050645 1997

WISCONSIN GROUNDWATER COORDINATING COUNCIL

REPORT TO THE LEGISLATURE

August 1997

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1997

GROUNDWATER
Wisconsin's
buried treasure

State of Wisconsin \ GROUNDWATER COORDINATING COUNCIL

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August, 1997

To: The Citizens of Wisconsin
The Honorable Governor Tommy G. Thompson
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Assembly Environment Committee
Assembly Natural Resources Committee
Secretary Charles H. Thompson - Department of Transportation
Secretary William McCoshen - Department of Commerce
Secretary Alan T. Tracy - Department of Agriculture, Trade and Consumer Protection
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Secretary George E. Meyer - Department of Natural Resources
President Katharine Lyall - University of Wisconsin System
State Geologist James Robertson - Geological and Natural History Survey

This is the 1997 Groundwater Coordinating Council (GCC) Report to the Legislature. The Council was formed in 1984 to help state agencies coordinate non-regulatory activities and exchange information on groundwater. The Council has served as a model for interagency coordination and cooperation among state government officials, the Governor, local government and federal government. It has achieved the distinction of being one of the few groups in the nation to effectively coordinate groundwater activities in its state from an advisory position.

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

- Publication of the "Status of Groundwater Quantity in Wisconsin" report by the DNR in April, 1997. The report summarizes available information on groundwater quantity, provides options for managing groundwater quantity problems, and encourages a more comprehensive and coordinated approach to planning. The report has been distributed to local governments, state agency staff, the Legislature and other interested persons. This report is available on the DNR's Bureau of Drinking Water and Groundwater web page (http://www.dnr.state.wi.us/eq/wq/dw/gw/pubdwnld.htm).

- Creation of a web site by UW Water Resources Center (WRC) staff to make groundwater monitoring and research summaries accessible by computer. To enhance the utility of projects funded through the joint solicitation process, all 72 summaries published in "Wisconsin Groundwater Research and Monitoring Project Summaries" are now positioned for inspection and downloading from the world wide web (www.library.wisc.edu/libraries/Water_Resources/wgrmp/wgrmp.htm). Summaries have been downloaded over 1,100 times in the second half of FY 97.

- Publication of the revised Groundwater Sampling Desk Reference and Field Manual in September, 1996. Due to numerous advances in groundwater sampling and monitoring technology in recent years, the new documents go into detail on how to consistently collect high quality, representative groundwater samples and measurements. Both the Desk Reference and Field Manual have been widely distributed and well received. These two documents are available on the DNR's Bureau of Drinking Water and Groundwater web page (http://www.dnr.state.wi.us/eq/wq/dw/gw/sample.htm).

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

Susan L. Sylvester, Chair
Groundwater Coordinating Council

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LIST OF ABBREVIATIONS AND ACRONYMS

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

EXECUTIVE SUMMARY

This is the Report to the Legislature by the Groundwater Coordinating Council (GCC) as required by s. 15.347, Wisconsin Statutes. The report describes the condition and management of the groundwater resource and summarizes the Coordinating Council's activities for fiscal year (FY) 1997.

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

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

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

1. The GCC and the UWS Groundwater Research Advisory Council continued coordination of the annual solicitation for groundwater research and monitoring proposals among state agencies. Twenty-seven projects were funded in FY 97 by one or more of the following agencies: UWS, DATCP, DNR and COMM. The projects funded are listed in Table 1. The locations of the field sites for the projects are shown in Figure 3. A joint solicitation for groundwater-related monitoring and research project proposals for funding in FY 98 was distributed in October, 1996. A copy of the joint solicitation is contained in the Appendix. A total of 22 project proposals were received. Seventeen new projects were selected by the UWS, DNR, and/or DATCP for funding in FY 98 in addition to 9 projects which will carry over into the new fiscal year. The FY 98 groundwater monitoring and research projects and their funding agency are listed in Table 2. The GCC endorsed the UWS groundwater research plan for FY 98 as required by s. 160.50(1m), Wis. Stats.

2. The GCC continued to coordinate efforts to enhance the utility of groundwater monitoring and research funded through the joint solicitation process. In FY 96 the DNR published "Wisconsin Groundwater Research and Monitoring Project Summaries", summaries of 72 final reports of projects funded by the State of Wisconsin between 1989 and 1994. In FY 97, UW Water Resources Center (WRC) staff made these summaries accessible by computer through the creation of a web site (www.library.wisc.edu/libraries/Water_Resources/wgrmp/wgrmp.htm). All 72 currently available project summaries are now positioned for inspection and downloading by researchers, field specialists, state agency and academic library staff, environmental consultants, legislative personnel, and citizens groups having access to the world wide web. The electronic version of the Wisconsin Groundwater Research and Monitoring Project Summaries has had 411 visitors to its WRC WEB site in its first six months (through June of 1997). The total number of summaries downloaded during this period was 1,157.

3. Through its subcommittees, the GCC continued to address important data management issues. An informational brochure that standardizes a procedure for assigning Wisconsin Unique Well Numbers (WUWN), a key step in tracking groundwater quality data was published by the DNR and DATCP in November 1996. The brochure targets state, county, and local agency staff and various private industry staff. A strategy was developed to identify the groundwater data needs of local government entities. Groundwater related forms were evaluated for electronic submittal. Issues related to coordination and integration of well construction data into an automated format were examined. Data confidentiality issues including laboratory and agency concerns, disclosure/informed consent issues, open records requirements, and other regulations and policies that affect

.collection, integration and distribution of groundwater data by state agencies were examined. Plans were made to update the Directory of Groundwater Databases.

4. The "Status of Groundwater Quantity in Wisconsin" report was approved by the GCC in February, 1997 and published in April, 1997. DNR staff wrote the report with the assistance of the Groundwater Quantity Technical Advisory Committee, composed of state and federal agency staff, to summarize available information on groundwater quantity and provide options for managing problems (see the Executive Summary of the report in "Condition of the Resource: Groundwater Quantity"). The report was distributed to local and state government staff, the Legislature and other interested persons and has been well-received. The report encourages a more comprehensive and coordinated management approach by organizations involved in county comprehensive planning, wellhead protection, county master plans, rural development and other planning activities for addressing groundwater withdrawals. This report is available on the DNR's Bureau of Drinking Water and Groundwater web page (http://www.dnr.state.wi.us/eq/wq/dw/gw/pubdwnld.htm)Groundwater quantity remains a research and monitoring priority. One groundwater quantity-related monitoring project was funded in FY 97 and three are being funded in FY 98 through the joint solicitation process.

5. 1995 Wisconsin Act 27 required the Office of the Lieutenant Governor to evaluate designated boards, councils, and commissions, and recommend continuation, termination or transfer of their functions to another state body. In FY 96 the GCC completed a detailed documentation of the reasons for its creation, its charge, makeup, activities, meeting records, meeting attendance, and other information for the Office of the Lieutenant Governor in a response to a survey designed to evaluate state entities. In FY 97 the GCC was notified that the Lieutenant Governor recommended that the GCC be continued; making it one of only 63 continuing entities out of 144 organizations evaluated .

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

INTRODUCTION

PURPOSE

The Groundwater Coordinating Council is required by s. 15.347, Wis. Stats., to prepare a report which "summarizes the operations and activities of the council ..., describes the state of the groundwater resource and its management and sets forth the recommendations of the council. The annual report shall include a description of the current groundwater quality of the state, an assessment of groundwater management programs, information on the implementation of ch. 160, Wis. Stats., and a list and description of current and anticipated groundwater problems." This report is due each August. The purpose of this report is to fulfill this requirement for FY 97.

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

SUMMARY OF WISCONSIN'S GROUNDWATER LEGISLATION

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

1) Standards. Under chapter 160, Wis. Stats., the Department of Natural Resources (DNR) must establish state groundwater quality standards based on recommendations from the Department of Health and Social Services (DHSS). Standard setting is a continuing process based on a priority list of substances detected in groundwater or having a high possibility of being detected, established by the DNR in conjunction with other state agencies. The state groundwater standards are contained in chapter NR 140, Wisconsin Administrative Code. For each substance there is an enforcement standard (ES) which determines when a violation has occurred and a preventive action limit (PAL) which is set at a percentage of the ES. The PAL serves as a trigger for possible remedial action.

2) Regulatory Programs. Once groundwater quality standards are established, all state agencies must manage their regulatory programs to comply. Each state regulatory agency must promulgate rules to assure that the groundwater standards are met and to require appropriate responses when the standards are not met. The state regulatory agencies are the DNR (solid and hazardous waste, industrial and municipal wastewater, spills); the Department of Industry, Labor & Human Relations (DILHR) (private sewage systems, petroleum product storage tanks - now in the new Department of Commerce); the Department of Agriculture, Trade and Consumer Protection (DATCP) (pesticide use and storage and fertilizer storage); and the Department of Transportation (DOT) (salt storage). The implementation of the groundwater standards by the state agencies is described under "Summary of Agency Activities".

3) Aquifer Classification. One of the most important features of Wisconsin's groundwater law is an item that was omitted. When Wisconsin was debating the groundwater protection legislation, the U. S. Environmental Protection Agency (EPA) tried to develop a nationwide groundwater approach. A keystone of EPA's proposal

was aquifer classification - a scheme whereby each aquifer would be classified according to its potential use, value or vulnerability and then would be protected to that classification level. This entails "writing off" certain aquifers as industrial aquifers not entitled to protection and never again usable for human water supply. Wisconsin said "no" to aquifer classification. The philosophical underpinning of Wisconsin's groundwater law is the belief that all groundwater in Wisconsin must be protected equally to assure that it can be used for people to drink.

4) Monitoring and Data Management. At the time the groundwater legislation was created, there was concern that Wisconsin needed a groundwater monitoring program to determine whether the groundwater standards were being met. Therefore, a groundwater monitoring program was created under s. 160.27, Wis. Stats. Money from the Groundwater Account of the Environmental Fund has been used for problem-assessment monitoring, regulatory monitoring, at-risk monitoring and management-practice monitoring, as well as establishment of a data management system for collection and management of the groundwater data. See the "Groundwater Monitoring and Research" discussion 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, COMM, and DNR participated in a joint solicitation for groundwater-related research and monitoring proposals for funding during fiscal year 1997. See the "Groundwater Monitoring and Research" section for more details.

6) Coordination. In establishing the groundwater law, the Legislature recognized that management of the state's groundwater resources was a responsibility divided among a number of state agencies. Therefore, the Groundwater Coordinating Council was created to advise and assist state agencies in the coordination of non-regulatory programs and the exchange of information related to groundwater. The Coordinating Council has been meeting since 1984. See the "Coordination Activities" discussion in this report.

7) Local Groundwater Management. The Groundwater Protection Act clarified the powers and responsibilities of local governments to protect groundwater in partnership and consistent with state law.

   a. Zoning authority for cities, villages, towns and counties was expanded to "encourage the protection of groundwater."

   b. Counties can adopt ordinances regulating disposal of septage on land (consistent with DNR requirements); cities, villages or towns may do so if the county does not.

   c. Counties can regulate (under DNR supervision) well construction and pump installation for certain private wells.

   d. Property assessors must consider the time and expense of repairing or replacing a contaminated well or water supply when assessing the market value of real property; they must consider the "environmental impairment" of the property value due to the presence of a solid or hazardous waste disposal facility.

