects (Anderson, Armstrong, Browne, and Turyk), freeing up about $46,702 for funding new projects. However, the USGS requires that WRI submit its request by January 15th, a month before the GCC is scheduled to approve the UWS groundwater program for FY02. This is an issue, because GCC must approve the groundwater research program for UWS each year. Thus, Jim requested that the GCC grant approval at this time for submitting these 4 projects for partial funding by USGS. Nick Neher asked if the 4 projects were meeting contract obligations, i.e. making progress. Henry Anderson mentioned that it might be good to have a process for approving continuing projects based upon reports being submitted on time and budgets being in order. Jim mentioned that WRI currently does not require quarterly reports as the DNR does. Nick Neher

moved that "*the GCC give WRI approval to fund the second year of four UWS continuing projects contingent upon demonstrated acceptable progress and honored terms of existing contracts."* Jack Metcalf seconded the motion and the motion carried on a unanimous vote.

8. **Research Summaries and Final Reports** - Jim Hurley reported that final reports for UWS funded projects will no longer be produced by the WRI. PIs will now be expected to write final reports, using a 15-page format that will be provided to each PI. Jim handed out a copy of the new format. Two-page research summaries will be part of the final report, and will follow the format that the DNR is currently using. The summaries will be posted on the web. Jim reported that he and Tim are currently working on getting the research summaries for past DNR, UWS, and DATCP projects on the WRI web site as well.

9. **"Next Steps II" groundwater management workshop** – Tim Asplund provided an update of the progress made on planning for a workshop to scope out the future of groundwater management in Wisconsin. Both the Planning & Mapping and Local Government Subcommittees spent much of their time at recent meetings discussing ideas and giving input. Tim handed out a summary page identifying potential participants, format of the conference, timing, funding issues, and final outcomes based on these discussions. Tim pointed out a few of the highlights and received input from the GCC on several items:
   - Format - The Subcommittees felt that effort should be concentrated on a one-time conference or workshop rather than a series of sessions held around the state. The GCC supported that idea.
   - Participants - Several suggestions for additional participants were made, including cranberry growers, power companies, the bottled water industry, Federal agencies (EPA, USGS, NRCS, Forest Service), and state agencies not represented on the GCC.
   - Outcomes - Carol Cutshall reiterated that the GCC should not use the results of this conference to make recommendations to the legislature on policy matters. Jamie Robertson asked if the GCC should be facilitating the conference or whether it was really an agency or UW-Extension initiative. Mike Lemcke said that the GCC is the facilitator and that it is within its purview. Jamie suggested that the outcome of the workshop be presented as findings, and that the purpose of the conference would be to identify issues rather than propose solutions or specific recommendations.
   - Funding - Registration fees might be a good way to encourage commitment and put an added value on the conference. However, participation should be affordable. Agencies may be asked to pitch in to cover some of the costs. Tim will bring a proposal to the GCC at the next meeting with cost estimates and how the funds would be obtained.
   - Timing - We need to be aware of the field season when planning the conference. Early September was suggested as a more appropriate time, and would give more time to make arrangements.
   - Planning - Tim reported that he was going to convene a Steering Committee consisting of representatives of the groups identified as participants. This group will meet once or twice during the winter to plan the scope and format of the workshop, identify groups to be invited, and suggest topics for breakout groups and keynote talks. Carol volunteered Bob Pearson to assist Tim with the details and logistics of the meeting planning itself.

10. **2001 Midwest Groundwater Conference** – Jim Hurley reported that Wisconsin will be hosting this annual conference in 2001. It will be held October 22-24 at the Inn on the Park in Madison. Ken Bradbury (WGNHS) is the chair. The conference generally draws about 200 people from around the Midwest and will consist of field trips, technical sessions, and a poster social. Current sponsors are WGNHS, WRI, and the DNR. Jim asked if the GCC would also like to be a sponsor. Everyone agreed enthusiastically.

11. **Update on Perrier** – Bill Furbish, of DNR, provided an update on the application by Perrier Group of America, to install two high capacity wells to support a bottling operation near Big Springs in SE Adams County. Bill brought in a detailed map of the site showing the proposed test and monitoring well locations, adjacent wetlands and streams, and surface water monitoring sites. Bill reported that Perrier was currently conducting pump tests of 1000 gallons per minute (GPM) at the site and would continue for 14 days. Data generated as part of the tests will be used in models (MODFLOW and G-FLOW) to predict the long term

impacts of the wells and set the permitted pumping rate. Groundwater levels, as well as streamflow and surface water levels would be monitored throughout the test period. Fourteen days was chosen to approximate equilibrium conditions for modeling purposes. Bill reported that George Kraft of UW Stevens Point and Jim Krohelski of USGS would be involved in the modeling. Jack Metcalf asked why Perrier chose Big Springs. Bill responded that Perrier needed a "big" spring to meet their bottling needs, and that they needed to locate near a flowing spring to meet FDA rules for spring water. Bill said that Perrier has been in Wisconsin for several years looking for suitable sites.

Mike Lemcke reported that the legislature was likely to consider several initiatives that would give the DNR more authority in future high capacity well cases. For example, the legislature may choose to give the DNR the ability to set criteria for deciding when an Environmental Assessment (EA) would be required. Bill reported that DNR currently issues about 200 high capacity well permits in a year. About half of these are temporary and the other half are irrigation or industry related. Only a handful of them are controversial. For comparison purposes, in a dry year a typical irrigation well would pump 1000-1500 GPM; however, water would not be pumped continuously. Perrier's proposal of 500 GPM would consume 5-6 times as much water on an annual basis. Most other agriculture operations are small in comparison. City water supplies, which have comparative pumping rates, usually draw upon deep aquifers. In addition, the water that will be pumped by Perrier will be leaving the site, unlike most other operations. Thus there is cause for concern in this case.

Bill reported that three lawsuits are currently underway to block Perrier for proceeding with their proposed operation. Two of them are against the DNR saying that the conclusions of the EA are wrong and that a full Environmental Impact Statement needs to be done. A third has been filed against Perrier, saying that current zoning does not permit the wells that are being used for testing. These suits will likely delay the process.

Susan Sylvester expressed the need for a statewide picture of groundwater levels in order to model of the effects of such withdrawals. Efforts have been made locally and regionally in some cases, but there needed to be someone to integrate information or coordinate efforts to get a statewide perspective. Everyone agreed that this was a critical need and that it brought up other issues, such as water conservation and water rights. Jamie Robertson pointed out that there are regional models available (Dane County, SEWRPC) and that groundwater level information would be completed for 18 counties by 2002. Models may be able to be applied on a case level in other areas, but it would take a long time to have that level of detail available statewide.

12. **Technical presentation on the Nine Springs project –** Sue Swanson, a graduate student in the UW-Madison Department of Geology and Geophysics, gave a presentation on a 3-year project partially funded by the DNR through the joint solicitation. The Nine Springs watershed, located in the heart of Madison, has experienced dramatic declines in wetland area and degradation of native wetland plant communities due to extensive agriculture and urbanization. However, pockets of high quality wetland still exist, primarily in the vicinity of springs. These springs are an important part of the local water budget, and they have unusually steady flow rates. The objective of the study was to test conceptual models of the local hydrogeology in order to better understand the geologic controls on the magnitude of spring flow as well as the steady nature of the spring flow. The three conceptual models were that the springs and their observed flow characteristics can be attributed to 1) heterogeneity of the surficial glacial deposits; 2) preferential flow paths along shallow sandstone layers; or 3) windows in the Eau Claire aquitard which might allow water from the lower bedrock aquifer to contribute to spring flow. This information can then be used to better predict impacts of increased groundwater use and changes in land use.

    Sue used flow data, natural gamma logs, and conducted packer tests to help characterize the hydrostratigraphy in the Nine Springs area and to test the conceptual models. She also used generic numerical models to simulate observed groundwater flow conditions in the watershed including steady spring flow (>0.1 cfs) and diffuse groundwater discharge to wetlands (<0.3 ft/d). She concluded that the most likely scenario was #2, which suggests that springs and their observed flow characteristics may result from preferential flow through shallow, high-permeability sandstone layers. The implications of this work are that increased municipal pumping may

not have immediate effects on the springs since wells draw primarily from the lower bedrock aquifer, but that land use practices that affect groundwater recharge are more likely to affect spring flow.

13. **Meeting dates for 2001 –** February 9th at Water Resources Institute, May 11th at DNR Service Center in Dodgeville, August 17th at DNR Central Office, November 9th at DATCP.

The meeting adjourned at 3:05. The next meeting is scheduled for 12 noon on February 9th at the Water Resources Institute on the UW-Madison campus.

Respectfully submitted,

Tim Asplund, Water Resources Specialist
Department of Natural Resources

Wisconsin Groundwater Coordinating Council
CONFERENCE CALL MINUTES – FEBRUARY 23, 2001

Members Participating: Susan Sylvester (DNR), Jack Metcalf (Governor's Rep), James Robertson (WGNHS), Nick Neher (DATCP), Carol Cutshall (DOT), Henry Anderson (DHFS)

Other Participants: Jim Hurley (WRI), Tim Asplund and Jeff Helmuth (DNR), Christine Mechenich (Central Wisconsin Groundwater Center).

The conference call began at 11:00 AM. Note that this call replaced the February 9th meeting that was canceled due to inclement weather.

1. **General Business** – Introductions were made. The minutes from the November 10th meeting were approved without modification.

2. **Planning and Mapping Subcommittee Report** - Tim Asplund reported that the Subcommittee has been actively distributing the *Wisconsin Interagency Karst Reporting Form* and has been getting responses from many quarters. The WGNHS has received approximately 15 forms as of mid-February. It has become apparent that there are many people interested in this effort and that the next step will be to deal with existing databases and data sources. Tim reported that the Subcommittee would like approval to convene a "Karst Working Group" or task force to bring together people from various agencies that might have existing information on karst features. The purpose of the group would be to identify existing sources of information related to karst and to help determine whether and how to combine this information into one database or link it together in some other manner. Nick Neher suggested that the Subcommittee compile a list of potential participants and clear it with Susan Sylvester before proceeding.

   Tim also reported that the Subcommittee has been discussing the recent "Smart Growth" or comprehensive planning legislation and how the GCC might be involved in providing guidance to local governments on groundwater issues and data sources. One idea was to provide input to or review guidance documents being developed for the different "elements" that will be required in future comprehensive plans. Nick Neher suggested that the Subcommittee contact the DNR representative on the Wisconsin Land Council to see how the GCC could be involved. Jamie Robertson mentioned that WGNHS will be reviewing the Natural Resources component of the guidance and would be sure that groundwater issues are being considered.

3. **Monitoring and Data Management Subcommittee (MDMS) Report** - Jeff Helmuth reported that the Subcommittee is making an attempt to include review of monitoring activities in its regular meeting agenda, but that most of the time is spent on data management issues. Jeff highlighted the following discussion items from its January meeting:
   - Act 88 - This Act could have a major impact on distributing groundwater data among agencies via the internet, due to privacy concerns about disclosing personally identifiable information about well owners. A current proposal in legislative committee would make this Act apply only to licensing and registration databases. If the final interpretation is broader, DNR will likely use a log-in/password system to their groundwater databases to allow full access to other agencies.
   - Minimum data elements -The Subcommittee has been working to revise this list of minimum data elements for groundwater databases to reflect recent changes in DNR's Locational Data Standards. Once completed, the Subcommittee will present the list to the GCC for endorsement and then make them available to other agencies and local governments. Finally, the Subcommittee is hoping to present these elements to the Land Information Board for adoption as standards for GIS databases.
   - Other issues - The Subcommittee also discussed the new locational data standards and GPS Guidance documents that Lisa Morrison recently completed, the updates to the Well Forms Program developed by Randell Clark, a new SWAP susceptibility determination module, and WGNHS interest in bringing together their hydrogeology data into a unified database.

   The next meeting of the MDMS is scheduled for April 24, 2001.

4. **Education Subcommittee Report** – Chris Mechenich greeted everyone and welcomed the opportunity to address and touch base with the GCC. Chris reported on the following activities:
   - Groundwater Quantity and Conservation - The Subcommittee began a discussion about education needs related to groundwater quantity and water conservation at the last meeting and plans to continue that discussion at their meeting in March. Some preliminary ideas include a web site devoted to groundwater quantity, a poster for display purposes, and an updated brochure.
   - GCC Web Site – The Subcommittee will be looking at ways to make use of the GCC web site as a means of providing groundwater information and educational materials to a more general audience.
   - Groundwater Awareness Week and other "weeks" – The Subcommittee agreed that it could take the role of providing press releases about different groundwater and drinking water awareness weeks and serve as a clearinghouse for providing information about activities and resources available. For various reasons, the Subcommittee was not able to coordinate a press release for Groundwater Awareness Week in January, but is on track for Drinking Water Awareness Week in May. Since this week will occur prior to the next GCC meeting, Chris asked if the GCC wanted to have input or approval of any press release that the Subcommittee composes. The press release would likely be on GCC letterhead and would contain generic information pertaining to available resources and tips on water conservation. Nick Neher suggested that the Subcommittee works with Susan Sylvester to approve the press release and work through DNR channels to get it distributed. The rest of the GCC concurred.