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

SUMMARY OF AGENCY ACTIVITIES

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

DEPARTMENT OF NATURAL RESOURCES

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

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

1. Bureau of Drinking Water and Groundwater - Regulation of public water systems and private drinking water supply wells. In addition, the Groundwater Section (GS) assists in coordinating groundwater activities of the DNR, as well as other state agencies.

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

3. Bureau of Remediation and Redevelopment - Oversees clean-up actions at spills, abandoned containers, state funded responses, closed wastewater and solid waste facilities, hazardous waste corrective action and generator closures and sediment clean-up actions.

4. Bureau of Watershed Management - Regulates Wisconsin Pollutant Discharge Elimination System (WPDES) permittees at wastewater land disposal sites. The Bureau of Watershed Management cooperates with the Bureau of Remediation and Redevelopment at leaking underground storage tank (LUST), Environmental Response and Repair, and Superfund Cleanup sites, by issuing WPDES permits for the discharge of contaminated groundwater.

The GS is responsible for adoption of groundwater standards contained in ch. NR 140, Wis. Adm. Code, development of an annual groundwater monitoring plan, coordination of the joint solicitation for groundwater-related monitoring and research proposals, review and management of groundwater monitoring projects, coordination of groundwater components of basin plans and of nonpoint source priority watershed projects, coordination of wellhead protection activities, and maintenance of a data management system for groundwater data.

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

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

developing additional NR 720 soil standards, supporting groundwater standards development and streamlining the cleanup process.

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

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

Work proceeds on methods for automating report submittals and is in the testing phase. Wisconsin Unique Well Number (WUWN) labels have been received and a system for distribution has been developed. Distribution will begin as soon as revised forms are printed.

GS staff performed 8 inspections of drilling operations in FY 97. These inspections are designed to educate drillers and environmental consultants about NR 141 and to enhance compliance with the code. Efforts continue to develop and educate operators and consultants on the proper techniques for geoprobe operation.

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

Bureau of Drinking Water and Groundwater staff created a world wide web site in FY 97. The site provides an important link for people to access information on groundwater. The site contains information on public water systems, private wells, well drilling, pump installation, groundwater and DNR staff. Groundwater sections include groundwater publications (online viewable, downloadable, or a contact for requesting copies), sampling information, groundwater data, general groundwater information, fun with groundwater (20 question quiz and animated water cycle image), and links to other related sites. The address for the Bureau home page is
http://www.dnr.state.wi.us/eq/wq/dw/index.htm
In September 1996, GS staff published revisions to the DNRs Groundwater Sampling Desk Reference and Field Manual. Both the Desk Reference and the Field Manual were revised for the first time since 1987 due to numerous advances in groundwater sampling and monitoring technology in recent years. The new documents go into much greater detail on how to consistently collect high quality, representative groundwater samples and measurements. The review process for the documents included extensive comments from 5 environmental consulting firms, a private laboratory, and DNR and DATCP staff. Both the Desk Reference and Field Manual have been widely distributed and well received. The two documents are available on the Bureau of Drinking Water and Groundwater's web page (http://www.dnr.state.wi.us/eq/wq/dw/gw/sample.htm).

The DNR continued its groundwater monitoring program which includes problem assessment monitoring, at-risk well monitoring, management practice monitoring and regulatory monitoring. During FY 97, $184,384 was awarded to eight projects for the management practice monitoring program (see Table 1). The eight projects were selected during the joint solicitation process described under "Groundwater Monitoring and Research" in this report. During FY 98, approximately $283,317 will be awarded to ten projects for the management practice monitoring program (see Table 2). Seven projects are new studies selected during this year's joint solicitation process.

Under direction of the GCC, UW Water Resources Center (WRC) and GS staff coordinated efforts to distribute the

findings of groundwater monitoring and research funded through the joint solicitation process. In FY 96 DNR and WRC staff and principal investigators wrote summaries of 72 final reports. These summaries were published together in the "Wisconsin Groundwater Research and Monitoring Project Summaries" (WDNR PUBL-WR-423-95) in September 1995. In FY 97 all 72 summaries were made available on the WRC world wide web site. Paper copies of all final reports and summaries continue to be distributed by the WRC and DNR.

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

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

The DNR works with the Wisconsin Rural Water Association to develop community plans and provide technical assistance through conferences and training sessions for community officials and water system operators.

The DNR provided funding in FY 97 for a pilot project to delineate WHP areas for all of the municipal water supply wells in Dane County. The DNR is working to disseminate the information to the municipalities in the county.

In FY 96 GS staff completed the delineation of WHP areas for all municipalities in the state using the EPA-approved calculated fixed radius method. This simple method results in a circular WHP area around each well. The size of the WHP area depends on the pumping rate of the well and the general hydraulic properties of the aquifer. In addition to the calculated fixed radius delineations, GS staff may use groundwater flow modeling to delineate more sophisticated WHP areas. In FY 97 staff evaluated software to be used for modeling and began to target municipalities for these more advanced delineations.

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

The operation of the Crandon mine would necessitate groundwater pumping. Effects of this pumping on nearby lakes and wetlands is being investigated using MODFLOW, a code developed by the USGS. A second model will be developed from the regional model to assess the possible release of contaminants from the tailings management area. GS staff assisted Bureau of Waste Management staff and DNR consultants in the evaluation of the model and geologic interpretations used in the model.

In FY 95, GS staff, with the help of a Groundwater Quantity Technical Advisory Committee, began preparing a report on groundwater quantity in Wisconsin. The GCC had identified the need for a report summarizing the status of the groundwater quantity issue. The report 'Status of Groundwater Quantity in Wisconsin" was completed and published in April, 1997. The report has been distributed to representatives of local, state, and federal government, the Legislature and other interested persons. It is also available on the worldwide web (http://www.dnr.state.wi.us/eq/wq/dw/gw/pubdwnld.htm). The Executive Summary of the report is included with this document (see Condition of the Resource: Groundwater Quantity).During FY 97, Bureau of Watershed Management staff maintained its enhanced efforts to address groundwater in the water quality management planning process.

Water Quality Management (WQM) plans are developed under Section 208 of the Clean Water Act and NR 121, Wis. Adm. Code. The plans provide water resources information and recommendations along river basin and watershed boundaries.

The GS provides guidance on availability of, and direct access to, groundwater documents germane to the planning basin, as well as insight concerning ongoing research in the planning area. GS staff obtain data from the Groundwater Retrieval Network to identify areas with nitrate and/or pesticide contamination for use in WQM Plan maps. By providing information to water quality planners during development of WQM Plans, the accuracy and thoroughness of each WQM Plan is enhanced. Most WQM Plans contain a groundwater report. During FY 97, Groundwater reports were prepared for the Manitowoc, Lower Rock and Black River basins.

Development of a draft method to rank watersheds in WQM Plans for funding by the DNR Nonpoint Source Pollution Abatement Program continued in FY 97. This method takes into account land use and water quality sampling results. The draft groundwater ranking criteria was tested on the Lower Rock River Basin as a pilot project. Due to current restructuring of the Nonpoint Source Pollutant Abatement Program and other DNR activities, implementation of the ranking criteria is on hold until further notice.

During FY 97, private wells in 10 watersheds were sampled for nitrate and atrazine using the triazine screen as part of the joint DNR-DATCP nonpoint source program. The existing priority watersheds include: Pigeon River, Middle Peshtigo/Thunder River, Fond du Lac River, Lower Rib River, Kinnickinnic River, Lower Little Wolf, and the Pine and Willow Rivers. Lake projects sampled included: Big Wood Lake, Rock Lake, and Horse Creek Lake. No new watersheds were selected for FY 98 due to a budget shortfall. However, those projects still in planning are being brought into implementation. Sampling was offered to well owners free of charge and on a voluntary basis. All wells sampled were assigned a Wisconsin Unique Well Number and inventoried. A total of 741 nitrate analysis were performed in FY 97 showing that nitrate + nitrite exceeded the preventive action limit (PAL) of 2 milligrams/liter (mg/L) in 48.5% and the enforcement standard of 10 mg/L in 16.5 % of the samples analyzed. Triazine screen analyses were done for 748 wells in FY 97. The PAL of 0.3 micrograms per liter (ug/L) atrazine plus metabolites was exceeded in 19.5 % of wells sampled. The ES of 3.0 ug/L atrazine plus metabolites was exceeded in less than 1 % of wells sampled.

Bureau for Remediation and Redevelopment, GS, and Legal Services staff worked together to develop revisions to chapters NR 140 (Groundwater Standards), NR 722 (Remedy Selection), NR 724 (Remedial Action Implementation), and NR 726 (Case Closure) to allow greater flexibility in closing cases where groundwater contamination exceeds the PAL or ES. Revisions to NR140 list natural attenuation as one of many potential options to cleanup contaminated groundwater. Revisions to ch. NR 726 allow DNR staff to close out a case using natural attenuation as a final remediation response when groundwater standards are exceeded, provided specific criteria are met. These criteria are: the contamination has not migrated beyond the property boundary, the source of contamination has been adequately addressed, monitoring confirms natural attenuation is addressing the contamination and a restriction is placed on the property deed that limits groundwater use. The rule revisions became effective November 1, 1996. Related guidance documents are being developed to provide a better understanding of the closure flexibility rule proposal, site specific soil standards, and overall approaches to clean-up actions.

The NR 706 rule package (Hazardous Substance Discharge Notification Requirements) was adopted by the Natural Resources Board and became effective March 1, 1997. The rule establishes *de minimis* notification exemptions under certain circumstances for petroleum, agrichemicals and substances for which there are federal reportable quantities. The rule also clarifies that only discharges **to the environment** require immediate notification.

In FY 95 the Emergency and Remedial Response section (currently the Bureau for Remediation and Redevelopment), with the help of an external advisory committee and a focus group, completed a series of administrative codes (NR 700-736) covering remedial responses to environmental contamination including soil contamination. In October 1995 the program obtained a Brownfields Memorandum of Agreement for Superfund working cooperatively with USEPA-Region V that formally acknowledges the state approach to cleanups. The program has also been seeking the US EPA Hazardous Waste Program's formal acknowledgment of the NR 700

Rule series to address RCRA-C hazardous waste sites. The final goal is to amend the state's authorization Memorandum of Understanding (MOU) to recognize the application of the NR 700 Rule Series to hazardous waste corrective action and generator closures. The MOU is expected to be finalized by late 1997. This effort should provide for more streamlined environmentally sound approaches to this category of contamination sites.

The Remediation and Redevelopment program, as part of its responsibility to administer the State's Environmental Fund to cleanup severe contamination problems, initiated, or continued action at locations where groundwater contamination is known or suspected. Approximately $4.3 million was spent during FY 97 to address groundwater contamination at existing project sites. An additional $800,000 in bonding funds was committed for construction projects associated with prevention of groundwater contamination and groundwater remediation.