5. **FY 02 Joint Solicitation** – Tim Asplund gave an overview of the Joint Solicitation process and provided some statistics on the proposals that were received. A total of 30 proposals were submitted, 26 of which were eligible for UWS funding. The proposals averaged about $33,000, totaling over $1 million for FY02. New researchers submitted six of the proposals. Proposals were received from 4 different UWS campuses, the State Laboratory of Hygiene, the US Geological Survey, and two private institutions. A tentative list of proposals to be funded by DNR and DATCP was included with the meeting agenda, but will not be finalized until the state budget has been passed. Commerce decided not to fund any of the proposals that were submitted

6. **FY02 UWS Groundwater Research Plan** - Jim Hurley reviewed the 4 currently funded projects that will continue into FY02. At the last meeting, the GCC had given conditional approval to funding these projects. The WRI was able to use matching US Geological Survey funds to cover salaries and some supplies for these projects, which resulted in approximately $225,000 for new projects in FY02 (not including fringe). The Groundwater Research Advisory Council (GRAC) met on February 1st and reviewed all 26 proposals that were eligible for UWS funding. The final list of 9 projects recommended by GRAC for UWS funding took into account the intentions of DATCP and DNR, external reviewer comments, GCC Subcommittee ratings, available and requested funds, relevance of projects, and PI qualifications. Henry Anderson moved to accept the FY02 UWS Groundwater Research Plan for new and continuing projects as presented. Nick Neher seconded the motion and the motion carried on a unanimous vote. [Fran Garb also voted to accept the plan in absentia.]

7. **"Next Steps II" groundwater management workshop** – Tim Asplund provided an update of the progress made on planning for a workshop to scope out the future of groundwater management in Wisconsin. Tim convened a Planning Group consisting of representatives from some of the different groundwater constituencies (agriculture, environmental, municipalities, academia, industrial users, etc.). This group has met twice (January 17th and February 19th) and plans to meet on March 20th to make some final decisions. Some of the decisions made so far:
   - Tentative conference title: "Wisconsin Groundwater Summit - Setting the Agenda for Critical Issues"
   - Location: Waukesha County - tentative reservations have been made at the Country Inn Hotel in Pewaukee for October 30-31, 2001.
   - Format of meeting:

- Day 1: early AM - Keynote presentations on status of groundwater quantity and quality, issues or drivers affecting groundwater, progress report on groundwater management, identification of trends and projections of groundwater use, case studies
- Day 1 Late AM - Panel discussion involving Keynote presenters and representatives from key user groups and stakeholders
- Day 1: early PM - 4 -6 Breakout sessions, with assignments made in advance. All groups would be given a set of questions to address, with the direction of a facilitator and note-taker
- Day 1: Late PM - Wrap up session with reports from smaller groups
- Day 2: AM - Core group meets to synthesize information presented and discussed on previous day and to develop outline for conference proceedings or other outcomes

Decisions to be made at the next meeting include 1) Who should be invited to participate in the conference, and how should the invitations be made? 2) Who should we ask to give keynotes or participate in panel? And 3) What specific questions should we ask participants to address in the breakout sessions?

The GCC offered some suggestions for keynote speakers, including Susan Sylvester (DNR and GCC), Ken Bradbury (WGNHS), Jim Krohelski (USGS), and former Governor Tony Earl. Chris Mechenich suggested looking into a professional facilitator to help facilitate the break out sessions. Nick Neher suggested working with each agency on GCC to identify facilitators, noting that DATCP and DNR both have good qualified people that are trained in this capacity. Jamie expressed his appreciation to the Subcommittees in getting this initiative rolling and felt it was headed in a good direction. Tim will keep the GCC informed as more details come together.

8. **Agency Transitions** – Susan Sylvester updated the GCC on the recent changes in DNR administration. Darrell Bazzell, former Deputy Secretary, was appointed Secretary on February 6th. She does not anticipate any major changes in DNR policy, mission, or vision, as Secretary Bazzell had worked closely with George Meyer for the past 5 years. She noted that George Meyer will stay on at the DNR working on various initiatives, and will continue his involvement in the leadership of two national organizations of state environmental and conservation agencies. Nick Neher reported that DATCP would be undergoing a change in administration as well, with the appointment of Jim Harsdorf, former state legislator and ATCP Board member as Secretary. This change will take effect sometime in late March.

The meeting adjourned at 12:10. The next meeting is scheduled for 12 noon on May 11th at the DNR Service Center in Dodgeville.

Respectfully submitted,

Tim Asplund, Water Resources Specialist
Department of Natural Resources

Wisconsin Groundwater Coordinating Council
MEETING MINUTES – MAY 11, 2001

Members Present: Susan Sylvester (DNR), Jack Metcalf (Governor's Rep), Ron Hennings for Jamie Robertson (WGNHS), Nick Neher (DATCP), Carol Cutshall (DOT), Henry Anderson (DHFS), and Eric Scott (Commerce)

Others Present: Tim Asplund, Mike Lemcke, and Shannon Fenner (DNR), Jim VandenBrook (DATCP).

The meeting began at 12:10 PM.

1. **General Business** – Introductions were made. The minutes from the February 23rd conference call were approved without modification. Ron Hennings handed out brochures for the Midwest Groundwater Conference to be held in Madison on October 22-24, 2001.

2. **Education Subcommittee Report** – Ron Hennings reported on the following activities of the Education Subcommittee:
   - Drinking Water Awareness Week (May 6-12, 2001) - Subcommittee members actively promoted this week in a variety of ways. The DNR and UW Extension issued press releases prior to and during the week to promote drinking water protection and awareness of groundwater issues. Don Swailes of DNR and Chris Mechenich of the Central Wisconsin Groundwater Center (CWGC) participated in a call-in show for Wisconsin Public Radio on May 8. Mike Lemcke passed out a copy of a proclamation issued by Governor Scott McCallum, in honor of Drinking Water Awareness week. On Earth Day, the video *Water Rich, Water Poor* was broadcast on Wisconsin Public Television. Chris provided teachers with suggested study questions via the CWGC web site.
   - Education Resource Directory – Tim Asplund is working with the Subcommittee to update the Groundwater Education Resource Directory by the end of the year. Except for the publication list, the Directory is just about completed.
   - Chair of Subcommittee - Chris Mechenich has indicated to the Subcommittee that she is ready to pass along chair responsibilities to someone else. Chris has done an exceptional job, but has chaired the group for more than 5 years. This is an opportunity for someone from another agency to step in and be more involved.

3. **Monitoring and Data Management Subcommittee (MDMS) Report** - Mike Lemcke reported on the following activities of the MDMS:
   - Membership - Chuck Warzecha has stepped down from membership on the MDMS, but will remain on the Planning and Mapping and Local Government Subcommittees. Mark Werner of DFHS will take Chuck's place on the MDMS.
   - Minimum data elements -The Subcommittee has been working on a list of minimum data elements for groundwater databases. The final list was to have been reviewed and endorsed by the GCC then made available to other agencies and local governments. However, the Federal government (EPA and USGS) recently released their own set of data elements for all water quality data. The MDMS will be reviewing this Federal list to check for similarities and differences. The Subcommittee will either revise the list to be consistent with the Federal standards or determine how to proceed.
   - Act 88 - The Subcommittee continues to track this issue.
   - WCR Scanning Project - The WGNHS recently completed a substantial effort to scan in the 350,000 well construction reports dated prior to 1988 and to key in 7 data elements to allow queries of the reports electronically. This phase of the project was funded with SWAP dollars. The next step is to make the dataset available to a wider audience. The MDMS will continue to advise the WGNHS on how to make these reports available in a useful format. Ron Hennings noted that the WGNHS wants to push forward with this project and get a system in place soon.
   - Karst Reporting Form - Members of the MDMS participated in a Karst Data Work group meeting on May 4, 2001 to decide what to do with the data generated from the Karst Reporting Form and other existing

databases. There are a lot of concerns about privacy and confidentiality. Private landowners are concerned about trespassers looking for caves, sinkholes or other features on their property. Researchers and agencies do not want to disclose exact locations of sensitive resources such as caves and bat roosting areas. The MDMS will work closely with the Planning and Mapping subcommittee to develop a plan for dealing with karst data. Jack Metcalf mentioned that Bill Singer of Singer Lumber Company might be a good source for information on sinkholes and former mines in the Dodgeville area.

- SWAP - Nick Neher noted that DATCP is trying to figure out how to geolocate livestock feeding operations as a biosecurity issue. The SWAP program may already be doing this for the larger operations and he is concerned that work is being duplicated. He proposed that the agencies cooperate more closely on this.

4. **Planning and Mapping Subcommittee Report** - Tim Asplund reported on the following activities of the P&M Subcommittee:
   - Membership - The Subcommittee would like round out its membership by adding a representative from the NRCS and an additional UWS person with a GIS interest or background. Tim will invite Jon Hempel, new State Soil Scientist at NRCS to attend a future P&M meeting to discuss further involvement with the GCC. Several names of potential UWS people were mentioned.
   - Karst Data Workgroup- The first meeting of this group was May 4, 2001. It was attended by interested folks from DNR, DOT, WGNHS, DATCP, NRCS, UW-Milwaukee, UW-Green Bay, UW-Oshkosh, and Dodge County Extension. The purpose of the group is to develop a plan for a web-based system which will (1) provide information about, and access to, Wisconsin karst datasets, (2) convert existing karst datasets (e.g., paper -> electronic), as appropriate, and (3) integrate datasets, as appropriate. The plan will identify and prioritize activities to coordinate karst data initiatives across the state, regardless of funding mechanism (e.g., SWAP, Joint Solicitation, other). Minor updates to the Wisconsin Interagency Karst Feature Reporting Form were suggested, including a few new "karst type" categories and better instructions for use. The group will meet again later in the summer to:
     - continue discussion of privacy (e.g., address data) and protection (e.g., caves) issues,
     - identify metadata tools and datasets;
     - review a draft database structure for inventory system, and a proposal for its development and implementation to be prepared by members of the P&M group; and
     - identify plan components to be developed (and bodies to do them!).
   - Karst Conference - Bob Pearson of DOT attended an international Karst conference in Louisville, KY in early April and presented a paper on the Karst Feature reporting Form. His talk was well received and Bob reported making many contacts. Bob prepared a manuscript that will be published in the proceedings from the conference.
   - Smart Growth and Groundwater Issues - The Subcommittee will be reviewing a draft document by UW-Extension providing guidance to local communities preparing comprehensive plans as part of the recent Smart Growth legislation. The guidance document will cover resources and items to consider in developing the Natural Resources Element of the plan. The Subcommittee will also discuss how to highlight groundwater issues and information sources. Suggestions include a separate fact sheet that lists all of the required elements of a comprehensive plan and how groundwater or drinking water might fit into these elements.

5. **FY 02 Joint Solicitation** – Tim Asplund briefly reported on the status of the FY02 funding for the Joint Solicitation projects. DNR, UWS, and DATCP will fund a total of 33 new and continuing projects in FY02. The recent budget discussions at the State level should not affect whether these projects get funded. However, the Water Resources Institutes Research program budget may be cut at the Federal level, potentially impacting the amount of resources available in FY03. If these cuts are made, the WRI will not have matching USGS funds to apply to Joint Solicitation projects for FY03. In the past 2 years, USGS co-funding has allowed 2 additional projects to be funded each year. Nick Neher suggested that the GCC should write a letter to the Wisconsin congressional delegation in support of restoring funding for the USGS Water Resources Research

program. Tim will prepare a letter for Susan Sylvester's signature and send these on to the appropriate congressional members.

Mike Lemcke mentioned that Steve Karklins of the DNR groundwater section would be attending a meeting of the Federal-State Toxicology and Risk Analysis Committee (FSTRAC) and reporting on the Joint Solicitation process and currently funded projects.

6. **Meet the GCC brochure** - Tim Asplund reported that the GCC brochure was out of print and that it might be a good idea to update it in preparation for the Groundwater Summit in October. Tim asked that GCC members provide him with updates to their biographies or suggestions for other changes to the brochure by the end of May. He also mentioned that it would be a good time to update the photographs if anyone wished to do so.

7. **World Wide Web demo** - Tim Asplund gave a brief "tour" of the Groundwater Coordinating Council's web pages with links to the karst web page at the WGNHS, online research summaries at WRI, and access through the new Wisconsin state "portal". He mentioned that a project for the next fiscal year was to add pages for each Subcommittee and to add the pictures and biographies from the "Meet the GCC" brochure. The links are provided below:

   GCC Home Page
   Karst information page
   Online research summaries
   Wisconsin State portal: (try searching on "groundwater")

8. **2001 Report to the Legislature** - Tim Asplund handed out copies of the proposed outline for the report and asked for any comments. He noted that the outline was essentially the same as the previous year, except that the two attachments would be the Karst Data Reporting form and an invitation to attend the Groundwater Summit. Highlighted activities include the karst form and data work group, minimum data elements, the groundwater education resource directory, and the electronic well forms program. Carol Cutshall recommended including a copy of the GCC web site home page and a clear reference to the web address. Susan Sylvester suggested including information about the new agency secretaries. Nick Neher asked to include a report on the DATCP private well survey (see next item), scheduled for completion in August.