The Bureau of Watershed Management continued to issue Wisconsin Pollution Discharge Elimination System (WPDES) permits to all communities and industrial facilities which discharge treated domestic or industrial wastewaters to a land treatment system. These permits contain groundwater monitoring requirements and data submittal which is used to evaluate facility compliance with state groundwater quality standards established in ch. NR 140 Wis. Adm. Code. WPDES permits issued to new municipal discharges to groundwater reflect the more stringent effluent limits for total nitrogen and chloride contained in ch. NR 206, Wis. Adm. Code. A concerted effort is being made to evaluate and require upgrading of groundwater monitoring systems at existing facilities.

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

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

The first year of a three-year investigation into elevated iron and manganese concentrations in groundwater at industrial wastewater land application sites has been completed. The study is being conducted by the Mid-West Food Producer's Association, a trade organization representing the vegetable producing industry. This investigation will be continued over the next two years. The Animal Waste Advisory Committee completed their report in January 1995. The report recommended appropriate management activities for livestock owners to protect water quality and was accepted by the Natural Resources Board in February 1995. Since then, DNR staff have worked closely with interested legislators to draft legislation needed to implement the recommendations.

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

DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION

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

Under the Wisconsin Groundwater Law, DATCP manages pesticides and pesticide practices to assure that established groundwater standards for contaminants are not exceeded. This may include prohibition of certain activities including pesticide use. The agency also manages practices to "minimize" groundwater contamination to

the extent "technically and economically feasible." DATCP regulates storage, handling, use, and disposal of pesticides and the storage of bulk quantities of fertilizer.

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

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

DATCP's primary effort related to nonpoint contamination (i.e., due to general use) of groundwater continues to involve the herbicide atrazine. In response to concerns about atrazine contamination, DATCP amended administrative rule ch. ATCP 30 in 1992 to manage the use of atrazine in an effort to reduce or eliminate the potential for further groundwater impacts. Rule revisions have been made annually in response to additional detections of atrazine in groundwater. Rule revisions for the 1997 growing season increased the number of atrazine use prohibition areas, based on groundwater sample results available as of September 1996. Information suggests that atrazine use has declined as a result of the atrazine management rule and concern about groundwater contamination.

Since the late 1980s, DATCP has also initiated a number of surveys to investigate pesticides in groundwater resulting from nonpoint sources. In FY 96, DATCP completed a resampling of 122 Wisconsin wells that previously exceeded a pesticide enforcement standard. This Exceedence Survey was funded by DATCP. Most of the wells in the survey had exceeded standards for atrazine. Most were also within an atrazine prohibition area. Of wells exceeding standards for atrazine, 84% declined in concentration and 16% increased. Forty-three percent of the wells tested above the atrazine enforcement standard and 57% tested below the standard. About 50% of well owners continue to use their contaminated well and about 25% have installed new wells at an average cost of $6,300. This survey was conducted again in FY 97 with similar results. DATCP hopes to conduct this survey annually to analyze contamination trends in prohibition areas.

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

In FY 97, DATCP also resampled 100 private wells that had a triazine immunoassay test result of 0.8 ug/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 ug/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 have and continue to result in groundwater contamination, putting nearby private and, in some cases, municipal wells at risk. Surface water run-off from contaminated areas can also result in direct human and livestock exposure, property damage and/or surface water contamination.

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

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

DATCP solely funded four pesticide research projects during FY 97 (see Table 1). DATCP's research fund, which is based on fees paid by pesticide manufacturers, provides approximately $135,000 annually to meet pesticide related research needs of the Department.

DATCP, through it's soil and water resource management program, provides funding primarily to counties to assist in the protection of these resources. A portion of this funding is dedicated to the development and implementation of improved nutrient and pesticide management practices. In FY 97 approximately $100,000 was provided to develop and demonstrate better management practices for nutrients and pesticides.

In FY 97 DATCP provided $339,000 to fund Clean Sweep projects in 23 counties for collection and disposal of waste pesticides and containers. Approximately 172,000 pounds of waste were collected from farm sites, thereby reducing the potential for inadvertent environmental damage. DATCP is requesting additional proposals from counties for the 1998 fiscal year. Approximately $560,400 will be available during FY 98 for these projects.

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

DEPARTMENT OF COMMERCE

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

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

COMM continues its involvement with the Washington Island decentralized wastewater management system. A local management board, (Sanitary District), is taking on the responsibility of overseeing the project and the

individual private sewage systems that have been installed. Modifications to some of the systems continue to be made in an effort to remove as much complexity from the operation and maintenance of these systems as practical while maintaining the goal of providing effective treatment and dispersal of the wastewater. Monitoring will continue to insure that groundwater protection standards can be met. A report by UW-Green Bay researchers is due to be published this summer.

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

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

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

The ERS Division continues to focus on the Federal EPA underground strorage tank (UST) upgrade compliance deadline of December 22, 1998. Educational outreach and enforcement strategies by the Department are structured to emphasize the requirements which must be met prior to December 1998. The Department is also exploring entering into a project with the Federal EPA to investigate groundwater protection compliance of non-petroleum hazardous substance tanks.

Since 1991 the database inventory of petroleum product tanks regulated under ILHR 10 has increased from 143,681 to 165,302 tanks as previously unregistered tanks have become registered. In 1991 the database included 68,056 tanks classified as federally regulated with 51,088 of those tanks in use. As of July 1, 1997 the database reflects 74,668 federally regulated tanks with only 17,170 tanks in use. In order to maintain a federally regulated tank in use the tank must have a valid use permit, which is complimented by an annual inspection. Annual inspections involve verification of leak detection and record keeping.

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

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

Educational outreach efforts and annual inspections by the Department and its agents should result in a high level of regulatory compliance, and a reduction of system failures and environmental contamination. Wisconsin's progress

continues to reflect very favorably with the Federal EPA and has resulted in additional grant moneys to assist program initiatives.

Petroleum Environmental Cleanup Fund (PECFA) - The PECFA program from August 1989 through June 1997 has reimbursed petroleum storage tank system owners approximately $444M to remediate petroleum contamination both in the soil and groundwater. The program, in addition to auditing owner invoices and authorizing payments, performs technical reviews for site investigations exceeding $40K, comparisons of remedial options and grants closures for a limited number of sites. The 1995-1997 state budget transferred the management of sites with soil contaminated by petroleum only to the newly created Department of Commerce (COMM). This approval process offers regulatory review in an effort to arrive at the lowest cost and most effective investigation and remediation. Between July 1, 1996 and June 30, 1997 the Site Review Section of PECFA reviewed and established remediation maximum reimbursement limits for 860 sites and an estimated cost of approximately $100K (first year costs only).

The PECFA program is currently experiencing a funding shortfall and statute and administrative code changes are in progress. The program currently receives approximately $20M in claims per month but, only has spending authority of approximately $7M per month. Claims received by the program in July 1997 may not receive payment until October 1999. The program receives funding from the petroleum inspection fee and increasing the fee for the PECFA program is not proposed. Bonding ($200M) to resolve the backlog of invoices currently awaiting review is proposed but, a backlog of paid invoices not yet submitted to the fund ($350M±) has yet to be addressed.

For more information, contact Mr. John Alberts, Department of Commerce, P. O. Box 7839, Madison, Wisconsin 53707-7839, phone: 608-266-9403, fax: 608-267-0592.

DEPARTMENT OF HEALTH AND FAMILY SERVICES

Chapter 160, Wis. Stats., directs the DHFS to recommend health-based enforcement standards for substances found in groundwater and specifies the protocol for developing the recommended standards. Recommended standards are sent to the DNR which proceeds through the rule-making process to amend ch. NR 140, Wis. Adm. Code. In June 1996, DHFS forwarded recommendations for 21 new groundwater standards. These proposals will be the subject of public hearings that DNR has scheduled for July 28 through July 31, 1997.

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

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

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

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

The Wisconsin Geological and Natural History Survey (WGNHS) performs basic and applied groundwater research

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

In FY 97, the WGNHS continued to respond to requests for information and assistance from other local, state, and federal agencies, consultants, students, and the public. These requests ranged from the simple, "What will I find underground if I dig or drill here?", to the more complex, such as questions about groundwater flow and contaminant transport in areas of agricultural chemical use or wellhead protection.

Public information, records, and research results that the WGNHS stores and disseminates save the considerable expense of gathering the same geologic or groundwater information several times for different purposes, or "re-discovering" the same information over time. To help this service, the WGNHS continues to review, sort and catalog about 18,000 well construction reports per year (in cooperation with the DNR), measure monthly groundwater levels in a monitoring network of 160 wells (in cooperation with the U. S. Geological Survey), collect, and describe geologic samples from 300 wells per year, and collect and analyze approximately 400 groundwater samples per year for nitrate, chloride, and several other basic parameters.

Research projects completed this year or in progress include:

1. Investigation of groundwater flow in fractured dolomite in Door County.
2. Hydrogeologic and engineering properties of glacial materials.
3. Age, origin, and movement of groundwater in low-permeability materials.
4. Hydrogeology of Dane County, including development of a computerized groundwater flow model for the county.
5. Hydrogeology of Southeast Wisconsin.
6. Delineation of hydrogeologic units throughout Wisconsin.
7. Extent of atrazine contamination in the Lower Wisconsin River valley.
8. Hydrology and hydrogeology of the Kickapoo River
9 Nitrate monitoring near Arena, Lower Wisconsin River Valley.
10. Hydrogeology and groundwater use, and quality of the Fox Cities area.
11. Delineation of wellhead protection areas for the City of Sturgeon Bay.
12. Review of material submitted regarding proposed Crandon mine.

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

DEPARTMENT OF TRANSPORTATION

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

* Salt Storage - Bureau of Highway Operations
* Salt Research - Bureau of Highway Construction (Geotechnical Section)
* Hazardous Materials (petroleum) - Bureau of Environment and District Environmental Coordinators
* Hazardous Waste - Division of Business Management (Risk & Safety Management Section)

* Wetlands - Bureau of Environment and District Environmental Coordinators
* Erosion Control and Storm Water Management - Bureau of Environment and District Environmental Coordinators.
* Potable Well Sampling - Bureau of Highway Operations

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

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

Salt Research - Since 1970, DOT has investigated potential road salt impacts on the environment adjacent to highways. Early investigations (1970s to early 80s) were focused on evaluating road salt impacts to surface water runoff, vegetation, and soils. In the last several years DOT has conducted limited investigations evaluating road salt impacts to groundwater (1 or 2 shallow monitoring wells per site). To date approximately 20 sites throughout the state have been studied. In general, each site is monitored quarterly for a period of 5 years. The monitoring consists of analyzing soil, water, or vegetation samples for calcium, sodium, chloride, and electrical conductivity. Approximately 5 sites are currently monitored, and future groundwater monitoring plans are being evaluated (i.e., longer monitoring periods and multiple well arrangements per site). Results from the studies are discussed in 5 separate DOT progress reports entitled: Investigation of Road Salt Content of Soil, Water and Vegetation Adjacent to Highways in Wisconsin (1972, 1975, 1979, 1989 and 1996).