9. **DATCP Private Well Survey** - Jim Vanden Brook reported on DATCP's statewide survey of pesticide and nitrate occurrences in private drinking water wells. Well sampling was recently completed. The survey was a follow up to similar surveys done in 1994 and 1996. The 2000 survey was designed to have more statistical power and included analysis for chloroacetanilide metabolites. Approximately 335 wells were sampled in a stratified random design. About 130 of the wells were included in the previous 1996 survey. The metabolites of alachlor, metolachlor, and acetochlor are of special concern because of their high water solubility, mobility, potential for leaching, and low degradation rates. A survey of municipal wells completed in June 2000 showed that about 50% had detects for one the metabolites.

   Jim highlighted the following analysis of the raw data. Once the statewide statistics are done, the percentages should be lower, because sampling was weighted toward agricultural areas.
   - decline in detection rates of atrazine, and deethyl-atrazine as well as the total chlorinated residues of atrazine (TCR) which includes atrazine and its breakdown products: deethyl-atrazine; deisopropyl-atrazine; and diamino-atrazine
   - slight increase in deisopropyl-atrazine and diamino-atrazine breakdown products
   - 31% of wells had detects of alachlor ethane sulfonic acid (ESA) and 5% for alachlor oxanillic acid (OA)
   - 27% of wells had detects of metolachlor ESA (7% for OA)
   - 3% of wells had detects of acetochlor ESA (0.3% for OA)
   - parent compounds of the three herbicides were rarely found in any wells

Jim noted that DATCP plans to analyze the relationship between groundwater contamination and land use to get a more accurate picture of where these are showing up. The fact that acetochlor is showing up is of interest since it has only been in use for about 5 years. The final report will be presented to the ATCP board in August and merits national attention, since this type of monitoring is not being done in other states. Susan Sylvester invited Jim back to present the final results at the August GCC meeting.

10. **Wisconsin Groundwater Summit**– Tim Asplund provided an update of progress made on planning for the Groundwater Summit, which will be held at the Country Inn Hotel in Waukesha on October 30-31, 2001. A planning group has met several times since January and will meet again on June 5th. Tim reviewed the tentative agenda for the Summit and shared a list of potential participating groups and individuals. The next step in the process is to prepare a letter of invitation on GCC letterhead Tim reported that there appeared to be a lot of interest and support for the Summit among different groups. Space limitations will determine how large a group can be accommodated. Representatives from diverse organizations will be encouraged to attend. Susan Sylvester mentioned that it is important to highlight the accomplishments of the research program coordinated through the GCC and to point out the successes that have resulted from interagency coordination.

    The GCC provided input on the following items:
    - Cost - Tim mentioned that costs for the Summit might be in the $5-6K range, with about $2000 of that being food expenses (lunch and breaks). Costs could be handled through a registration fee and/or support from the agencies. The GCC expressed willingness to split costs among themselves if participants are asked to cover costs of meals and breaks.
    - Facilitators - At the February meeting, the GCC agreed to provide facilitators for the breakout session. Tim asked that each member agency provide him with the name of one facilitator by the end of May.
    - Breakout sessions - Carol suggested that each of the 6 groups be given a specific issue or task to address. To help make the sessions more productive, materials could be provided to the participants ahead of time so people can prepare their remarks and suggestions in advance. Nick suggested appointing a team leader for each group to help coordinate the discussion.
    - Printed materials - Carol offered to provide additional funds for an editorial writer to help prepare written materials for the breakout sessions or the Summit in general.
    - Participation - Tim asked everyone to provide additional names and organizations that should be invited to participate. Nick and Henry provided a few suggestions at the meeting *[If anyone has additional suggestions, please provide these to Tim as soon as possible].*

11. **Smart Growth and Groundwater** – Shannon Fenner of the DNR presented an overview of Wisconsin's Comprehensive Planning Legislation and discussed the role of state agencies in its implementation. She also highlighted implications and opportunities for groundwater protection in the context of Smart Growth. For example, Smart Growth has the potential to nudge communities to develop sound land use goals and to prevent sprawl and associated groundwater issues (e.g. decrease in impervious surfaces, increased runoff, and increased demands on aquifers). Groundwater issues may be covered under several elements of the plan, including Agricultural and Natural Resources, Land Use, and Utilities and Community Facilities. Shannon pointed out that state agencies will be asked to consider local plans in their program decisions and to balance their mission with local planning goals. Nick commented that some provisions in this legislation present problems for DATCP in terms of agricultural reserve areas and maps. Consistency among local plans is another big issue. Carol Cutshall noted that DOT provided $250,000 to each of 2 groups of towns to do comprehensive planning as part of the Highway 12 project. Jim pointed out that there is a lot of information that local communities will need (soils, water table elevations) that is still 5 years away from being available. Mike Lemcke noted that the Planning and Mapping Subcommittee would be involved in reviewing the guidance documents for groundwater-related information as well as putting together a list of resources for local communities to use when preparing their plans. Everyone thanked Shannon for attending and commended her for her presentation.

The meeting adjourned at 2:50 PM. The next meeting is scheduled for 12 noon on August 17th at the DNR Central Office in Madison.

Respectfully submitted,

Tim Asplund, Water Resources Specialist
Department of Natural Resources

Joint Solicitation of Groundwater and Related Research/Monitoring Proposals

September 2000

The University of Wisconsin System (UWS) and the Wisconsin Departments of Natural Resources (DNR); Agriculture, Trade, and Consumer Protection (DATCP); and Commerce; are participating in a joint solicitation of research/monitoring proposals dealing with groundwater and/or pesticides. The four state agencies have a total of approximately $660,000 available for groundwater-related monitoring or research. Approximately $435,000 of that total will be available for new projects in fiscal year 2002 (FY 02). The four monitoring/research programs are summarized as follows:

1. UWS Groundwater Research - The UWS, through its UW-Madison Water Resources Institute (WRI), has received funding since FY 90 for groundwater research. They will have $300,000 to fund research in FY 02. Through FY 00, the UWS has spent $3.2 million on 87 groundwater research projects. Several projects have been co-funded with DNR, Commerce and/or DATCP and two were co-funded with WRI through the US Geological Survey.

2. DNR Management Practice Monitoring - The DNR has been funding groundwater management practice monitoring projects since FY 86. The DNR has approximately $200,000 available for FY 02 to support groundwater monitoring studies evaluating existing design and/or management practices associated with potential sources of groundwater contamination. The intent of these studies is to reduce the impacts of potential sources of contamination by changing the way land activities that may impact groundwater are conducted. The money comes from the Groundwater Account of the Environmental Fund (which is funded by various fees). Through FY 00, the DNR has spent approximately $4.7 million on 163 monitoring projects. Several of these projects have been co-funded with DATCP, Commerce and/or UWS.

3. DATCP Pesticide Research - Since 1989, the DATCP has had approximately $135,000 available annually to fund research on pesticide issues of regulatory importance. The money comes from fees paid by pesticide manufacturers to sell their products in Wisconsin. Through FY 00, the DATCP has spent about $1.4 million on 30 pesticide projects. Some of these projects have been co-funded with DNR and/or UWS.

4. Department of Commerce Private Sewage System Research – The Division of Safety & Buildings (formerly in the Department of Industry, Labor, and Human Relations) received an annual appropriation of $50,000 from 1990 to 1993 to fund research on alternatives to current private sewage-system technology. In 1994, when the appropriation expired, $75,000 generated through plan review and licensing fees became available each year for research on private sewage systems. As of July 1, 1996, the Division of Safety & Buildings including the private sewage system research program was transferred from DILHR to the newly created Department of Commerce. Commerce will have $25,000 for new research projects in FY 02. Through FY 00, the DILHR/Commerce has spent approximately $550,000 on seven projects. Two projects were co-funded with DNR and UWS.

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

- Facilitate proposal writing
- Streamline the review process
- Curtail duplication
- Improve coordination among agencies and researchers

- Enhance communication among the agencies and among principal investigators (P.I.)

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

- The UWS, through its Water Resources Institute (WRI) and oversight from the UWS Groundwater Research Advisory Council (GRAC), has approximately $185,000 available in FY 02 to fund new projects. The remainder of the UWS groundwater research funds has been committed to ongoing projects for FY 01. The funds are restricted for use by faculty within the UW System or by academic staff who have achieved nomination to P.I. status (see Application Requirements on p. 10). Projects of fundamental and applied research will be supported on all matters relating to groundwater including natural science, engineering, social science and law. Funding decisions are based on ratings by GCC subcommittees and reviews solicited from an international list of experts in the field of the proposed work. The GRAC, which consists of university, state agency, and public representatives, meets as a body to discuss the results of the review process and thereupon to recommend a priority list of projects that the UWS should strive to fund in accordance with budgetary resources. A suitable UWS Groundwater Research Program is then assembled by the WRI and submitted to the GCC for approval before the Department of Administration can release UWS research funds upon passage of a State budget. UWS projects will be considered for one or a MAXIMUM of two years during a solicitation cycle. Projects that appear to be continuations of a previously funded project with two years of UWS support and projects that have been twice rejected will not be considered. The UWS also strives to avoid funding situations where a P.I or co-P.I.'s name appears on more than two UWS projects during any given fiscal year.

- The DNR has approximately $125,000 available in FY 021 to fund new groundwater monitoring projects. The remainder has been allocated for ongoing monitoring or related projects. The monitoring will establish and improve management practices that will allow the state to meet the groundwater quality standards enumerated in NR 140, Wisconsin Administrative Code. The DNR Bureau of Drinking Water and Groundwater makes funding decisions with input from other DNR staff, GCC subcommittee members, and experts in the field. Funds are restricted to use by UWS and state agency contractors. Contracts will be approved on an annual basis.

- The DATCP has approximately $100,000 available for FY 02 to fund new projects. Investigators should note that the focus of the DATCP program is on pesticide research, which includes but is not limited to groundwater issues. Any college or university, research foundation or individual having a demonstrated capacity in pesticide or other applicable research may submit proposals. Funding decisions are made by the DATCP Secretary based on recommendations by the Bureau of Agrichemical Management staff who receive input from GCC subcommittee members and experts in the field.

- The Department of Commerce will administer $25,000 for FY 02 to support research on performance and monitoring of onsite wastewater treatment systems. The Division Administrator makes funding decisions with input from division staff and experts in the field.

For investigators who are not affiliated with the state and therefore not eligible for funding by UWS or DNR, a willing UWS faculty member or state agency staff member may be added as a co-principal investigator to attain eligibility.

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

Submission of Proposals

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

Attached is the description of each agency's guidelines, the outline for a cover page, and a detailed format for the proposal. **Proposals should be no longer than 20 pages.** All pages should be 8.5" x 11" and single sided. The project summary, narrative, curriculum vitae, and budget should start on a new page, be double-spaced (except for Figure and Table legends), and use no smaller than 11-point font. All margins should be no less than 0.75 inches. All except the cover page must be consecutively paginated on the bottom of the page. Include literature citations in the proposal where appropriate (single-spaced within, double-spaced between). Any section of a proposal that exceeds the maximum page limits specified in the table below will be grounds for returning the proposal to the author.

Section	Maximum Pages
Cover Page	1
Project Summary	2
Narrative and supplements	10
Curriculum vitae	4
Budget	3

These revised proposal guidelines were first established in conjunction with the FY 97 Joint Solicitation package to enhance efficiency of the time-consuming review process. Compliance to stated proposal guidelines will be part of the criteria used in both acceptance and scoring of proposals. Proposals that severely disregard these guidelines will be returned to investigators. An example of a funded proposal in compliance with these guidelines will be made available to investigators upon a request made to the contact person for the primary state agency to which the proposal is directed. These contacts are listed below. Investigators who are new to this program are encouraged to solicit an example proposal. A compliance checklist is also provided on page 9 to assist proposal authors.

The deadline for submittal of proposals is November 13, 2000. No proposals will be accepted after the close of WDNR business at 4:30 PM on November 13, 2000 unless they are postmarked on November 10, 2000 or earlier. **In past years, project proposals covering more than one topic or project area may have had more success in obtaining funding if they had been split into two projects. Likewise, two or more similar proposals may have been more successful if they had been combined. To facilitate this possibility, we ask that proposal authors seeking consideration for splitting or joining submit their proposals by 4:30 PM, November 3, 2000.**

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

Tim Asplund, DG/2
Wisconsin Department of Natural Resources
101 S. Webster St.
P.O. Box 7921
Madison, WI 53707-7921

In addition, please provide an electronic version of each proposal on 3.5" diskette or CD-ROM. The preferred format is PDF; however, MS Word 97+ or WordPerfect are also acceptable. Figures and tables should be embedded within the document if possible. Please do not e-mail proposals.

No facsimiles of proposals and no hand-written proposals will be accepted. Special attachments (maps, brochures, etc.) will be accepted, noted, and kept on file, but will not be included in the package of materials submitted to reviewers.

Review of Proposals

The UW Water Resources Institute conducts an external peer review of all proposals. A minimum of four written reviews will be solicited from an international list of experts in the field of each proposal. **Therefore, we request that investigators provide the names and addresses (Email also) of three suggested reviewers with expertise in the field of the proposal.** One name may be from Wisconsin. Proposals are also evaluated and ranked by the Research and Monitoring & Data Management Subcommittees of the Wisconsin Groundwater Coordinating Council, by the Groundwater Research Advisory Council, and by targeted State Agency personnel before the final ranking is established and subsequent project selections are made. Funding decisions will be made in March 2001. Proposals which give rise to funded projects become the property of the granting Wisconsin State Agency.

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

Proposals that are not chosen for funding through this solicitation may be referred to other potential funding sources for their consideration. Investigators will be notified of any such referrals. Likewise, other funding organizations may refer proposals to the funding agencies involved in this solicitation. Those proposals may be considered for funding.

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

James P. Hurley, University of Wisconsin-Madison: (608) 262-1136
Tim Asplund, Wisconsin Department of Natural Resources: (608) 267-7449
Jeff Postle, Wisconsin Department of Agriculture, Trade and Consumer Protection: (608) 224-4503
Harold Stanlick, Wisconsin Department of Commerce: (262) 521-5065

PROPOSAL FORMAT (Original, three collated copies, and electronic file)

Deadline for Submission: November 13, 2000.

I. Cover Letter – Include the names of 3 possible reviewers.

II. Proposal.

A. Cover Page--Sample copy is appended.

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

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

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

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

D. Principal Investigators

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

E. Budget using order shown in sample form

1. Salaries and wages
2. Fringe benefits (include percentage of grant to be used for faculty salaries, wages, and benefits)
3. Supplies and publication costs: list office, laboratory, computer and field supplies separately.

4. Travel to support field operations only. Travel to meetings is excluded because of the limited funding.

5. Other costs: e.g., equipment maintenance and fabrication, subcontracts, rentals, etc.

6. Total direct costs.

III. Electronic version of proposal on 3.5" diskette or CD-ROM.

The preferred format is PDF; however, MS Word 97+ or WordPerfect are also acceptable. Figures and tables should be embedded within the document if possible. Please do not e-mail proposals.

SAMPLE COVER PAGE

Project Title

(Maximum of 100 characters)

PRINCIPAL INVESTIGATOR (designate primary contact if more than one):

Name
Title, Affiliation, and complete mailing address including ZIP
Telephone FAX
Email address if available

CO-PRINCIPAL INVESTIGATOR(S):

Name
Title, Affiliation, and complete mailing address including ZIP
Telephone FAX
Email address if available

Location of Research

Desired Start-up Date and Duration of Project:

Amounts Requested:

FIRST YEAR	SECOND YEAR	TOTAL
$$$$$	$$$$$	$$$$$

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

[If appropriate for more than one agency rank highest (1) to lowest (3)]

UWS ( ) DNR ( ) DATCP ( ) Commerce( )

Date of Submittal:

SAMPLE BUDGET PAGE

Budget Period from July 1, 2001 to June 30, 2002

(Make a separate page for each year of support)

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

   Name and title if known

   a.

   b.

   c.

   d.

2. Fringe Benefits

   % of which salaries

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

3. Supplies and Publication Costs

   a. Office

   b. Laboratory

   c. Field

   d. Computer

   e. Publication Costs

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

5. Other Costs.

6. Total Direct Costs

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

PROPOSAL GUIDELINE CHECKLIST

GENERAL PRESENTATION		
ITEM	**GUIDELINE**	**THIS PROPOSAL**
Font	Minimum of 11 point	
Margins	Minimum of 0.75”	
PAGE LIMITATIONS		
Cover Letter	***Include names of 3 possible reviewers***	
Cover Page	1 page	
Project Summary	Maximum of 2 pages	
Narrative and supplements	Maximum of 10 pages	
Curriculum Vitae	Maximum of 4 pages total and 2 for 1 P.I.	
Budget	Maximum of 3 pages	
Entire Proposal	Maximum of 20 pages	
PAGINATION		
Cover Page	Page 1 but do not paginate	
Project Summary	Begin on new page, paginate as 2 and 3	
Narrative and supplements	Begin on new page, paginate starting at 4	
Curriculum Vitae	Begin on new page, paginate consecutively	
Budget	Begin on new page, paginate consecutively	
LINE SPACING		
Cover Page	Refer to sample on Page 7	
Project Summary	Double spaced	
Narrative Body	Double spaced	
Figure Legends	Single spaced	
Tables / Titles	Single spaced	
Citations	Single within, double between	
Training and Info Transfer	Single	
Curriculum Vitae	No specific guidelines	
Budget	Refer to Sample on Page 8, single if needed	

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

As part of the joint solicitation for groundwater research proposals, the UWS, through its Water Resources Institute (WRI) and its Groundwater Research Advisory Council, seeks projects of a fundamental or applied nature on any aspect of groundwater research in the natural sciences, engineering, social sciences or law. Projects funded in the current cycle are listed on the WRI web site at *www.wri.wisc.edu*.

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

Budgetary Considerations: About $185,000 will be available for new grants in FY 02. Projects will not be approved in any one budget cycle for a period of more than two years and then contingent on satisfactory progress. No capital equipment (more than $5,000 per item) may be purchased. **Travel for attendance at scientific meetings will not be accepted.** Faculty salaries and fringe benefits to be paid from any project may not exceed 10% of the total individual grant (including fringe benefits). Overhead costs are not allowed. Supplies should not exceed 20% of individual grant.

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

- Chemical and biological degradation of pollutants in surface soils, subsoils, and groundwater, including identification, toxicity, and persistence of degradation products.

- Transport of pollutants in soil and groundwater, including elucidation of soil and hydrologic factors controlling movement and development or validation of predictive models.

- Impact of waste, and agricultural (including agricultural feeding operations), industrial, or municipal management practices on groundwater quality.

- Characterization of geologic factors affecting groundwater movement, contamination, and aquifer recharge.

- Interactions of groundwater and surface water including chemical transformations in the hyporheic zone; impacts of groundwater withdrawal on surface waters; and, influence of groundwater discharge on water quality and stream biota.

- Land-use impacts on wetland quality and the interaction of groundwater with wetlands.

- Examination of the social and economic impacts of groundwater contamination and groundwater protection policies.

- Investigations on the development, understanding, improvement, cost-effectiveness, or utility of innovative biological, chemical or physico-chemical technologies for remediation of contaminated soils and/or groundwater.

- Biological, ecosystem, and human health effects of common groundwater pollutants and development or evaluation of surrogate, cost-effective bioassay systems for risk assessment.

- Field validation of effects of new technologies for on-site waste treatment (septic systems) on groundwater quality.

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

Review: Each project will be reviewed and ranked as outlined on page 3.

DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION (DATCP)
PESTICIDE RESEARCH PROGRAM

RESEARCH GRANT PROGRAM FOR FY 02
SOLICITATION OF APPLICATIONS

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

DATCP RESEARCH PRIORITIES FOR FY 02

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

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

2) **Development of Methods for Cleaning Pesticide Mixing/Loading Pads and Disposing of Pesticide Rinsates.**

Projects should evaluate methods of decontaminating pesticide mixing/loading pads and disposing of or treating pesticide-contaminated rinsate water.

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

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

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

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

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

This project should study groundwater contamination by field application of pesticides in key environmental settings such as fractured bedrock areas.

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

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

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

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

8) **Pesticide Use Surveys.**

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

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

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

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

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

11) **Evaluation of Health and Environmental Risks from Commonly Used Lawn Care Pesticides**

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

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

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

DEPARTMENT OF COMMERCE

RESEARCH OBJECTIVES

The Department of Commerce supports research focused on the performance of onsite sewage system designs, products, and management practices that can be incorporated into the administrative rules regulating onsite sewage systems. These designs, products, or management practices must be:

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

The Department also intends to monitor on an ongoing basis, the performance of various onsite sewage system methods and technologies. The purpose of the performance monitoring is to provide additional information on the long-term performance of the various onsite sewage system methods and technologies, to confirm their reliability, to provide data for improvements and to monitor long-term compliance with the groundwater standards.

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

Budgetary Constraints: The Department is limited to a budget of $25,000 per year, and existing projects may receive continued funding for another year. Applicants are encouraged to seek additional funding from the DNR, or other sources, where projects also meet funding priorities of other agencies.

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

Review: Each project will be reviewed individually.

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
GROUNDWATER MANAGEMENT PRACTICE MONITORING PROGRAM

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

Applicant Requirements

Funds are restricted to use by UWS and state agency contractors. Others may submit proposals if they include a state-affiliated co-principal investigator.

Budget Considerations

Monitoring proposals will be considered for a maximum of two years. Projects costing less than $35,000 annually will be given greater consideration than more expensive projects. Management practice monitoring projects are funded solely by state funds; there are no federal funds involved. Budget items to be identified should include such things as personnel costs, supplies, equipment, necessary travel, and other appropriate items. The management practice monitoring funds cannot support indirect costs or the purchase of capital equipment.

A number of projects that are being funded in FY 01 will continue into FY 02. As a result, some money will be set aside to fund continuing projects. Approximately $125,000 will be available to fund new monitoring projects in FY 02 (July 1, 2001 through June 30, 2002).

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

Contractual Requirements

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

For each new monitoring well, a soil boring form (Form 4400-122), a well construction report (Form 4400-113A), and a monitoring well development form (Form 4400-113B) shall be submitted on paper or in a computer format supplied by the DNR.

For all existing groundwater sample points (monitoring wells, piezometers, and private water supplies), an inventory form (Form 3300-67) supplied by the DNR shall be completed and submitted on paper or in computer format.

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

All groundwater quality monitoring data shall be submitted in a computer format compatible with the state Groundwater Retrieval Network and shall be reported to the DNR within two weeks after the contractor has received the data. The contractor shall verify computerized data.

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

The contractor shall request and use labels with Wisconsin Unique Well Numbers from the DNR for wells constructed and/or sampled to allow identification of wells.

Abandonment of monitoring wells shall be the responsibility of the contractor. Wells shall be abandoned in accordance with DNR regulations (Chap. NR 141, Wis. Adm. Code) and approved procedures upon completion of the project, unless alternative prior arrangements have been made with the DNR. A well abandonment report shall be submitted on a form (Form 3300-5) or in a computer format supplied by the DNR.

Quarterly project status reports shall be submitted to the project manager within 30 days of the end of each quarter. A final report and a project summary shall be submitted to the project manager within 60 days of the end of the contract period. The final report shall be submitted unbound. The project summary shall be submitted in electronic format in an outline form provided by the project manager. If reports are not received, investigators will be ineligible for future solicitations until contractual obligations are met.

Review of Proposals

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

Two important criteria in evaluating each proposal are: 1) whether the proposal addresses an emerging issue or a ongoing monitoring need as listed below; and 2) whether the project involves either groundwater monitoring or activities conducted to support groundwater monitoring. Support functions can include, among other things, laboratory analysis technique development, well drilling and construction methodology development, data management and definition of geologic and hydrogeologic conditions for groundwater management purposes. Other criteria for funding include project cost, proposed timeline, whether the proposed project methodology meets the stated objectives, whether the resources requested are adequate to carry out the project, and whether the project investigators have the abilities to complete the proposed project.

In making final funding decisions, the DNR's Groundwater Section will formulate its recommendations based on: 1) input from all project reviewers, and 2) available funds. The Director of the DNR's Bureau of Drinking Water and Groundwater will make the final funding decisions.

Management Practice Monitoring Priorities

Proposals will be considered for funding that address one or more of the following emerging issues or ongoing monitoring needs.

Emerging Issues

In September 2000 the Research and Monitoring & Data Management Subcommittees of the Wisconsin Groundwater Coordinating Council and Department staff identified the following emerging issues as being of the highest importance for groundwater monitoring and research in the state. Unlike the ongoing priority monitoring topics that follow the emerging issues, these are specific ideas for projects for which state groundwater experts see an immediate need.

Groundwater Withdrawals and Connections to Surface Waters – Recent events (high capacity well permits, aquifer storage and recovery pilot programs, arsenic, and urban growth near recharge areas) have highlighted the need for continued understanding of the implications of groundwater use on groundwater quality, groundwater quantity, and surface water resources. Research is needed in the following areas: monitoring of surface and groundwater flow to determine hydrologic connections and pathways between them; investigation

of the occurrence and causes of aquifer drawdowns that affect surface water features such as springs, streams and wetlands; identification of areas of the state sensitive to groundwater withdrawals; quantification of environmental, social and economic impacts of groundwater withdrawals; impact of induced flow of surface water to groundwater. Further information on this issue may be obtained by contacting Tim Asplund (608-267-7449).