Hazardous Materials (Petroleum) and Hazardous Waste - As part of the road construction program, DOT performs an estimated 50 to 100 environmental assessments annually along right-of-way where potential sources of petroleum or hazardous waste contamination may occur. Assessments consist of standard environmental audits of properties adjacent to highways, and environmental drilling and sampling to identify or delineate the extent of soil or groundwater contamination. Numerous contaminated sites are identified as part of the environmental assessment process. This information is shared with DNR so appropriate enforcement and remedial action is taken to protect groundwater resources. In addition, DOT works with DNR and DILHR on 5 to 15 sites per year where underground storage tank removal or other remedial actions are necessary to accomplish highway improvement (e.g., managing the removal, treatment, and disposal of contaminated soils or groundwater).

Wetlands - During the past 7 years, DOT has engaged in a cooperative study with the U. S. Geological Survey to investigate groundwater relationships with respect to wetland creation and restoration projects. The projects are required as compensatory mitigation under section 404 of the Clean Water Act. The groundwater studies are intended to increase the certainty of establishing wetland hydrology. In addition, DOT has several ongoing wetland monitoring projects which evaluate wetland hydrology, water quality and biotic response to constructed mitigation sites.

Since July 1993, DOT has had an interagency approved wetland mitigation banking program. Currently wetland loss

due to highway, bridge and airport projects may be compensated for in the bank system. For the period from January 1991 to November 1996 wetland losses of 1172.25 acres at 447 construction projects were compenstated by 1689.49 acres of wetland restoration and creation statewide. Compensation at bank sites was 65.5%, while compensation on-site and off-site (including consolidated sites) was 16.3% and 18.3%, respectively. The acres of wetland loss for the 155 projects compensated on- and off-site was 416.13 and resulted in 599.22 acres of compensation.

As of November 1996 there are 17 open bank sites, which contain 1114.75 available acres. There are 10 planned bank sites, which are expected to yield 929 acres. Depending on the nature of the site, some component of groundwater, water chemistry, and vegetational monitoring is conducted at various DOT wetland bank sites.

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

Chapter 10 of the Facilities Development Manual has been revised to include management of storm water runoff from transportation facilities. The revised Manual contains interim storm water management policy. Currently, storm water best management practices are being incorporated into projects on a case-by-case basis.

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

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

UNIVERSITY OF WISCONSIN SYSTEM

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

Research - During FY 97 the UWS directed a wide-ranging program of priority groundwater research consisting of 12 projects. The projects include short-term and long-term studies, and may be either of a fundamental or an applied nature. They provide a balanced program of laboratory, field, and computer-modeling studies and applications aimed at preserving or improving groundwater quality. Among the categories of groundwater problems investigated are:

1. Contaminant transport in wetland associated groundwater.
2. Development of a variable rate nitrogen application approach for corn to control nitrogen losses to groundwater.
3. Hydrogeologic field measurements and computer modeling of a Silurian aquifer.
4. New and improved technologies for in situ remediation of contaminated groundwater. (3 projects)
5. New and improved technologies for waste management and the protection of groundwater quality. (2 projects)
6. Improvements in detection limits of microcontaminants during groundwater monitoring.

7. Improvements in biological risk analysis from contamination of groundwater by mixtures of pesticides and agricultural chemicals.
8. Improved methodology for assessing the impact of land-use changes on groundwater flow patterns.
9. Development of a statistical model for selecting the most appropriate suite of microbiotests for application to groundwater monitoring.

The 12 projects funded provided training in several disciplines for postdoctoral research associates, graduate student research assistants, and undergraduate students at UW-Madison and UW-Milwaukee. In addition to these projects, UWS completed the second phase of a major program aimed at publication, distribution, and computerized dissemination of research findings resulting from its groundwater research program. Phase 2 encompassed the creation of a web site (www.library.wisc.edu/libraries/Water_Resources/wgrmp/wgrmp.htm) for exclusive presentation of the summaries of research / monitoring projects funded by the State of Wisconsin between 1989 and 1994. The first 48 Summaries, mostly from WDNR, WDOC (Formerly WDILHR), and WDATCP projects, were reformatted and mounted on the server in mid-December of 1996. The remaining 24 UWS Summaries, containing graphics and tables, were html and/or PDF (Adobe Acrobat's Portable Document Format) encoded and uploaded in late June of 1997 to complete the second phase. All 72 currently available project summaries are now positioned for inspection and downloading by researchers, field specialists, state agency and academic libraries, environmental consulting firms, legislative personnel, and citizens groups having access to the world wide web.

The Web Site exercise is part of an effort coordinated by the GCC and being undertaken in conjunction with UWS, DNR, DOC, and DATCP. The purpose is to enhance the utility of research findings resulting from studies funded through the Wisconsin Joint Solicitation process with advice from the UWS Groundwater Research Advisory Council (GRAC) and program planning from the GCC. Future related efforts will likely be directed at keeping the web site up-to-date with current incoming final project reports due by the end of calendar year 1997.

The UWS selected six new groundwater research projects for support from the FY 98 joint solicitation (see Table 1). One project will be co-funded with DATCP and 5 projects selected from the FY 97 joint solicitation will receive continuation support during FY 98.

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

Information Transfer - The updated (July 1997) UWS Water Resources Center home page (***www.library.wisc.edu /libraries/water_resources/page.htm***) now provides convenient links to the UW-Madison's Water Resources Center (WRC) Library, the Wisconsin Groundwater Research and Monitoring Project Summaries discussed above, a compilation of the WRC's Publications from 1996 to 1994, and a WRC Staff Directory. The recently updated WRC Library home page also has an extensive list of links and pointers to Wisconsin and national water resources information on the World Wide Web. The WRC Library itself houses over 26,000 hard copy and microfiche documents covering all major topics in water resources, and over 35 journals and 130 newsletters dealing with water issues or technology. Two electronic library workstations are new to the WRC library. These provide access to MadCat, journal, and information databases for Center Staff, UWS faculty, staff, and students, Wisconsin State Government, business and industry, and the citizens of Wisconsin.

The electronic version of the Wisconsin Groundwater Research and Monitoring Project Summaries has had 411 visitors to its WRC WEB site in its first six months (through June of 1997). The total number of summaries downloaded during this period was 1,157. If this rate of response continues, it will undoubtedly reveal the GCC Summary WEB site as a dominant mechanism for distributing research findings resulting from the Wisconsin's Groundwater Research Program.

Information/Education - The UWS institutions and county-based staff continue involvement in groundwater education activities. In cooperation with other state and federal agencies, groups and individuals, innovative problem-solving educational programs on groundwater resources are provided to the State's citizens through

publications, meetings, teleconferences, satellite programs, water testing, and other forms of assistance. Activities of several specific programs follow.

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

Field operations for the USDA Water Quality Demonstration Project -East River (Green Bay) concluded in 1995. The goal of this five-year project was to determine whether farmers would voluntarily adopt innovative management practices that protect water quality. The project's educational efforts emphasized manure handling, private well protection, milkhouse waste reduction, integrated crop management, and fuel and pesticide storage. Nutrient crediting of applied manure resulted in a reduction of phosphorus and nitrogen on corn fields. The transfer of knowledge gained from this project to other water quality initiatives and stakeholders continued this year in a six-page project overview.

The USDA Hydrologic Unit (Stevens Point, Whiting, and Plover Wellhead Protection) project in Portage county encourages farmers to adopt research-based management techniques to maintain or improve the communities groundwater. Practices including irrigation water management and integrated crop management complement groundwater education as the project's main focus. This project, part of the President's 1989 Water Quality Initiative, will run through 1998. It aims to manage crop nutrients and pests comprehensively, resulting in reduced fertilizer and pesticide use. Project farmers have decreased their use of nitrogen fertilizers, a source of nitrate contamination.

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

The UW Nutrient and Pest Management (NPM) program is engaged in 50 on-farm demonstration and field day activities to disseminate information on agricultural best management practices (BMPs) around the state. The program helps landowners understand how their farm practices may influence groundwater quality . Another incentive is farm profitability. Over the past six growing seasons, NPM regional specialists established 215 demonstrations on 95 farms statewide. Overall, 83% of the improved management practice demonstrations were more profitable than the standard practices to which they were compared.

The UWS cooperates with other state agencies involved in the Non-point Source Water Pollution Abatement program (Priority Watershed Program). This program improves water quality by providing education, technical assistance, and financial assistance through cost-sharing for BMPs in more than 50 watersheds. Several projects incorporate groundwater education strategies into their overall information and education programs. Five Area Water Quality Education Specialists and a staff of three publication/editorial specialists work with County Extension Agents and Land Conservation staff to educate rural and urban residents. Well water testing and groundwater education are common elements in these projects. Additionally, this programming includes drinking water fact

sheets, newsletter articles about groundwater and, in some instances, specific watershed studies that address unique water quality problems. In 1997, this program is likely to undergo a reorientation following river basin lines. Subsequent changes in program focus will likely occur.

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

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

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

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

Last year, the Center assisted 2,427 households in having their water tested in conjunction with county Extension offices and the UW - Stevens Point Environmental Task Force Lab. Of these, 8% exceeded drinking water standards for nitrate-nitrogen. Fourteen percent were unsafe because of coliform bacteria. Twenty-five percent had moderate to severe corrosivity indexes. Seventeen education programs helped 1,257 well users understand potential remedies for these problems and the relationship of land use practices to groundwater quality.

Other projects included continuing to study agrichemical loading in the Central Sands; basin-scale modeling of contaminant loading and migration to the Stevens Point, Whiting and Plover municipal wells; grant-funded workshops which provided sand-tank groundwater flow models to five Central Wisconsin schools; and assisting in a Golden Sands Resource Conservation and Development area project to develop and distribute education materials on corrosive water. The Center also now has a Web site at www.uwsp.edu/groundwater/.

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

UWS GROUNDWATER-RELATED PUBLICATIONS (most were published in FY 97, others were published earlier but were not included in previous years' reports)

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

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

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

Andrews, E., J. Hawthorne and K. Pickering. 1996 Watershed Education--Goals and Strategies for Training, Communication, and Partnerships. UW Env. Res. Center and National Fish and Wildlife Foundation

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On Farm Demonstration Guidebook

Johnson, S.E., K.P. Schmidt, L.W. Good. 1996. Seeing is Believing, NPM, Univ. Wis. Extension, 75 pp.

Nutrient Management Fast Facts

Revision to the Wisconsin Soil Test Recommendation Program

Water Resources web site

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

Farm*A*Syst/Home*A*Syst Program descriptions

National Farm*A*Syst Directory - Updated annually

Wisconsin Farm*A*Syst Packet

Home*A*Syst: Environmental Risk Assessment Guide for the Home

Evaluacion De Las Condiciones que Pueden Afectar La Calidad Del Aqua Potable - Spanish version of the basic model "Farm and Home Assessment". Basic model addresses surface and ground water issues

Home*A*Syst: Environmental Risk Assessment for the Home. Video 8 min.