Natural Attenuation – In September 1996, chapter NR 726 was revised to allow case closure of sites above NR 140 groundwater enforcement standards. A case can be closed above enforcement standards if is demonstrated that natural attenuation is effectively cleaning up groundwater. Once the site is closed there is a presumption that natural attenuation will continue cleaning up groundwater until enforcement standards are met. Many sites have been closed since 1996. There is a need to go back and audit a sub-set of these sites to determine whether the assumptions made at closure were appropriate. Questions that need to be addressed include: 1) Has the plume margin changed since closure and how much? 2) Have contaminant concentrations in groundwater changed since closure and how long will it take to meet enforcement standards? 3) Has land use surrounding the site changed since closure, e.g., have potable wells been installed near the site? 4) Was site closure appropriate? Further information on this issue may be obtained by contacting Steve Karklins (608-266-5240).

Water Quality in the Deep Sandstone Aquifer - Elevated sulfate and total dissolved solids (TDS) have been found in some new deep municipal wells in the Lower Fox River Valley making the wells unusable. In some other existing deep wells as far south as Milwaukee the TDS have been increasing over the years. Naturally occurring radium is also a problem in many of these wells. At present the sources of these dissolved substances and the hydrogeologic and geochemical mechanisms for mobilizing them are unclear. Research is needed to define the extent of these water-quality problems, to determine the sources of the dissolved constituents, to determine the hydrogeologic processes responsible for mobilizing the constituents, and for developing advice for the design and placement of new wells and the remediation of older wells. Further information on this issue may be obtained by contacting Ken Bradbury (608-263-7921).

New Pesticides – Evaluate the impacts on groundwater of new pesticides such as those in the sulfonylurea class of herbicides. Develop laboratory analytical methods to detect and quantify new pesticides and their metabolites in groundwater. Further information on this issue may be obtained by contacting Jeff Postle (608-224-4503).

Antibiotics and Hormones - Research is needed to determine whether antibiotics and hormones are entering Wisconsin's groundwater. Antibiotics and hormones are widely used in medicine. Certain drugs are also used to enhance the health of livestock, swine and poultry. Pharmaceuticals can enter the environment via municipal sewage effluent, private septic tanks, and animal feedlots. Research proposals should address at least one of the following questions: 1) Can commonly used drugs be detected in groundwater? 2) How do antibiotics and hormones behave in the environment, e.g. do they leach, how quickly do they breakdown? and 3) What are the most cost-effective analytical methods for antibiotics and hormones in water? Further information on this issue may be obtained by contacting Lynda Knobeloch (608-266-0923).

Microbial Pathogens – Research is needed to develop and test cost-effective screening tools that indicate the presence of, and/or quantify microbial pathogens in groundwater. Further information on this issue may be obtained by contacting Don Swailes (608-266-7093).

Nitrogen Contamination - Conduct site-specific studies to compare the NRCS 590 standard as proposed in ATCP 50 to current management practices. Further information on this issue may be obtained by contacting Jim Vanden Brook (608-224-4501).

Infiltration of Urban Runoff - As part of the Runoff Management Program Redesign, Wis. Adm. Code Chapter NR 151 has been proposed to encourage infiltration of stormwater and preserve groundwater recharge. There is a need to monitor the impact of stormwater infiltration on groundwater quality including organic compounds, metals, bacteria and viruses to evaluate DNR performance standards for pretreatment and infiltration devices at residential, commercial and industrial sites. Further information on this issue can be obtained by contacting Laura Chern (608 266-0126).

Ongoing Needs

The following priority topics for groundwater management practice monitoring represent ongoing needs as determined by the Research and Monitoring & Data Management Subcommittees of the Wisconsin Groundwater Coordinating Council, a number of state agency staff, and university researchers. The list of priorities is not in any specific order. Further information on any of these topics may be obtained by contacting Tim Asplund (608-267-7449).

Arsenic in Groundwater – Serious arsenic problems exist in Wisconsin, especially in the Lower Fox River Valley. Research to further characterize the source, extent, health effects, and treatment is a continuing need. Examples: define the lateral and vertical extent of the arsenic contamination as well as other associated metals and water quality problems; improve understanding of the system geochemistry, including reaction triggers and the mobility of the contaminants released; find solutions to drinking water problems such as well construction/reconstruction options and treatment; and conduct toxicological and risk assessment studies that may be needed to determine impacts on human health and the environment.

Nitrogen Contamination - Evaluate the extent of impacts of nitrate contamination on groundwater quality. Examples: monitoring and evaluation of the impacts of animal operations on groundwater; evaluating the effectiveness of Best Management Practices (BMPs) in reducing nitrogen levels in groundwater. Compare methods that can be used to evaluate the groundwater impacts of current farming systems as well as the economic and water quality impacts of alternative farming systems.

Data Management/Data Integration – Improve existing state methods for managing and integrating groundwater monitoring data. Examples: working with state agencies to identify existing archives of data related to groundwater quality and management practice monitoring; conducting a survey to identify data elements common to management practice monitoring projects.

Microbial Contaminants - Investigate the incidence and analytical and monitoring techniques for microbial contaminants, including parasites, bacteria, and viruses in groundwater.

Health Effects of Groundwater Contaminants - Research is needed to better characterize the impact of contaminated groundwater on public health. Proposals should focus on contaminants that are commonly encountered in public and private drinking water supplies at levels of health concern. Pathogenic microorganisms, toxic chemicals (both naturally-occurring and synthetic), and their metabolites are of interest.

Groundwater Remediation - Evaluate current or developing remediation technologies, with an emphasis on natural attenuation. Examples: comparing the effectiveness of pump & treat versus natural attenuation through modeling by running sensitivity analysis on permeability, electron acceptor availability, contaminant mass in smear zone, and extraction well location; and identifying biogeochemical parameters for cost effective evaluation of natural attenuation at petroleum contaminated sites.

Pesticide Management – Evaluate pesticide use impacts on groundwater quality. Examples: monitoring to determine if changes in pesticide application procedures and/or tillage practices have significant potential for reducing pesticide impacts on groundwater; evaluation of the extent of groundwater contamination from

agricultural and nonagricultural pesticide use and handling in various geologic settings; monitoring at pesticide loading facilities to evaluate the effectiveness of the facility to protect the surrounding soils and groundwater from contamination; monitoring to identify the soil and geologic conditions under which pesticide contamination is likely to occur.

Wellhead Protection/Source Water Assessments – Delineate wellhead protection areas in karst and confined geologic settings. Evaluate methods and planning strategies to protect groundwater in wellhead protection areas. Investigators should be familiar with the state Wellhead Protection and Source Water Assessment Plans.

Landfill Regulation – Evaluate current or innovative landfill design, operation or monitoring criteria in relation to compliance with groundwater quality standards. Investigate groundwater impacts of closed landfills.

Wastewater Treatment/Disposal – Monitor and evaluate the extent to which current and alternative on-site wastewater (private sewage) systems comply with state groundwater quality standards. Examples: evaluate new onsite wastewater treatment performance as a function of pretreatment, soil depth, texture and structure, and other factors; and monitoring of nitrogen and phosphorus near lakeshore communities. Also monitor different types of wastewater land application and land spreading practices. This would include the landspreading of wastewater byproduct solids, such as sludges and septage, as well as the land application of industrial, agricultural and municipal wastewaters.

Substances of Concern – Evaluate sources, fate, transport and risk to potable wells from substances (man-made and naturally occurring) detected in groundwater. This includes review and evaluation of existing groundwater databases; identification and sampling of at-risk potable wells; and correlation of land-use and hydrogeology with risk to potable wells from the substances. Substances detected in groundwater that require an evaluation include, but are not limited to, rhodamine (used as tracer), p-isopropylbenzene (cumene), strontium (non-radioactive), tert-butyl alcohol (TBA) and aluminum.

New Technology - Develop new laboratory or field technology (or new applications of existing technologies) for determining the characteristics of groundwater and geologic formations for management purposes, including downhole monitoring techniques.

Resource Definition – Conduct studies to better describe the geologic, hydrogeologic, and geochemical conditions that affect the groundwater quality and quantity in an area of the state. Example: evaluation of groundwater flow and/or contaminant transport in karst areas.

Table 3 - State of Wisconsin Groundwater Monitoring/Research Projects 1986-2001
(Sorted by principal investigator within initial funding year)

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
1986				
Hydrogeological Investigation of VOC Contaminated Private Wells Near Hudson, Wisconsin	Anklam	1986	DNR	31b
Treatment of Cheese Processing Wastewater by Ridge and Furrow Disposal - Nitrogen Transformations	Boyle	1986	DNR	23
A Case Study of Nitrogen Transformations at a Rapid Infiltration System Used for the Disposal of Food Processing Wastewater	Boyle, Hoopes	1986	DNR	17b
Volatile Organic Compounds in Small Community Wastewater Disposal Systems Using Soil Absorption	Boyle, Sonzogni	1986	DNR	5
Investigation of Hydrogeology and Groundwater Geochemistry in the Shallow Fractured Dolomite Aquifer in Door County, Wisconsin	Bradbury	1986-90	DNR	12
Hydrogeology of the Wisconsin River Valley in Marathon County, Wisconsin	Bradbury	1986	DNR	22
The Prediction of Nitrate Contamination Potential Using Known Hydrogeologic Properties	Cherkauer	1986-87	DNR	10
The Effect of Construction, Installation and Development Techniques on the performance of Monitoring Wells in Fine-Grained Glacial Tills	Cherkauer, Palmer	1986	DNR	16
Volatile Organic Compounds in Groundwater and Leachate at Wisconsin Landfills	Friedman	1985-87	DNR	4a
Barron County Nitrate Study	Hanson	1986-87	DNR	37
Field Investigation of Groundwater Impacts from Absorption Pond Systems Used for Wastewater Disposal	Hoopes	1985-86	DNR	17a
A Simple Stochastic Model Predicting Conservative Mass Transport Through the Unsaturated Zone into Groundwater	Hoopes	1986	DNR	1
The Use of Groundwater Models to Predict Groundwater Mounding Beneath Proposed Groundwater Gradient Control Systems for Sanitary Landfill Designs	Hoopes	1986	DNR	6
Evaluation Techniques for Groundwater Transport Models	Hoopes	1986	DNR	7
The Occurrence of Volatile Organic Compounds in Wastewater, Sludges and Groundwater at Selected Wastewater Treatment Plants in Wisconsin	Hunger	1985-90	DNR	18

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Groundwater Quality Monitoring - Long Term Effects of Intensive Farming and Sprinkler Irrigation on Groundwater Quality	Kammerer	1986	DNR	15
Fate of Aldicarb Residues in A Groundwater Basin near Plover, Wisconsin	Kraft	1986-87	DNR	3
Monitoring of Volatile Organic Compounds in Tomah, Wisconsin	Krohn	1986, 1989	DNR	31a
Fate and Mobility of Radium-226 in Municipal Wastewater Sludge Following Agricultural Landspreading	Portle	1986	DNR	19
Groundwater Monitoring for Pesticides	Postle	1986-97	DNR	2
Graphical and Statistical Methods to Assess the Effect of Landfills on Groundwater Quality	Potter	1986-87	DNR	14a
Groundwater Quality and Laundromat Wastewater: Summit Lake, Wisconsin	Saltes	1986-88	DNR	29
Filtration Preservation Study of Groundwater Samples	Sauer	1984	DNR	21a
West Bend Road Salt Use and Storage Study	Sucht	1986-91	DNR	8
Environmental Investigation of the City of Two Rivers Landfills, Manitowoc County, Wisconsin	Van Biersel	1986-87	DNR	24
Volatile Organic Compound Contamination of Private Water Supplies Adjacent to Abandoned Landfills in Marathon County	Wittkopf	1986-89	DNR	41
1987				
Plover Area Nitrate Study	Bailey	1987-88	DNR	48
Characterization of Groundwater Impacts at an Above Ground Petroleum Storage Terminal	Becker, Ham	1987	DNR	43
Research and Data Analysis of Groundwater Contamination from Municipal Rapid Infiltration Land Disposal Systems	Boyle, Hoopes, Potter	1987-88	DNR	56
Downward Movement of Water Below Barnyard Grass Filter Strips - Case Studies	Bubenzer, Converse	1987-89	DNR	39
1987 Volatile Organic Compound Testing Project in Rock County, Wisconsin	Holman	1987	DNR	40
Flambeau Paper Sulfite Lagoon Site Contamination Study	Lantz	1987	DNR	30