Farm and Home Pollution Prevention Update Newsletter

Site Evaluation Training Manual. 46 slides, 20 min. Script and handouts

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

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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 nitrates. Each is discussed below.

Volatile Organic Chemicals

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

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

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

Wisconsin has 94 active, licensed solid waste landfills, all of which are required to monitor groundwater. Two studies conducted over four years revealed that out of 51 landfills (all but one are currently closed - both industrial and municipal, engineered and unengineered), 27 (53%) had VOC contamination in groundwater. VOCs contaminated groundwater at 21 (81%) of the 26 unengineered municipal solid waste landfills included in the two studies. While 20 different VOCs were detected overall, 1,1-Dichloroethane was the most commonly occurring VOC at all solid waste landfills. The two DNR publications: "Volatile Organic Compounds in Groundwater and Leachate at Wisconsin Landfills," dated February 1988, and "VOC Contamination at Selected Landfills - Sampling Results and Policy Implications" dated June 1989, further describe the research results. In a follow-up VOC study conducted from July 1992 through June 1994, the DNR reviewed historical data and sampled groundwater at 11 closed, unengineered landfills and at six older, engineered landfills. VOC levels have decreased after closure at all but two of the unengineered landfills, though at many sites VOC levels do not show continued decline. Also, the level of contamination remains high at many closed sites. No VOC contamination was attributable to leachate migration at any of the six older, engineered landfills.

Wisconsin requires underground storage tanks with a capacity of 60 gallons or greater to be registered with COMM. This registration program has identified a total of 165,307 tanks as of July 1, 1997, of which 74,668 tanks are regulated by the federal underground storage tank program. Only 17,170 regulated tanks are currently in use, and 49,452 tanks have been removed. A federally regulated tank is any tank, excluding exempt tanks, that is over 110 gallons in size, has at least 10 percent of its volume underground, and is used to store a regulated substance. Exempt tanks include: farm or residential tanks of 1,100 gallons or less; tanks storing heating oil for consumptive use on the premises where stored; septic tanks; and storage tanks situated on or above the floor of underground areas, such as basements and cellars. .

Underground storage tanks over 110 gallons have been federally regulated since 1988. As of March 21, 1996, DNR records indicate there are 8,330 active underground storage tank contamination cleanups and approximately 6,453

inactive sites. The contaminants most commonly associated with leaks from petroleum underground storage tanks are benzene, toluene, ethyl benzene, and xylene (BTEX compounds). More than 5,000 LUST sites have BTEX groundwater standards exceedances. Drinking water at more than 250 households has been contaminated by leaks from underground storage tanks.

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

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

The Hazardous Substance Spill Law, ch. NR 292.11 Wis. Adm. Code, formerly section 144.76, Wis. Stats, requires immediate notification when hazardous substances are discharged, as well as taking actions necessary to restore the environment to the extent practicable. Approximately 1200 discharges are reported annually to the DNR, and of those, approximately 65% are petroleum related, with another 15% being agrichemicals. The NR 700 series contains the requirements for notification and for taking immediate and/or interim actions when releases occur. Groundwater monitoring is performed when necessary to delineate the extent of contamination.

Pesticides

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

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

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

Groundwater Survey for Alachlor in Southern Wisconsin- Since the late 1980s, DATCP has also initiated a number of surveys to investigate pesticides in groundwater resulting from nonpoint sources. A study completed in 1994, sought to determine the extent of alachlor and ESA (a breakdown product of alachlor) contamination in Southern Wisconsin private wells. The study was conducted in 11 counties where alachlor sales and use have been concentrated. Test kits were sent to approximately 1300 homeowners whose wells had either a previous detection of a triazine-based compound or a previous detection of nitrate over 10 ppm. 669 samples were returned for immunoassay analysis (triazine screen) at DATCP's Bureau of Laboratory Services. Triazine-based compounds were detected in approximately 45% of these samples. Well owners with a detection were offered free follow-up sampling and more comprehensive laboratory analysis for alachlor, ESA, other commonly used pesticides, and nitrate. Two hundred ninety-three follow-up samples were analyzed. Follow-up analysis indicated that approximately 4.1% of the 293 follow-up samples had detections of alachlor and that 70.3% had detections of ESA. Alachlor was detected above the ES of 2.0 parts per billion (ppb) in six follow-up samples. ESA was detected above the Interim Health Advisory of 20 ppb in two follow-up samples.

DATCP plans to conduct site investigations around wells with alachlor exceedences of the ES or ESA exceedences of the Interim Health Advisory to identify the source(s) of groundwater contamination. Information from the

investigations will be used to determine what actions DATCP will take in response to alachlor and ESA contamination in groundwater.

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

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

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

Since the start of this program, DNR groundwater databases have amassed more than 10,000 individual results from the triazine screen analysis. Data received from the SLOH indicates that approximately 42 percent of the samples indicated a detection for a triazine based compound. Approximately 17 percent of the samples have a result which exceeds the PAL for atrazine of 0.3 ppb, and approximately 1.7 percent have exceeded the ES of 3.0 ppb. Comparison to the ES and PAL is used only for reference since the immunoassay triazine analysis screens for ten compounds other than atrazine specifically, and does not detect two of the three atrazine metabolites included in the groundwater standard. Comparison to the ES and PAL for atrazine has some reference value because atrazine has been so heavily used in Wisconsin, and there have been few detects of the other triazine-based compounds in groundwater.

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

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

Nitrate

Nitrate-nitrogen is the most commonly found groundwater contaminant, and frequently exceeds the state drinking water standard and ES of 10 milligrams/liter (mg/l). Consumption of water containing high concentrations of nitrate by infants under 6 months of age can induce methemoglobinemia or "blue baby syndrome." This condition occurs

when hemoglobin is oxidized to a form that is unable to carry oxygen to the body's tissues. All infants are at risk of nitrate poisoning, but those suffering from gastrointestinal illnesses appear to be more sensitive than healthy infants. Serious poisonings in infants have occurred following ingestion of water containing nitrate concentrations as low as 50 mg/l, just 5 times the current ES. Most infant deaths have involved rural well water that contained nitrate levels above 100 mg/l. The developmental effects of low-level exposure are not known, but some experts believe this could cause a chronic oxygen shortage which could injure an infant's nervous system. Some scientific studies have found evidence suggesting that women who drank nitrate contaminated water during pregnancy were more likely to have miscarriages or give birth to babies with birth defects. Nitrate is not known to be harmful to adults or older children. However, since scientists are unsure about the chronic health effects of nitrate, long term ingestion of water that contains high nitrate levels is not recommended.

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

Nitrate can enter groundwater from many sources, including nitrogen based fertilizers, animal waste storage and feedlots, municipal and industrial wastewater and sludge disposal, refuse disposal areas, and private sewage systems. A U.S. Centers for Disease Control (CDC) and Prevention sampling project indicated that approximately 6.5 % of private wells in the state contain nitrate above the ES. This number can be highly variable between counties, but if true, approximately 50,000 of Wisconsin's approximately 800,000 wells exceed the standard of 10 mg/l of nitrate.

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

In response to widespread flooding in the summer of 1993 the CDC sponsored a private well sampling program across the 9 Midwestern flood affected states. DNR Water Supply staff took 636 private well samples with at least eight samples taken in each county. Each well was analyzed for nitrates, coliform bacteria, E. coli bacteria, atrazine, radon and some for sulfates and arsenic. A GIS coverage consisting of point locations for each private well sampled was created by the DNR Water Resources Management Program.

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

DHFS and the UW Dept. of Preventive Medicine received funds from the DNR to study the economic and health impacts of nitrate-contaminated groundwater. Their study was completed in June of 1997. Researchers sent surveys to more than 1500 families whose wells had been tested for nitrate during 1994-1996 and found to have nitrate-N levels below 2 mg/L (low exposure) or greater than 12.9 mg/L (high exposure). High and low-exposure families were matched by county of residence. Surveys requested information about the age and depth of the household well, water consumption habits, response to their nitrate test result, and health histories. In addition, the female head of each household was asked to complete a health and reproductive history questionnaire. 562 surveys were completed and returned for analysis.

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

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

COMM continues evaluating state-of-the-art septic system designs for nitrate removal. In addition, DATCP has been evaluating the need for regulation of nitrogen-based fertilizers. DATCP proposed regulatory authority for fertilizer use in the FY 96-97 budget but the proposal was not approved. A new nutrient management budget initiative was proposed in FY 97 that would give DATCP the authority to promulgate regulatory and non-regulatory rules related to nutrient management.

Biological Hazards

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

Natural Groundwater Quality

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

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

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

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

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

CONDITION OF THE RESOURCE - GROUNDWATER QUANTITY

This is the Executive Summary of the "Status of Groundwater Quantity in Wisconsin" report publish in April, 1997. The full report is available from the DNR and is downloadable from the world wide web at: www.dnr.state.wi.us/eq/wq/dw/gw/pubdwnld.htm

Purpose of Report

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

Findings

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

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

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

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

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

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

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

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

Under Wisconsin Law, chapter 281, Wis. Stats. (formerly ch. 144), the DNR is the "central unit of government to protect, maintain, and improve the quality and management of the waters of the state, ground and surface, public and private." The DNR carries out these responsibilities through its Drinking Water and Groundwater, Watershed Management, Waste Management and Fisheries Management and Habitat Protection programs. The DNR regulates high capacity wells and surface water diversions. Other agencies involved in groundwater quantity issues include the WGNHS, Central Wisconsin Groundwater Center, GCC, Public Service Commission, the USGS, local units of government and water utilities.

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

COORDINATION OF GROUNDWATER MONITORING AND RESEARCH

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

1. DNR Management Practice Monitoring - The DNR has had approximately $350,000 available each year since FY 86 up through FY 95 to support groundwater monitoring studies evaluating existing design and/or management practices associated with potential sources of groundwater contamination. In FY 96 and FY 97 there was approximately $200,000 to $300,000 available for monitoring projects. Through FY 97, the DNR has spent approximately $3.8 million on 142 monitoring projects. Seven projects have been co-funded with DATCP, four projects have been co-funded with the UW and one project has been funded by DNR, DATCP and UWS. The money has come from the Groundwater Account of the Environmental Fund (which is funded by various fees). The intent of these studies is to reduce the impacts of potential sources of contamination by changing the way land activities which may impact groundwater are conducted.

2. UWS Groundwater Research - The UWS has received funding since FY 90 for groundwater research. The money is part of the base UWS budget. They received $200,000 in FY 90 and $300,000 annually since then. Through FY 97, the UWS has spent $2.3 million on 63 groundwater research projects. Three of the 63 projects have been co-funded with DATCP, four have been co-funded with the DNR and one project was jointly funded by DNR, DATCP and UWS.

3. DATCP Pesticide Research - Since 1989, DATCP has had approximately $125,000 available annually as a result of the pesticide law to fund research on pesticide issues of regulatory importance. The money comes from fees paid by pesticide manufacturers to sell their products in Wisconsin. Through FY 97, DATCP has spent about $950,000 on 19 pesticide projects. Three have been co-funded with the UWS, seven have been co-funded with the DNR and one project was jointly funded by DNR, DATCP and UWS.