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Groundwater Survey of Bacterial Contamination Near Rapid Infiltration Wastewater Treatment System	Norenberg, Standridge	1987	DNR	21b
Investigation of Large Scale Subsurface Soil Absorption Systems	Peerenboom	1987	DNR	42
Hydrogeologic Investigation and Groundwater Quality Assessment (Havenswood Landfill)	Singh	1987	DNR	28
Nitrate Contamination in West-Central Wisconsin with Emphasis on Mill Run First Edition Subdivision	Tinker	1987-90	DNR	11
Lead Migration from Contaminated Sites - Door County, Wisconsin	Wiersma, Stieglitz	1987-88	DNR	13
1988				
A Ground Penetrating Radar Study of Water Table Elevation in a Portion of Wisconsin's Central Sand Plain	Anderson (Mary), Bentley	1988	DNR	50
VOC Contamination at Selected Wisconsin Landfills - Sampling Results and Policy Implications	Battista	1988-89	DNR	4b
Assessment of Geologic Controls on Groundwater Flow and Distribution in Precambrian Bedrock, Central Wisconsin, Using Remote Sensing and Geophysical	Brown, Davidson Jr.	1988	DNR	49
Digital Simulation of Solute Transport to Green Bay and Lake Michigan by Groundwater from Door County, Wisconsin	Cherkauer	1988-91	DNR	57
Degradation of Atrazine, Alachlor, Metolachlor in Soils and Aquifer Materials	Chesters	1988-90	DNR	52
Radionuclides in Drinking Water of North central Wisconsin	Dobbins, Fitzgerald	1988-89	DNR	54
Sealing Characteristics of Sodium Bentonite Slurries for Water Wells	Edil	1988	DNR	34
Mutagenic Effects of Selected Toxicants Found in Wisconsin's Groundwater	Meisner, Belluck	1988-89	DNR	38
Mineralogical and Geophysical Monitoring Naturally Occurring Radioactive Elements in Selected Wisconsin Aquifers	Morsky, Taylor	1988	DNR	51
Evaluation of the Effect of Stormwater Disposal on Groundwater	Nienke, Shaw	1988-89	DNR	53
Methods for Determining Compliance with Groundwater Quality Regulations at Waste Disposal Facilities	Potter	1988-89	DNR	14b

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Analytical Determination of Atrazine Alachlor and Their Selected Degradation Products in Contaminated Groundwater: Implication for Wisconsin Groundwater	Sonzogni	1988-89	DNR	47
Lead Contamination Study of Door County	Stoll	1988	DNR	44
Freedman Creek Hydrogeologic Baseline Report	Wilson	1988-89	DNR	45
1989				
Effect of Soil Type on Atrazine and Alachlor Movement Through Unsaturated Zone	Daniel	1989	DATCP/ DNR	62
Effects of Volatile Organic Compounds on Clay Landfill Liner Performance	Edil, Berthouex, Park, Sandstrom	1989	DNR	61
Grade A Dairy Farm Water Well Quality Survey	LeMasters, Doyle	1989	DNR	58
Groundwater Quality Investigation of Selected Townships in Jefferson County, Wisconsin	Madison	1989	DNR	60
Designs for Wellhead Protection in Central Wisconsin	Osborne, Sorenson, Knaak, Mechenich,	1989	DNR	63
Pesticide Migration Study	Shaw	1989-90	DNR	55
Optimum Manure Application Rate - Corn Fertility Management and Nitrate Leaching to Groundwater in Sandy Soils	Shaw	1989-90	DNR	71
Subdivision Impacts on Groundwater Quality	Shaw, Ameson, VanRyswyk	1989	DNR	67
Demo of Low Input Strategies for Potato/Vegetable Production in Irrigated Sands	Shaw, Curwen, Kraft, Osborne	1989-90	DNR	59
1990				
A Field Evaluation of Drainage Ditches as Barriers to Contaminant Migration	Bahr, Chambers	1990-91	DNR	75
Incorporation of County Groundwater Inventory Data into the DNR Groundwater Information Network (GIN)	Bohn	1990	DNR	68
Atrazine Contamination of Groundwater in Dane County, Wisconsin	Bradbury, McGrath	1990-91	DATCP/ DNR	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/DNR	65
Follow Up to the Grade A Dairy Farm Well Water Quality Survey	Cowell, LeMasters	1990	DATCP/ DNR	70

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Report on Bacteriological Water Quality Monitoring of Door County Variance and Special Casing Approval Wells	Hutchinson	1990-91	DNR	72
DNR and DATCP Rural Well Survey	LeMasters	1990	DATCP/ DNR	69
Variation in Hydraulic Conductivity in Sandy Glacial Till: Site Variation Versus Methodology	Mickelson, Bradbury, Rayne	1990-92	DNR/UWS	74
Analytical Determination of Pesticide Metabolites and Carrier Chemicals in Wisconsin Wells	Sonzogni, Eldan, Lawrence	1990	DNR	77
Nitrogen Isotope Monitoring at Unsewered Subdivisions	Tinker	1990	DNR	76
Volatile Organic Chemical Attenuation in Unsaturated Soil Above and Below an Onsite Wastewater Infiltration System	Tyler, Peterson, Sauer	1990-91	DNR/UWS	73
1991				
Integrated Decision Support for Wellhead Protection	Adams, Bensen	1991	UWS	
Role of Mobile Colloids in the Transport of Chemical Contaminants in Groundwaters	Armstrong, Shafer	1991-93	UWS	
On-site Nitrogen Removal Systems Research Demonstration Project: Phase I	Ayres & Assoc.	1991	DILHR	
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	78
Renovation of Pesticide Contaminated Rinse Waters	Chesters, Harkin	1991	UWS	
In-situ Removal of Fe, Mn, and Ra from Groundwater	Christensen, Cherkauer	1991	UWS	
Reactions of Chlorohydrocarbons on Clay Surfaces	Fripiat	1991	UWS	
The Biological Impact of Landfill Leachate on Nearby Surface Waters	Geis, Sonzogni, Standridge	1991	DNR	83
Chemical Transport Across a Sediment-Water Interface	Green	1991-92	UWS	
Adsorptive Behavior of Atrazine and Alachlor in Organic-Poor Sediments	Grundl	1991	UWS	
Effect of Complex Mixtures of Leachate on the Transport of Pollutants in Groundwater	Grundl, Cherkauer	1991-92	UWS	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Bioremediation of Herbicide-Contaminated Soil and Water	Harris, Armstrong	1991	UWS	
Near-Source Transport of Contaminants in Heterogeneous Media	Hoopes	1991-92	UWS	
Design of a Small Scale Transportable Mixing/Loading System	Kammel	1991	DATCP	
Municipal Wastewater Project	Kopecky	1991	DNR	85
Dependence of Aldicarb Residue Degradation Rates on Groundwater Chemistry in the Wisconsin Central Sands	Kraft, Helmke	1991-92	DNR	84
Using Ground Penetrating Radar to Predict Preferential Solute Movement and Improve Contaminant Monitoring in Sandy Soils	Kung, Madison	1991	UWS	
Nitrate Movement Through the Unsaturated Zone of a Sandy Soil in the Lower Wisconsin River Valley	Lowery, Kussow	1991-93	UWS	
Effect of Soil Type, Selected BMPs, and Tillage on Atrazine and Alachlor Movement Through the Unsaturated Zone	Lowery, McSweeny	1991	DATCP/ DNR	66
A Study of the Response of Nitrate and Pesticide Concentrations to Agricultural BMPs in Sandy Corn Fields	Madison, Cates	1991-94	DNR	81
Facility Plan Amendment for Wastewater Collection for Green Lake Sanitary District, Green Lake, WI	McMahon & Assoc.	1991	DILHR	
Contamination Attenuation Indices for Sandy Soils: Tools for Information Transfer	McSweeney, Madison	1991	UWS	
Tracking Contaminant Pathways in Groundwater Using a Geologically Based Computer Code for Outwash	Mickelson, Anderson	1991-92	UWS	
A Tracer Technique for Measuring Regional Groundwater Velocities from a Single Borehole	Monkmeyer	1991	UWS	
The Economic Effects of Groundwater Contamination on Real Estate	Page	1991	UWS	
Prediction of Organic Chemical Leachate Concentrations from Soil Samples	Park	1991	UWS	
Crop Rotations Effects on Leaching Potential and Groundwater Quality	Posner, Bubenzer, Madison	1991-92	DNR	80
Barnyard Management Practices: Effect on Movement of Nitrogen Through Soils and Impact on Groundwater Quality	Shaw	1991-92	DNR	9

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
A Comparative Study of Nitrate-N Loading to Groundwater from Mound, In Ground Pressure and at Grade Septic Systems	Shaw, Turyk	1991-92	DNR	82
Waupaca County Groundwater Project: Towns of St. Lawrence and Little Wolf	Wilson, Blonde	1991	DNR	79a
1992				
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 of Radionuclides in Wisconsin Groundwater	Bradbury, Mudrey	1992	DNR	91
Evaluation of NURE Hydrogeochemical Groundwater Data for Use in Wisconsin Groundwater Studies	Bradbury, Mudrey, Shrawder	1992	DNR	90
Preliminary Comparison of a Discrete Fracture Model with a Continuum Model for Groundwater Movement in Fractured Dolomite	Bradbury, Muldoon	1992	DNR	89
GIS Mapping of Groundwater Contaminant Sources, Quality and Contamination Susceptibility for Door County	Carlson, Stoll, Hronek	1992-93	DNR	93
Distribution, Transport and Fate of Major Herbicides and Their Metabolites	Chesters	1992-93	UWS/DATCP	
Dane County Atrazine/Land Management Project	Conners, Bohn, Madison, Muldoon, Richardson	1992	DATCP/ DNR	99
Use of Tire Chips to Attenuate VOCs	Edil, Park	1992-93	UWS	
Municipal Wastewater Absorption Pond Renovation for Enhanced Nitrogen Removal	Gilbert	1992-93	DNR	97
Living Mulch Systems for Nitrate Trapping in Vegetable Production	Harrison	1992-93	UWS	
Remediation of Soils Contaminated by Leaking Underground Storage Tanks by Vapor Extraction and In-situ Biostimulation	Hickey, Jacobsen, Bubenzer	1992-93	DNR	96
Herbicide and Nitrate Movement in a Sandy Soil in the Lower Wisconsin River Valley	Lowery, McSweeney	1992-93	UWS/DATCP	
Spatial Attributes of the Soil-Landscape-Groundwater System of the Lower Wisconsin River Valley	McSweeney, Madison, Attig, Bohn, Falk	1992-93	DNR	88

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Nitrogen Removal from Domestic Wastewater in Unsewered Areas	Otis, Converse	1992-96	DILHR	
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	
Investigation of Potential Groundwater Impacts at Demolition Landfills and Deer Pits	Pugh, Connelly	1992-93	DNR	98a
Assessment of Wisconsin's Groundwater Monitoring Plan Program for Active Non-Approved Landfills (1985-1990)	Pugh, Gear	1992	DNR	92
Evaluation of Denitrification Systems for Improving Groundwater from On-Site Waste Disposal Systems	Shaw	1992-93	DNR	95a
Arsenic as a Naturally Elevated Parameter in Water Supply Wells in Eastern Winnebago and Outagamie Counties	Stoll	1992	DNR	87
Waupaca County: Towns of Lebanon and Scandinavia	Wilson, Blonde	1992	DNR	79b
1993				
Urban Stormwater Infiltration: Assessment and Enhancement of Pollutant Removal	Armstrong	1993-94	DNR	102
Trace Metal Transport Affected by Groundwater Stream Interactions	Bahr	1993-94	UWS	
Tracer Study for Characterization of Groundwater Movement and Contaminant Transport in Fractured Dolomite	Bradbury, Muldoon	1993-94	DNR	101
Evaluation of Five Groundwater Susceptibility Assessments in Dane County, Wisconsin	Bridson, Bohn	1993-94	DNR	100
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	
A Further Study of Organics at Wisconsin Municipal Solid Waste Landfills	Connelly	1993-94	DNR	104
Ultrasonic Verification Technique for Evaluating Well Seals	Edil	1993-94	UWS	
Long-Term Transformation and Fate of Nitrogen with Mound Type Soil Absorption Systems for Septic Tank Effluent	Harkin	1993-94	DNR	103

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
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	
1994				
Photocatalytic degradation of volatile organic carbon	Anderson (Marc)	1994-95	UWS	94REM2B2
Improved design of pump and treat systems for heterogeneous aquifers	Bahr	1994-95	UWS	94REM3B2
Herbicide contamination of soil and groundwater at a mixing and loading site	Chesters	1994-95	UWS/ DATCP	94PES2B2
An Investigation of Field-Filtering and Low-Flow Pumping When Sampling for Metals	Connelly	1994	DNR	106
Mineral phase sorption of selected agrichemicals to Wisconsin Soils	Grundl	1994-95	UWS	94PES1B2
Stratigraphy, sedimentology, and porosity distribution of the Silurian rocks of the Door Peninsula, Wisconsin	Harris	1994-95	UWS	94HGE2B2
Using 'PREDICT' to reduce herbicide usage and improve groundwater quality	Harvey	1994-95	UWS	94PES6B2
Comparative evaluation of biostimulation approaches for enhancing in situ TCE degradation in contaminated aquifers	Hickey	1994-95	UWS	94REM6B2
Leaching Potential of Imazethapyr and Nicosulfuron in Sparta Sand	Lowery	1994	DATCP	
Cover Crops to Limit Herbicide Use on Sweet Corn	Newenhouse	1994	DATCP	
Groundwater Hydrogeology of an Agricultural Watershed	Potter	1994-95	DATCP/ DNR	109
Investigation of Potential Groundwater Impacts at Yard Waste Sites	Pugh, Connelly	1994	DNR	98b
Optimization of Two Recirculating Sand Filters for Nitrogen and Organic Chemical Removal from Domestic Wastewater	Shaw	1994	DNR	95b
Factors Affecting the Determination of Radon in Groundwater	Sonzogni	1994	DNR	111