4. DILHR/COMM Private Sewage System Research - DILHR received a special GPR appropriation of $50,000 from 1990 to 1993 to fund research on alternatives to current private sewage system technology (s. 145.20(5), Stats.) In 1994, when the appropriation expired, $75,000 generated through plan review and licensing fees became available each year for research on private sewage systems. Through FY 97, DILHR/COMM has spent approximately $500,000 on five projects. COMM opted not to participate in the joint solicitation in FY 98.

Approximately $7.6 million has been spent through FY 97 on 213 different projects dealing with groundwater or related topics.

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

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

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

role in establishing research priorities and an advisory role in project selection to minimize overlap and duplication.

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

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

FY 97 Joint Solicitation

The joint solicitation for FY 97 was distributed in November, 1995. A total of 35 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 February 1996 to review and rank the projects submitted for funding. As a result of the subcommittee meeting the GRAC meeting in March, and review of the proposals by agency staff, 18 new projects were selected for funding in FY 97. Nine on-going projects were carried over into FY 97. A total of 27 projects were funded through the joint solicitation at a cost of approximately $718,000 (see Table 1).

FY 98 Joint Solicitation

A joint solicitation for project proposals by the UW System, DNR, DATCP and COMM was distributed in October, 1996 for funding in FY 98. The deadline for proposals was December 11, 1996. The process was moved forward one month to allow investigators more time to hire assistants before the onset of the fiscal year. The joint solicitation package contains a listing of the priorities for each of the agencies (see Appendix). The priority needs for the DNR's management-practice monitoring program for FY 98 were reviewed by the Monitoring & Data Management and Research Subcommittees of the GCC and DNR staff. The two subcommittees met in late January to rank the 22 proposals submitted. Fifteen of the 22 proposals received will be funded in full or in part through the joint solicitation process. The projects to be funded in FY 98 are listed in Table 2.

In FY 96, the GCC began compiling information about other groundwater research programs. There was discussion at GCC meetings of groundwater-related research programs within and outside of Wisconsin. Groundwater-related research projects funded through the Fertilizer Research Council in FY 96 and FY 97 are listed in the Appendix.

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

Table 1 - Groundwater Projects Funded Through the Joint Solicitation for FY 97
(Map numbers are for locating projects on the State map in Figure 3)

DNR Projects

*GIS as a Tool to Prioritize Environmental Releases, Integrate their Management, and Alleviate their Public Threat. Richard Stoll. $28,626 (Map # 1)

*Optimum Management of Ground-water Resources in the Lower Fox River Valley. James Krohelski. $34,375 (Map # 2)

*Variability of Nitrate Loading and Determination of Monitoring Frequency for a Shallow Sandy Aquifer, Arena, Wisconsin. Fred Madison $11,501 (Map # 3)

*Pesticides and Groundwater Impacts. Jeffrey Postle $4,154(Map # 4)

A Study of Well Construction Guidance for Arsenic Contamination in Northeast Wisconsin. Annette Weissbach $15,380 (Map #5)

Stratigraphic Controls on Distribution of Hydraulic Conductivity in Carbonate Aquifers. Tony Simo $25,506 (Map # 6)

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

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

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

DNR/UWS Co-Funded Project

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

UWS Projects

*Characterization of the Role of Evapotranspiration on Groundwater Movement and Solute Chemistry in Groundwater-fed Wetlands. Kenneth Potter. $17,676 (Map # 7)

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

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

Development of a Variable Rate Nitrogen Application Approach for Corn. Larry Bundy $11,580 (Map # 8)

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

Stratigraphy, sedimentology, and Porosity Distribution of the Silurian Aquifer of Ozaukee County, Wisconsin. Mark Harris $8,600 (Map # 9)

Improved Estimation of Groundwater Recharge Rates. Mary P. Anderson $22,100 (Map # 10)

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

(Map # 11)

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

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

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

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

DATCP Projects

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

*Land Use Effects on Groundwater and Streamwater Quality in the Little Plover River Watershed. Byron Shaw. $33,930 (Map # 12)

Fate of Nicosulfuron in Sparta Sand. Birl Lowery $13,575 (Map # 13)

Determining Compatibility Between Herbicide Release and Habitat for Karner Blue Butterfly in Red Pine Plantations. Ed Sucoff $10,059 (Map # 14)

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

COMM Projects

*Evaluation of Shallow-Soil Absorption Fields Associated with Advanced On-site Disposal System. Ronald Stieglitz. $17,781 (Map # 15)

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

Holding Tank Effluent and Fecal-Contaminated Groundwater: Sources of Infectious Diarrhea in Central Wisconsin. Mark Borchardt $27,203 (Map # 16)

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

* Projects preceded by an asterisk were also funded in FY 96.

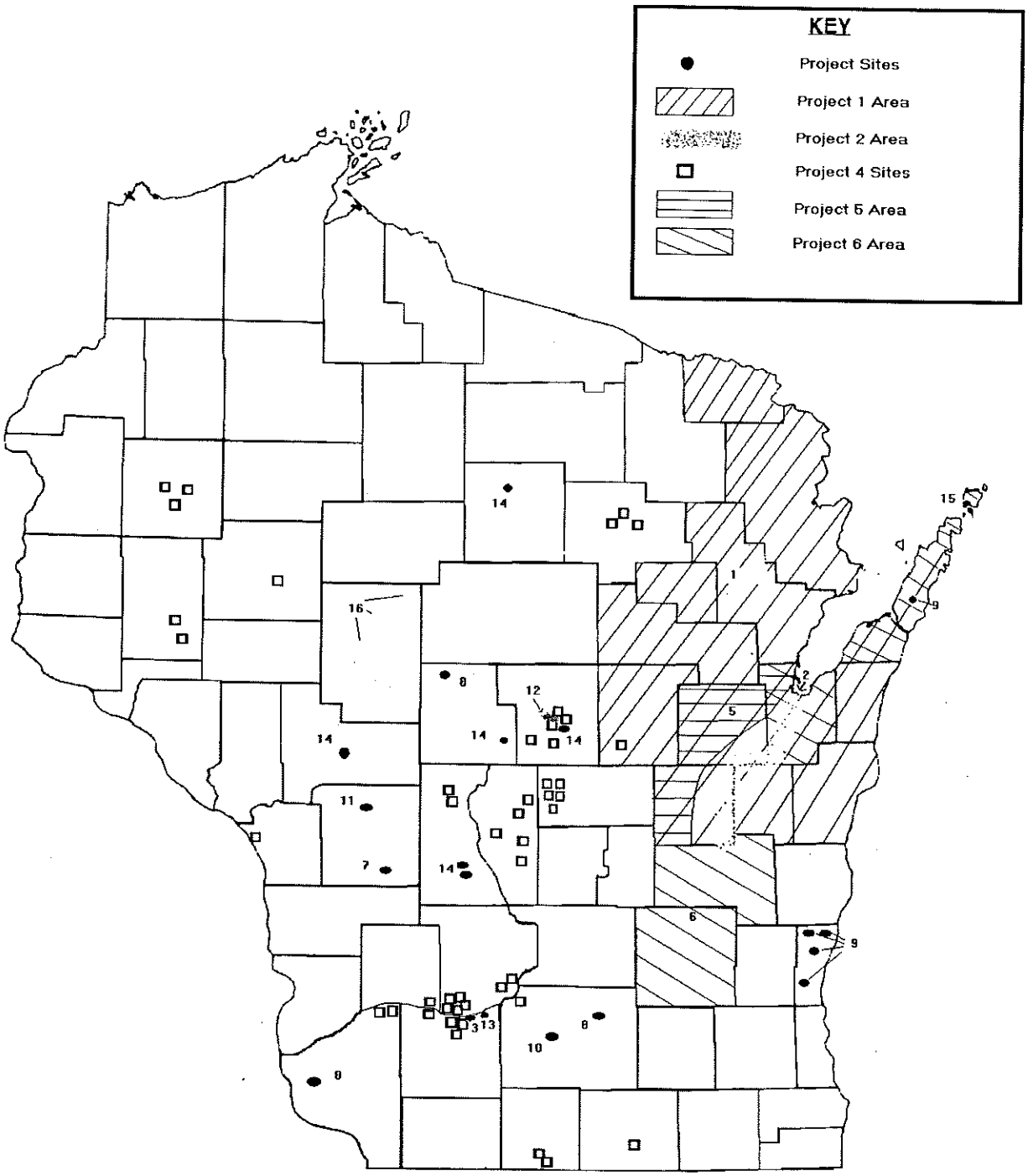

Figure 2 - Location of groundwater monitoring or research studies for F.Y. 1997

Table 2 - Groundwater Projects to be Funded Through the Joint Solicitation for FY 98

DNR Continuing Projects

A Study of Well Construction Guidance for Arsenic Contamination in Northeast Wisconsin. Annette Weissbach $17,548

Stratigraphic Controls on Distribution of Hydraulic Conductivity in Carbonate Aquifers. Juan Antonio Simo $31,655

Pesticides and Groundwater Impacts. Jeff Postle $4,154

DNR New projects

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

Northeast Region Public water Supply Location Utilizing Geographic Information Systems and Global Positioning Systems. Richard Stoll $28,000

Determination of the Hydrostratigraphy of the Deep Sandstone Aquifer in Southeastern Wisconsin. Timothy Eaton $26,447

Evaluation of Geology and Hydraulic Performance of Wisconsin Ground-Water Monitoring Wells Alexander Zaporozec $19,894

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

Groundwater-Surface Water Interactions in the Nine Springs Watershed. Jean Bahr $45,387

Evaluation of the Confining Properties of the Maquoketa Formation in the SEWRPC Region of Southeastern Wisconsin. Ken Bradbury $51,724

The total cost for all projects funded by the DNR through the FY 97 joint solicitation process is $283,317.

UWS Continuing Projects

Development of a Variable Rate Nitrogen Application Approach for Corn. Larry Bundy $14,400

Hydrogeochemical and Microbiological Studies for Enhanced Ground Water Bioremediation. Jean Bahr $32,000

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

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

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

UWS New Projects

Assessment of Impacts on Groundwater/Lake and Wetland Systems Mary Anderson UW-MAD $21,400

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

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

Groundwater/Surface Water Interface Bryant Browne UW-SP $30,600

Determining Ground-Water Recharge Rates in Southern Washington County Douglas Cherkauer UW-MIL $29,000

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

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

DATCP/UWS Co-Funded Project

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

DATCP New Projects

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

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

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

The total cost for all projects funded by DATCP through the FY 97 joint solicitation process, including the co-funded project above is $59,330

COMM Continuing Project

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

Holding Tank Effluent and Fecal-Contaminated Groundwater: Sources of Infectious Diarrhea in Central Wisconsin? Mark Borchardt $28,218

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

BENEFITS FROM MONITORING AND RESEARCH PROJECTS

Table 3 (see Appendix) is a list of groundwater-related monitoring and research projects funded by state agencies since enactment of Wisconsin's comprehensive groundwater protection legislation (1983 Wisconsin Act 410) in 1984. Those agencies which have funded projects are the DNR, DATCP, DILHR/COMM, and the UWS. There are 212 projects listed. One hundred-seventeen of these projects have been funded through the joint solicitation process which began in FY 92. The remaining projects were funded by the above agencies through separate solicitation processes prior to 1992. The table includes the project title, principal investigator or investigators, the years the project was funded, the funding agency or agencies and the project number if assigned.