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Integrated Computerized Mapping of Point Source Contaminants and Physical Environmental Characteristics to Protect and Manage Groundwater Quality	Stoll	1994	DNR	105
The Further Incidence of Native Arsenic in Eastern Wisconsin Water Supply Wells; Marinette, Oconto, Shawano and Brown Counties	Stoll	1994	DNR	110
Groundwater Survey of Alachlor and ESA its Polar Metabolite in Southern Wisconsin	Vanden Brook, Postle	1994	DATCP/ DNR	112
The Use of Peat as an Absorptive Medium	Wiersma, Stieglitz	1994	DATCP	
1995				
Evaluating the Effectiveness of Landfill Liners	Benson	1995-96	UWS	
Tracer Study for Characterization of Groundwater Movement and Contaminant Transport in Fractured Dolomite	Bradbury	1995-96	UWS	
Application of a Discrete Fracture Flow Model for Wellhead Protection at Sturgeon Bay, Wisconsin	Bradbury, Muldoon	1995-96	DNR	113
Direct and Residual Effects of Land-applied Sweet Corn Processing Wastes on Nitrate Loss to Groundwater	Bundy	1995-96	DNR	120
Integration of Hydraulics and Geology into a Hydrostratigraphic Model for the Paleozoic Aquifer of Eastern Dane County, Wisconsin	Cherkauer	1995	UWS	
A Comparison of Low Flow Pumping and Bailing for VOC Sampling	Connelly	1995	DNR	114
A Low-Input Crop Management Plan for Wisconsin Fresh-Market Vegetable Growers	Delahaut	1995	DATCP	
Use of Heavy Nitrogen to Study Nitrate Flux from Septic Systems	Harkin	1995-96	UWS/COMM	
Agrichemical Impacts to Groundwater Under Irrigated Vegetables in the Central Sand Plain	Kraft	1995-96	DNR	116
Vertical and Horizontal Variability of Hydrogeologic Properties in Glaciated Landscapes	Mickelson	1995	DNR	119
Synergistic Effects of Endocrine Disrupters in Drinking Water	Porter	1995-96	UWS	
Development and Demonstration of an Accurate Manure Spreading System to Protect Water Quality, Improve Waste Management and Farm Profitability	Shinners	1995-96	UWS	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Geologic Constraints on Arsenic in Groundwater with Applications to Groundwater Modeling	Simo	1995	UWS	
Characterization of E. Coli and Total Coliform Organisms Isolated from Wisconsin Groundwater and Reassessment of their Public Health Significance	Sonzogni	1995	DNR	117
Evaluation of Enzyme-linked Immunosorbent Assay for Herbicide Analysis of Wisconsin Soil in Comparison to Gas Chromatography	Sonzogni	1995	UWS	
An Evaluation of Long-term Trends and a Mineralogical Interpretation of Naturally Occurring Metals Contamination and Acidification of the	Weissbach	1995-96	DNR	115
Collection of Hydraulic and Geologic Data to Improve the Quality of the Wisconsin Groundwater Monitoring Network	Zaporozec	1995-96	DNR	118
1996				
Bioremediation of Hydrocarbons Influenced by Air Sparging: A Multi-model Approach to Assess Contaminant Mass Removal	Bahr	1996	UWS	
Delineation of Capture Zones for Municipal Wells in Dane County, Wisconsin	Bradbury	1996	DNR	121
Responses of Biological Toxicity Tests to Mixtures of Pesticides and Metabolites	Chesters	1996-97	UWS	
Evaluation of Well Seals Using an Ultrasonic Probe	Edil	1996	UWS	
Iron-based Abiotic Destruction of Chlorinated Solvents and Pesticides in Groundwater	Eykholt	1996	DATCP	
Biostimulation of Trichloroethylene Degradation in Contaminated Aquifers	Hickey	1996	UWS	
Optimum Management of Ground-water Resources in the Lower Fox River Valley	Krohelski	1996-97	DNR	122
Variability of Nitrate Loading and Determination of Monitoring Frequency for a Shallow Sandy Aquifer, Arena, Wisconsin	Madison	1996-97	DNR	123
Characterization of the Role of Evapotranspiration on Groundwater Movement and Solute Chemistry in Groundwater-fed Wetlands	Potter	1996-97	UWS	
Ground-water Recharge and Contamination in Wisconsin's Driftless Area	Potter	1996	DATCP	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Land Use Effects on Groundwater and Streamwater Quality in the Little Plover River Watershed	Shaw	1996-97	DATCP	
Stratigraphic Controls on the Mobilization and Transport of Naturally Occurring Arsenic in Groundwater: Implication for Wellhead Protection in	Simo	1996	UWS	
Evaluation of Shallow-soil Absorption Fields Associated with Advanced On-site Disposal System	Stieglitz	1996-97	DNR/UWS COMM	125
GIS as a Tool to Prioritize Environmental Releases, Integrate their Management, and Alleviate their Public Threat	Stoll	1996-97	DNR	126
The Use of Azimuthal Resistivity & Self Potential Measurements to Delineate Groundwater Flow Direction in Fractured Media	Taylor	1996	UWS	
An Integrated Approach to the Management of Insects in Sweet Corn Grown for Fresh Market	Wedberg	1996-97	DATCP	
1997				
Improved Estimation of Groundwater Recharge Rates	Anderson (Mary)	1997	UWS	
Hydrogeochemical and Microbiological Studies for Enhanced Ground Water Bioremediation	Bahr	1997-98	UWS	
In situ Air Sparging: Air Plume Characterization and Removal Effectiveness	Benson	1997-98	UWS	
Groundwater Protection by Application of Modern Portfolio Theory to Microbiotesting Strategies	Blondin	1997	UWS	
Holding Tank Effluent and Fecal-Contaminated Groundwater: Sources of Infectious Diarrhea in Central Wisconsin?	Borchardt	1997-98	COMM	
Development of a Variable Rate Nitrogen Application Approach for Corn	Bundy	1997-98	UWS	
Groundwater Bioremediation: Monitoring with MMO Probes	Collins	1997-98	UWS	
Experimental Verification of Models Used to Evaluate Landfill Liner Effectiveness	Edil	1997	UWS	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Stratigraphy, sedimentology, and Porosity Distribution of the Silurian Aquifer of Ozaukee County, Wisconsin	Harris	1997	UWS	
Molecular Techniques for Detection and Identification of Sewage-Borne Human Pathogens in Soils	Hickey	1997-98	COMM	
Nitrate-Contaminated Drinking Water Followback Study	Kanarek	1997	DNR	131
Fate of Nicosulfuron in Sparta Sand	Lowery	1997	DATCP	
Treatment of Groundwater Contaminated with Chlorinated Aliphatics Using a Silicone Tubing Supported Methanotrophic Biofilm Reactor	Park	1997-98	UWS	
Evaluation of the Use of DUMPSTAT to Detect the Impact of Landfills on Groundwater Quality	Potter	1997	DNR	130
Stratigraphic Controls on Distribution of Hydraulic Conductivity in Carbonate Aquifers	Simo	1997-98	DNR	129
Improved Detection Limits for Ground Water Monitoring	Sonzogni	1997	DNR/UWS	128
Determining Compatibility Between Herbicide Release and Habitat for Karner Blue Butterfly in Red Pine Plantations	Sucoff	1997	DATCP	
A Study of Well Construction Guidance for Arsenic Contamination in Northeast Wisconsin	Weissbach	1997-98	DNR	127
1998				
Assessment of Impacts on Groundwater/Lake and Wetland Systems	Anderson (Mary)	1998	UWS	
Groundwater-Surface Water Interactions in the Nine Springs Watershed	Bahr	1998-99	DNR	137
Evaluation of the Confining Properties of the Maquoketa Formation in the SEWRPC Region of Southeastern Wisconsin	Bradbury	1998	DNR	138
Watershed-Scale Nitrate Contamination and Chloroflurocarbon Ages in the Little Plover Basin: A Study at the Groundwater/Surface Water Interface	Browne	1998-99	UWS	
Determining Ground-Water Recharge Rates in Southern Washington County	Cherkauer	1998-99	UWS	
Characterization of the Hydrostratigraphy of the Deep Sandstone Aquifer in Southeastern Wisconsin	Eaton	1998-99	DNR	134

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Further Evaluation of Well Seals Using an Ultrasonic Probe	Edil	1998	DNR	136
Evaluation of Exploration Borehole Seals Using Time Domain Reflectometry (TDR)	Edil	1998-99	UWS	
Fate of Metolachlor, Alachlor, and Nitrate in Granular Iron/Soil/Water Systems,	Eykholt, Davenport, Wonsettler	1998	DATCP	
Investigation of Air Sparging: Numerical Modeling, Laboratory Verification and Design Guidelines	Hoopes	1998-99	UWS	
The Direct Effect of Agricultural Chemicals on Wisconsin's Declining and Endangered Amphibians	Karasov	1998-99	UWS/DATCP	
Relationships Between Water Quality in Stream Base Flow and Private Wells and Land use in the Tomorrow/Waupaca River Watershed	Shaw	1998-99	DNR	132
Impact of Ginseng Production on Groundwater Quality,	Shaw, De Vita	1998	DATCP	
Northeast Region Public Water Supply Location Utilizing Geographic Information Systems and Global Positioning Systems	Stoll	1998	DNR	133
Effects of Fosamine, Picloram, and Triclopyr on Reducing Aspen in Prairie Bush Clover Habitat,	West	1998	DATCP	
Evaluation of Geology and Hydraulic Performance of Wisconsin Ground-Water Monitoring Wells	Zaporozec	1998	DNR	135
1999				
On-line SFE/GC for Improved Detection of Trace Organic Pollutants in Ground Water Monitoring	Armstrong	1999	UWS/DATCP	
A Rational Design Approach for Permeable Reactive Walls	Benson	1999-2000	UWS	
Viral Contamination of Household Wells Near Disposal Sites for Human Excreta	Borchardt, Sonzogni	1999-2000	DNR	144
Groundwater Flow and Heat Transport in Wetlands: Transient Simulations and Frequency-Domain Analysis	Bravo	1999-2000	UWS	
Monitoring: Evaluation of the Abundance, Diversity, and Activity of Methanotroph Populations in Groundwater	Collins	1999-2000	UWS	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Mechanical Controls on Fracture Development in Carbonate Aquifers: Implications for Groundwater Flow Systems	Cooke	1999-2000	DNR	142
Acute and Chronic Toxicity of Nitrate to Brook Trout (Salvelinus fontinalis)	Crunkilton	1999-2000	DNR	140
Maquoketa Shale as Radium Source to the Cambro-Ordovician Aquifer System	Grundl	1999-2000	DNR	141
Sedimentology, Stratigraphy, and Porosity-Conductivity Relations of the Silurian Aquifer of Ozaukee County, Wisconsin	Harris	1999-2000	UWS	
Analysis of Microbiological and Geochemical Processes Controlling Biodegradation of Aromatic Hydrocarbons in Anaerobic Aquifers	Hickey	1999-2000	DNR	143
Assessing and Reducing Leaching of Agricultural Chemicals on Silt Loam Soils under Different Farming Systems	Kung	1999-2000	DATCP	
Using Geographic Information Systems and Soil Landscape Models to Predict Critical Sites for Nonpoint Source Pollution	Lowery	1999-2000	DATCP	
Water and Land Use: Interpretation of Existing Data to Foster Constructive Public Dialogue and Policy Formulation	Read	1999	UWS	
Natural Attenuation of Fuel and Related Groundwater Contaminants - A Measurement Method	Sonzogni	1999	UWS	
Fate of the Herbicides Atrazine, Cyanazine, and Alachlor and Selected Metabolites	Stoltenberg	1999	DATCP	
Hydraulic Conductivity and Specific Storage of Maquoketa Shale	Wang	1999	UWS	
2000				
A groundwater model for the Central Sands of Wisconsin: Assessing the environmental and economic impacts of Irrigated agriculture	Anderson (Martha), Bland, Kraft	2000	DATCP/ DNR	146
Remediating groundwater using reactive walls containing waste foundry sands	Benson, Eykholt	2000-01	DNR/UWS	147
Field verification of capture zones for municipal wells at Sturgeon Bay, Wisconsin	Bradbury, Rayne, Muldoon	2000	DNR	148
Refinement of two methods for estimation of groundwater recharge rates	Bradbury, Anderson, Potter	2000	DNR	150