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

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

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

The state research and monitoring program funded several key projects to better understand the sources of atrazine contamination. When atrazine was first found in groundwater, an argument had been made that this was the result of point sources such as spills and mishandling. One of the most important findings that allowed DATCP to begin developing the atrazine rule was that normal agricultural applications of atrazine could lead to groundwater contamination. The DATCP groundwater monitoring project (Postle, 1986-96) for pesticides used monitoring wells located next to agricultural fields to study groundwater contamination by atrazine and other pesticides. This study showed that atrazine from field use on sandy soils could cause contamination, often above the 3 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 unengineered municipal solid waste landfills than at other types of landfills. A follow-up VOC study (Connelly 1993-94) showed that VOC levels have decreased at most of the unengineered landfills, though at many of the sites VOC levels do not show continued decline. There was no VOC contamination definitely attributable to leachate migration at any of the older, engineered landfills which confirmed that these sites are performing as SWM program staff had hoped. The results of the three VOC studies have been used to establish requirements for VOC sampling at new and existing landfills. These studies have also indicated that inorganic compounds could be useful in predicting VOC contamination at landfills. Therefore, until recent EPA rules required VOC monitoring, the SWM program allowed sites to sample for inorganic parameters as part of routine monitoring and not sample VOCs until inorganics were elevated. The VOC studies provided valuable data which was used to convince EPA to reduce the number of VOCs required for monitoring at municipal solid waste landfills in Wisconsin. This reduction in monitoring (the use of inorganics and the reduced number of VOCs when they are required) allowed landfill owners considerable savings while providing equivalent environmental protection. Additionally, the VOC data was used to require responsible parties to define the degree and extent of contamination

and remediate groundwater contamination at their landfills.

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

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

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

consuming locally contaminated water supplies and made appropriate health recommendations. Research is continuing to determine if well construction recommendations are adequate and to determine if arsenic and iron concentrations in groundwater increase over time in this area.

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

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

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

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

Previous support of county-wide groundwater inventory studies and of modeling methodologies has given WGNHS and USGS personnel the hydrogeologic databases and analytical tools needed for the construction of regional groundwater models such as the recently-completed Dane County groundwater model. This computer model, which covers all of Dane County, simulates current and future groundwater conditions and is being used to evaluate how current and future groundwater pumping affects regional water levels and also how groundwater use affects shallow lakes, streams, and wetlands. In addition, this model has been used to delineate groundwater capture zones for all municipal well in Dane County. Such models are critical tools in the planning process, and allow water managers to evaluate the impacts of various future water management and land use alternatives in order to make well-informed land-use decisions. Two projects are being funded in FY 98 to gather data for a similar project in Southeast Wisconsin.

Prevention and Remediation of Groundwater Contamination - Fifteen research projects emphasizing new

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

- New and enhanced physicochemical or biological methods to renovate waters contaminated by pesticides and volatile organic carbon compounds (Hoopes, 1997-98), (Hickey, 1996), (Bahr, 1996), (Anderson, 1994-95), (Chesters and Harkin, 1991), (Harris and Hickey, 1991-92);
- Enhancements in the ability to control, monitor, and predict the movement of landfill contaminants to groundwater (Edil and Park, 1992-93), (Benson, 1995-96);
- Improvements in the predictability of pump-and-treat remediation applications to contaminated aquifers (Bahr, 1994-95);
- Innovative agricultural practices designed to reduce groundwater contamination by pesticides and nitrate (Bundy, 1993-94), (Bahr, 1991-92), (Harrison, 1992-93), (Newenhouse, 1995); and
- Development of new technologies for evaluating the integrity of water supply well and exploration borehole seals (Edil, 1996), (Edil and Benson, 1997-98).

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

Biological Effects of Groundwater Contaminants - At the urging of the GRAC, the UW-Water Resources Center has solicited research projects during the last 4 years that deal with biological aspects of groundwater contamination. Two of the 5 biological projects, which have been supported, deal with cooperative biological effects among chemical contaminants. This is a subject of widespread current interest because synergistic interactions among chemical contaminants can often greatly enhance or diminish the toxicity of individual components of a mixture. Warren Porter of the UW-Madison Department of Zoology has completed an evaluation of interactions between endocrine disruptors (PCBs, phthalates, etc.) and a common groundwater contaminant (nitrate). Gordon Chesters and Harry Read of the UW-Madison Water Resources Center recently completed a DATCP supported project that focuses on biological interactions between different herbicides and the modulation of these interactions by common agricultural chemicals (e.g., nitrate). There is a great deal of current interest in these types of interactions because environmental toxicologists have heretofore focused exclusively on evaluations of the biological effects of individual chemicals which does not effectively encompass the environment of these compounds in the real world.

Mary Lynne Perille Collins of the UW-Milwaukee Department of Biological Sciences will complete a 2 year project during FY 98 that is aimed at providing a biological probe for methanotrophic bacteria. Methanotrophs are among the most promising of microbial mono-oxygenase bacteria with a capacity to facilitate remediation of groundwater

contaminated with a variety of pervasive organic chemicals. The goal of the project is to design and produce molecular probes for methanotrophs by taking advantage of DNA sequence information that has recently become available. These probes can be used to rapidly and efficiently monitor specific methanotrophic growth and metabolic phenomena at treated sites and to relate these activities to diverse in situ environmental conditions that are likely to affect the success or failure of the remediation effort. George Blondin of the UW-Madison Water Resources Center recently completed a 1 year project aimed at providing a statistical model for assembling the most efficient suite of biological test regimes to monitor the biological activity of a complex water sample containing any number and kinds of suspected contaminants. The project addresses the proliferation of new, rapid, and cost effective microbiotests that have evolved as commercially available toxicity monitoring products over the past several years. Since all microbiotests have inherent biases in terms of their biological response to different classes of contaminants, test suites of a few different microbiotests are usually employed to provide the needed biological diversity to effectively accommodate a given array of suspected contaminants. Unfortunately, test suite components are usually assembled on the basis of intuition or familiarity. This project's goal is to provide a PC based statistical model that will enable the more rigorous assembly of the most efficient test suite. William Karasov of the UW-Madison Department of Wildlife Ecology has recently initiated the only new biological study this year --- a two year study of a possible relationship between common agricultural chemicals and Wisconsin's declining and endangered amphibian population.

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

GROUNDWATER DATA MANAGEMENT

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

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

The DNR groundwater data retrieval system, the Groundwater Retrieval Network (GRN), was completed in October 1993. The GRN currently has access to information on over 171,797 wells. These represent public and private water supply wells, piezometers, monitoring wells, and non-potable wells. Enhancements to the system, suggested by Regional and Central office staff, are implemented annually, to improve system functionality and ease of use. The current GRN system links to data systems in the Bureaus of Waste, Drinking Water and Groundwater and Watershed Management for retrieval. The Wastewater program data systems will be made accessible to the retrieval network when the redesign of this program system is completed.

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

To provide access to the system for other state agencies, computer hardware and software was provided to DATCP, COMM, DHFS, WGNHS and the CWGC. GRN documentation and training has been provided and is always available upon request.

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 "Atrazine Rule" (Chapter ATCP 30, Wis. Adm. Code), to respond to citizen requests on groundwater quality data for specific locations, and to initiate timely investigations of pesticide contamination of groundwater. DATCP ensures the quality of its database by carefully checking and cross-referencing paper lab slips and computerized data received from DNR and other sources. DATCP feels that this level of scrutiny is necessary because it 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's groundwater database currently contains information for over 19,500 wells and over 55,000 pesticide and nitrate-N results. These data represent samples analyzed by DATCP, SLOH, and other public and private laboratories. The groundwater database currently operates as a multiuser application developed in Paradox 4.0. Members of DATCP's Groundwater Unit and Containment and Remediation Unit access the database via Pathworks operating on the DATCP's VAX computer. DATCP plans to convert this application to Microsoft Access in fiscal year 1998. DATCP is also developing links between its groundwater sample database and the Agrichemical Management Bureau's new compliance tracking system (also an Access application). This link will allow staff to view groundwater sample results for specific compliance cases.

DATCP uses 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 data layers of well locations and atrazine concentrations, atrazine prohibition areas, and other pesticide and nitrate-N data. These GIS layers and associated database information are used to generate maps of statewide pesticide and nitrate-N detections in wells, as well as maps for the Atrazine Rule. Other GIS analyses involve identifying groundwater wells

that may be impacted by point sources of pesticide and nitrate-N contamination. DATCP has recently acquired global positioning system (GPS) receivers which will also be used to locate and map wells and other features, such as agrichemical facilities and spill sites, that may affect groundwater quality.

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

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

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

DEPARTMENT OF COMMERCE

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

DEPARTMENT OF HEALTH AND FAMILY SERVICES

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

UNIVERSITY OF WISCONSIN SYSTEM

The CWGC maintains a database of private well testing data from the Environmental Task Force Regional Laboratory at UW-Stevens Point, and Drinking Water Education Programs conducted through the Center. There are currently over 210,000 individual test results for approximately 34,300 samples covering the state. Chemistry data includes pH, conductivity, alkalinity, total hardness, nitrate-nitrite, chloride, saturation index, and coliform bacteria. The database primarily covers the period 1985 to the present. The database is PC-based and can be easily queried to be a significant source of information for local communities and groundwater managers. Thirty-five counties are represented by 100 or more samples in the databases, and 16 counties are represented by 500 or more samples.

DEPARTMENT OF TRANSPORTATION

The DOT maintains records of hazardous material (hazmat) investigations associated with highway projects. Records

of hazardous materials encountered during these investigations, including any groundwater contamination, are on file in the Bureau of Environment.

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

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

COORDINATION ACTIVITIES

GROUNDWATER COORDINATING COUNCIL

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

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

* The GCC and the UWS GRAC continued coordination of the annual solicitation for groundwater research and monitoring proposals among state agencies. Twenty-seven projects were funded in FY 97 by one or more of the following agencies: UWS, DATCP, DNR and COMM. The projects funded are listed in Table 1. The GCC approved the 1998 fiscal year joint solicitation package for groundwater research and monitoring to meet state needs described in a previous section. The package was sent out in October 1996 and is contained in the Appendix. A total of 22 project proposals were received. A comprehensive review process ensued that resulted in the selection of 17 new projects for funding for FY 98. The 17 new projects selected by the UWS, DNR, and/or DATCP for funding in FY 98 are in addition to 9 projects which carried over from FY 97. At their February 28, 1997 meeting the GCC unanimously approved the proposed UWS groundwater research plan as required by s. 160.50(1m), Wis. Stats. The UWS will fund 5 continuing and 5 new projects in fiscal year 1998. The FY 98 groundwater monitoring and research projects are listed by funding agency in Table 2.