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
Causes of historical changes in groundwater recharge rates in southeastern Wisconsin	Cherkauer	2000-01	UWS	
Evaluating options for changing groundwater and leachate monitoring requirements for landfills to reduce mercury used by laboratories	Connelly, Stephens, Shaw	2000-01	DNR	151
Compatibility of containment systems with mine waste liquids	Edil, Benson	2000-01	UWS	
Time domain electromagnetic induction survey of eastern Waukesha County and selected locations	Jansen, Taylor	2000	UWS	
Admicelle-catalyzed reductive dechlorination of PCE by zero valent iron	Li	2000-01	UWS	
Development of neural network models for predicting nitrate concentration in well water	Lin, Shaw	2000-01	UWS	
Field monitoring of drainage and nitrate leaching from managed and unmanaged ecosystems	Norman, Brye	2000-01	UWS	
Macropore flow: A means for enhancing groundwater recharge or a potential source of groundwater contamination	Potter, Bosscher	2000-01	UWS	
Hydraulic Conductivity and Specific Storage of Maquoketa Shale	Wang	2000	UWS	
Improvement of Wisconsin groundwater monitoring network	Zaporozec	2000	DNR	149
2001				
Development of analytical methods for comprehensive chemical and physical speciation of arsenicals in groundwater	Aldstadt	2001	DNR	154
Removal of As(III) and As(V) in Contaminated Groundwater with Thin-Film Microporous Oxide Adsorbents	Anderson (Marc)	2001	UWS	
The Spatial and Temporal Variability of Groundwater Recharge	Anderson (Mary), Potter	2001	UWS	
Importance of Groundwater in Productions and Transport of Methyl Mercury in Lake Superior Tributaries	Armstrong	2001	UWS	
A study of microbiological testing of well water quality in Door County and incidence of illness in humans	Braatz	2001	DNR	159
A Basin-Scale Denitrification Budget for a Nitrate Contaminated Wisconsin Aquifer: A Study at the Groundwater/Surface Water Interface	Browne, Kraft	2001	UWS	

Title	Principal Investigator(s)	Years Funded	Funding Agency	Project # (if assigned)
New approaches to the assessment of microbes in groundwater: application to monitoring bioremediation and detection of pathogens	Collins	2001	DNR	155
VOC trend analysis of WI solid waste landfill monitoring data: A preliminary analysis of the natural attenuation process	Connelly	2001	DNR	153
Evaluation of pathogen and nitrogen movement beneath on-site systems receiving domestic effluent from single pass sand filters	Converse	2001	COMM	
Effectiveness of phytoremediation and hydrogeologic response at an agricultural chemical facility in Bancroft, WI	DeVita, Dawson	2001	DATCP	
Effect of Clean and Polluted Groundwater on Daphnia Reproduction and Development	Dodson	2001	UWS	
Verification and characterization of a fracture network within the Maquoketa shale confining unit, SE Wisconsin	Eaton	2001	DNR	157
Groundwater Modeling: Semi-Analytical Approaches for Heterogeneity and Reaction Networks	Eykholt	2001	UWS	
Geologic and geochemical controls on arsenic in groundwater in northeastern Wisconsin	Gotkowitz	2001	DNR	152
Screening of agricultural and lawn care pesticides for developmental toxicity using the mouse embryo assay	Greenlee	2001	DATCP	
Public health impacts of arsenic contaminated drinking water	Knobeloch	2001	DNR	158
Pesticide and nitrate leaching in soils receiving manure	Lowery, Arriaga, Stoltenberg	2001	DATCP	
An analysis of arsenic replacement wells to determine validity of current DNR well construction guidance	O'Connor	2001	DNR	156
Remediation of Soil and Groundwater Using Effectively and Ineffectively Nodulated Alfalfa	Turyk, Shaw	2001	UWS/DATCP	

WISCONSIN FERTILIZER RESEARCH COUNCIL RESEARCH

The Wisconsin Fertilizer Research Program was a pioneering idea to obtain research support from the private sector that would improve agricultural profitability and, at the same time, protect our natural resources. As state and federal research monies continues to decline, funds from fertilizer sales will become even more important in terms of helping farmers make wise decisions regarding fertilizer use in Wisconsin.

Each year, the State of Wisconsin collects fees from the sale or distribution of fertilizer, persuant to Chapter 273, State Laws of 1977. This includes a $0.10 per ton fee that is earmarked for research. At the end of each year, these moneys are forwarded to the University of Wisconsin system to be used for research on soil management, soil fertility, plant nutrition problems and for research on surface water and groundwater problems which may be related to fertilizer usage; for dissemination of the results of the research; and for other designated activities tending to promote the correct usage of fertilizer materials. Research is conducted by investigators within the University of Wisconsin system. These investigators submit proposals for research to the Fertilizer Research Council for funding consideration. If the University of Wisconsin system is unable to carry on the projected research, the Council may recommend other appropriate nonprofit research institutions or agencies for receipt of funds. Projects funded in FY 2001 and projects selected for funding in FY 2002 are listed in the following tables.

RESEARCH PROJECTS FUNDED BY THE FERTILIZER RESEARCH COUNCIL FOR FY 01

Project Number	Project title	Lead Project Investigator	Affiliation	FY 00-01
186-00	*Evaluating Benefits from Over-Winter Cover Crops*	Larry Bundy	UW- Wisconsin Madison Soil Science Department	$11,620
187-00	*Plant Availability of Phosphorus from Manure Differing in Phosphorus Concentration Compared With Other Phosphorus Sources*	Larry Bundy	UW- Wisconsin Madison Soil Science Department	$6,340
188-00	*Use of surfactant modified zeolite as fertilizer additive to control nitrate, sulfate, and phosphate release*	Zhaoui Li	UW-Parkside	$8,122
189-00	*Effect of stand age on alfalfa response to N and/or S and confirmation of alfalfa S needs in Wisconsin*	Keith Kelling	UW- Wisconsin Madison Soil Science Department	$7,522
190-00	*Evaluation of dairy manure use in potato production systems*	Keith Kelling	UW- Wisconsin Madison Soil Science Department	$9,600
172-99	Effect of Tillage and timing on legume N mineralization and N credit to small grains	Dr. Keith Kelling	UW- Madison Soil Science Dept	$9,800
175-99	Nitrogen application effects on residue decomposition and no-till corn yields	Dr. LG Bundy	UW- Madison Soil Science Dept	$9,700
177-99	Phosphorus losses in runoff from Wisconsin soils	Dr. LG Bundy	UW- Madison Soil Science Dept	$8,320
184-99	Interaction of soil pH and rate of topdressed K on alfalfa forage mineral levels, yield and quality	Dr. Keith Kelling	UW- Madison Soil Science Dept	$10,500

185-99	Investigations into improved nitrogen use efficiency of potatoes	Dr. Keith Kelling	UW- Madison Soil Science Dept	$8,500
165-97	Improving Alfalfa yields in northwest Wisconsin with sulfur fertilization	Keith Kelling,	UW- Madison, Soil Science	$2,000
114-90	Evaluation of certain non-conventional soil additives for improving crop yields in WI	Keith Kelling,	UW-Madison, Soil Science	$4,000
166-98	The Lancaster Experiment: Crop Rotations for the Unglaciated Soils of the Upper Mississippi Valley	Roger Higgs,	UW-Platteville, Agriculture	$7,900
167-98	Dynamic Simulation of Soil Nitrate for N Fertilizer Management	Bill Bland,	UW-Madison, Soil Science	$11,000
171-98	Effect of Subsoiling on Soil Physical Properties and Crop Growth in Several Wisconsin Soils	Dick Wolkowski,	UW-Madison, Soil Science	$5,190
TOTAL				$156,091.15

RESEARCH PROJECTS FUNDED BY THE FERTILIZER RESEARCH COUNCIL FOR FY 02

Project Number	PI	Title	Funding
191-01	Bundy	Manure Management and History Effects on Phosphorus Losses in Runoff from Land-Applied Manure in Corn Production	$15,130.00
192-01	Roper	Reducing Phosphorus Fertilizer Application to Cranberry Beds	$2,350.00
195-01	Cooper band	Water availability of phosphorus from animal manures and P fertilizers applied to soils	$25,919.00
190-00	Kelling	Evaluation of Dairy Manure Use in Potato Production Systems	$9,600.00
189-00	Kelling	Effect of Stand Age on Alfalfa Response to N and/or S and Confirmation of Alfalfa needs in WI	$7,900.00
188-00	Li	Use of Surfactant Modified Zeolite as Fertilizer Additive to control nitrate sulfate and phosphate release	$8,307.00
186-00	Bundy	Evaluating Benefits from Over-winter Cover Crops	$11,520.00
185-99	Kelling	Investigations into Improved N Use Efficiency in Potatoes	$ 9,000.00
184-99	Kelling	Interaction of Soil pH and Rate of Topdressed K on Alfalfa Forage Mineral Levels, Yield, and Quality	$11,000.00
177-99	Bundy	P Losses in Runoff from WI Soils	$8,650.00
175-99	Bundy	N-Application Effects on Residue Decomposition and No-till Corn Yields	$10,000.00
172-99	Kelling	Effect of Tillage and Timing on Legume N Mineralization and N Credit to Small Grains	$9,900.00
91	Kelling	Evaluation of Certain non-conventional soil additives	$5,000.00

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 groundwater component with the DNR, WGNHS, Southeast Wisconsin Regional Planning Commission (SEWRPC), LaCrosse, Dane and Sauk Counties and the Menominee Tribe of Wisconsin, and the Bad River Band of Lake Superior Chippewa. In addition, several projects are funded by Federal agencies: EPA-Region V and USGS. On going projects that have a significant ground-water component are listed below.

Ongoing projects with State and local agencies

1. Ground-water observation well network (WGNHS)
2. Wisconsin water-use data file (DNR)
3. Southeast Wisconsin Hydrologic Study (SEWRPC, DNR, WGNHS)
4. LaCrosse, Dane and Sauk County Groundwater Studies
5. Characterization of part of the aquifer flow system in the vicinity of the Bad River Indian Reservation (Bad River Band)
6. Hydrologic review of proposed zinc-copper mine near Crandon (DNR)
7. Delineation of zones of contribution for several Menominee towns (Menominee Tribe)
8. Hydrologic review of proposed water bottling site in southern Adams County (DNR)
9. Monitoring contaminant flux from a storm water infiltration facility to groundwater (DNR)

Ongoing projects with Federal agencies

1. Area-wide brownfield assessment – Menomonee Valley, Milwaukee (EPA)
2. Hydrologic and biogeochemical budgets in temperate lakes and their watersheds, Northern Wisconsin (USGS)
3. Western Lake Michigan Drainages National Water-Quality Assessment (USGS)

4. Groundwater/surface water Interaction – Mississippi River, Pool 8 (USGS-Biological Resources Division)

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 (*http://wi.water.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 siting and design 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. Statewide priorities include groundwater protection practices such as well decommissioning and nutrient and pesticide management and prescribed grazing.
- 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 Standards. Practice Standards benefit the public by helping to protect groundwater. For example NRCS Practice Standard Code 313 - Waste Storage Facility was recently completed. This revision enhances 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.

To find out more information about NRCS, go to the home page 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, employes of the agencies with members on the council, employes 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.

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

DATE: November 15, 2000

TO: Potential Cooperators

FROM: Planning and Mapping Subcommittee of the GCC

SUBJECT: Karst Feature Reporting Form – Voluntary Help Requested!

The Planning and Mapping Subcommittee of Wisconsin's Groundwater Coordinating Council (GCC) is announcing a new statewide initiative – inventory and mapping of karst features. We are asking for your help in using the attached *Wisconsin Interagency Karst Feature Reporting Form* to describe karst features that you come across during your routine field activities. The goals of this data collection initiative are to:

1) protect Wisconsin's groundwater resources and endangered species,
2) provide useful information for various land use planning activities, and
3) facilitate construction, agriculture, and resource planning and management activities.

"Karst" is the term used by geologists to describe areas where the bedrock, usually limestone or dolomite, has been (or has the potential to be) easily dissolved by surface water or groundwater. Karst landscapes may have deep bedrock fractures, caves, disappearing streams, springs, or sinkholes. These features can be isolated or occur in clusters, and may be open, covered, buried, or partially filled with soil, field stones, vegetation, water or other miscellaneous debris.

Identifying Wisconsin's karst features is important because:

- they can act as direct conduits for pollutants to enter groundwater, wells, springs, and streams,
- some endangered species live exclusively in karst features or landscapes, and
- bedrock in these landscapes, especially around sinkholes, may be weak and prone to collapse, raising unique safety and liability issues.

In Wisconsin, surficial and subsurface karst features or landscapes are most likely to occur in these counties: Brown, Buffalo, Crawford, Dane, Dodge, Door, Grant, Green, Iowa, Jefferson, Kewaunee, La Crosse, Lafayette, Monroe, Pepin, Pierce, Richland, Saint Croix, Sauk, Trempealeau, Vernon, and Waukesha.

If you know of existing karst features, or encounter them during future fieldwork, please consider completing the attached form. This information will be maintained on file at the Wisconsin Geological and Natural History Survey (WGNHS) and is open to the public. The WGNHS also maintains a web site with further information about karst and an electronic version of the karst form.

If you have any questions about the attached form or Wisconsin's karst features, please contact the WGNHS at (608) 262-1705. Thank you for your time and consideration.