* Through several of its subcommittees, the GCC continued to address important data management issues. An informational brochure that standardizes a procedure for assigning Wisconsin Unique Well Numbers (WUWN), a key step in tracking groundwater quality data was published by the DNR and DATCP in November 1996. The brochure targets state, county, and local agency staff and various private industry staff. Other data management activities include: 1) developing a strategy to identify the groundwater data needs of local government entities; 2) evaluating and preparing groundwater-related forms for electronic submittal; 3) examining issues related to coordination and integration of well construction data into an automated format. 4) summarizing data confidentiality issues including laboratory and agency concerns, open records requirements, disclosure/informed consent issues, other regulations and policies that affect collection, integration and distribution of groundwater data by state agencies; and 5) planning updates to the Directory of Groundwater Databases.

* The GCC continued to coordinate efforts to enhance the utility of groundwater monitoring and research funded through the joint solicitation process. In FY 96 the DNR published "Wisconsin Groundwater Research and Monitoring Project Summaries", summaries of 72 final reports of projects funded by the State of Wisconsin between 1989 and 1994. In FY 97, UW Water Resources Center (WRC) staff made these summaries accessible by computer through the creation of a web site (www.library.wisc.edu/libraries/Water_Resources/wgrmp/wgrmp.htm). All 72 currently available project summaries are now positioned for inspection and downloading by researchers, field specialists, state agency and academic libraries, environmental consulting firms, legislative personnel, and citizens groups having access to the world wide web. The electronic version of the Wisconsin Groundwater Research and Monitoring Project Summaries has had 411 visitors to its WRC WEB site in its first six months (through June of 1997). The total number of summaries downloaded during this period was 1,157. Future related efforts will be directed at keeping the web site up-to-date with current incoming final project reports due by

the end of calendar year 1997.

* 1995 Wisconsin Act 27 required the Office of the Lieutenant Governor to evaluate designated boards, councils, and commissions, and recommend continuation, termination or transfer of their functions to another state body. In FY 96, the GCC completed a detailed documentation of the reasons for its creation, its charge, makeup, activities, meeting records, meeting attendance, and other information for the Office of the Lieutenant Governor in a response to a survey designed to evaluate state entities. In FY 97 the GCC was notified that the Lieutenant Governor recommended that the GCC be one of 63 continuing entities out of 144 organizations evaluated .

* The GCC continued to promote communication, coordination, and cooperation between the state agencies through its quarterly meetings. The GCC received briefings on:
    - Subcommittee activities (see below)
    - Groundwater Quantity Report
    - DNR reorganization
    - Research and monitoring project summaries on the web
    - FY 1997 joint solicitation
    - FY 1998 joint solicitation
    - Status of Lieutenant Governor's evaluation of the GCC
    - DNR Groundwater Sampling Guidance
    - Contaminated site closure flexibility
    - Dane County hydrologic study and wellhead protection delineations
    - Dane County Drinking Water Task Force report
    - Field and modeling studies of groundwater contaminant transport
    - Wisconsin Geologic and Natural History Survey centennial
    - Atrazine Rule evaluation
    - Triazine herbicide interactions
    - Tracing groundwater flow through fractured rock in Door County
    - 1997 GCC Report to the Legislature
    - Relevance of research/monitoring proposals to groundwater problems of the state
    - Linkage of research and monitoring programs to those in other states
    - Optimum management of groundwater resources in the Lower Fox River Valley

* The "Status of Groundwater Quantity in Wisconsin" Report was approved by the GCC in February, 1997 and published in April, 1997. DNR staff wrote the report with the assistance of the Groundwater Quantity Technical Advisory Committee, composed of state and federal agency staff, to summarize available information on groundwater quantity and provide options for managing problems (see the Executive Summary of the report in "Condition of the Resource: Groundwater Quantity"). The report was distributed to local and state government staff, the Legislature and other interested persons and has been well-received. The report encourages a more comprehensive and coordinated management approach by organizations involved in county comprehensive planning, wellhead protection, county master plans, rural development and other planning activities addressing groundwater withdrawals. This report is available on the DNR's Bureau of Drinking Water and Groundwater web page (http://www.dnr.state.wi.us/eq/wq/dw/gw/pubdwnld.htm) Groundwater quantity remains a research and monitoring priority. One groundwater quantity-related monitoring project was funded in FY 97 and three are being funded in FY 98 through the joint solicitation process.

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

SUBCOMMITTEE ACTIVITY SUMMARIES

Research Subcommittee - The Research Subcommittee reviewed the priorities for the DNR's groundwater management practice monitoring program for FY 98. The revised priorities were included in the joint solicitation distributed by the UWS, DNR, COMM, and DATCP in November, 1996.

The subcommittee met with the Monitoring and Data Management Subcommittee in January to review the 22 proposals which had been received as a result of the joint solicitation. Subcommittee members made recommendations which were used by the three agencies and the UWS in deciding which groundwater-related proposals to fund for fiscal year 1998. The projects to be funded in FY 98 are listed in Table 2.

Monitoring & Data Management Subcommittee (MDMS) - The MDMS worked with the Education Subcommittee on distribution of a Wisconsin Unique Well Number (WUWN) labeling brochure. The brochure is general in nature and targets state, county, and local agency staff and various private industry staff to promote use of the WUWN. The two subcommittees also worked together to complete several education efforts for Drinking Water Week. Activities included public radio discussions, school presentations, and displays.

The MDMS worked with the Planning and Mapping Subcommittee to explore procedures to improve data transfer and reporting. Workgroups were established to complete tasks related to confidentiality, database documentation, WUWN assignment, automated well construction data format coordination, electronic data submittal and state and county data integration.

The MDMS reviewed the priorities for the DNR's groundwater management practice monitoring program for FY 98. The revised priorities were included in the joint solicitation distributed by the UWS, DNR, COMM, and DATCP in October, 1996. The subcommittee met with the Research Subcommittee in January to review the 22 proposals which had been received as a result of the joint solicitation. Subcommittee members made recommendations which were used by the three agencies and the UWS in deciding which groundwater-related proposals to fund for FY 98. The projects to be funded in FY 98 are listed in Table 2.

Planning and Mapping Subcommittee (PMS) - The PMS met three times during FY 97. The primary focus of the PMS continues to be the review and evaluation of groundwater mapping and analysis tools and practices. However, the subcommittee felt that some basic data collection, transfer, integration, and reporting issues needed to be addressed to facilitate its review and evaluation efforts. As a result, the PMS met jointly with MDMS at each meeting.

Members of the PMS and the MDMS established workgroups to address issues of data confidentiality, database documentation, Wisconsin Unique Well Number (WUWN) assignment, automated well construction data formats, electronic data submittal of groundwater and well information, and state and local data integration. These individual workgroups will continue to address data integration issues in FY 98, although the PMS and MDMS do not anticipate the need to meet jointly in FY 98.

In FY 97, PMS members also discussed issues related to wellhead protection areas, contaminant source databases and maps, transfer of groundwater and well data among state agencies, internet access to the groundwater quality and quantity data, and specific agency projects related to planning and mapping activities.

Education Subcommittee: The Education Subcommittee met four times during the past year. The subcommittee focus this year was on better communication with agency boards and committees whose decisions affect the groundwater resource, and on continuing efforts to provide better coordinated education messages at statewide events and observances.

After questions arose about whether agency board members had adequate groundwater background information when making groundwater related decisions, a process was developed to better communicate with new members of these
boards. Subcommittee members identified appropriate boards within each agency, and developed introductory letters which discussed the importance of the groundwater resource. Appropriate groundwater education materials were also included. Subcommittee members will send these packets out as new board members are appointed.

The subcommittee provided input to the State Lab of Hygiene in their revision of interpretive information for bacteria testing. Individual members also provided input to DPI in their development of education standards.

The subcommittee provided a forum for coordination of some National Drinking Water Week activities. This year it also produced a brochure titled "A Guide to Groundwater Information Sites at Wisconsin Farm Progress Days" which listed displays around the site related to groundwater.

Local Government Subcommittee - The Local Government Subcommittee (LGS) was formed in 1993 to represent local units of government and organizations representing local units of government. In 1997, the LGS met in person and held a teleconference to discuss the draft "Status of Groundwater Quantity in Wisconsin" report, the Dane County Safe Drinking Water Task Force Report, data management needs of local units of government and future meetings.

The LGS provided comments which were incorporated into the Status of Groundwater Quantity Report published in April. The LGS agreed that a letter should be sent to county officials encouraging the use of the process used by the Dane County Task Force to develop implementable groundwater protection recommendations. Letters were sent out to over 250 county officials in early May.

The LGS began discussion of data management needs of local units of government and prepared a draft State and County Data Integration Strategy to identify the groundwater data and data access needs of local governments. The draft strategy was presented at the May GCC meeting. The LGS also discussed the limitations in protecting groundwater by local units of government and will pursue this issue in later meetings.

DIRECTIONS FOR FUTURE GROUNDWATER PROTECTION

PRIORITY ISSUES THAT NEED TO BE ADDRESSED

* **Promote consistency between the agencies on data management issues:** Through publication of the Directory of Groundwater Databases and redesign of the DNR's groundwater computer system, state and local government agencies now have more convenient access to groundwater data. This effort must be maintained by updating the Directory of Groundwater Databases and identifying what local government data needs exist. Data consistency must be promoted by use of translatable geolocational coordinate systems and consistent data elements for use in a GIS environment. The GCC will continue to provide leadership and communication through its subcommittees. This continued effort displays the GCC's commitment to management of the resource through sound scientific methods.

* **Research on land use management and its impact on the groundwater resource:** Additional research is needed on the effect of various land uses (e.g. urbanization) on groundwater quality and quantity. Several projects that study the impacts of land use on groundwater have been and continue to be funded through the joint solicitation. These projects must be managed in such a way as to maximize their relevance to state land use problems. This issue crosses agency lines and promises to be an important issue for years to come.

* **To act as a coordinating and facilitating mechanism for the publication and distribution of information and educational materials on groundwater related issues:** The public has benefited from the consistent educational messages which have been endorsed by the Education Subcommittee. The Education Subcommittee will continue to provide its leadership and assistance to state agencies providing educational materials to the public.

* **Distribution of findings from groundwater research or monitoring projects:** There has been considerable progress in preparing summaries of the results of groundwater-related monitoring and research projects funded through the joint solicitation process. In FY 96 the DNR and UW WRC published a document containing 72 of these summaries. Recognizing that it is important for these summaries and their final reports to be distributed widely, all 72 summaries were reformatted and uploaded to a new GCC Summary WEB site maintained by UW-WRC during FY 97. The initial rate of response to this procedure for distributing Wisconsin groundwater research findings has been approximately 200 summary downloads per month over the fist six months of operation. To maintain and enhance this encouraging response it will be important to add new summaries annually as they become available, create a more visually appealing set of front-end pages for the site, and publicize the WEB site location and content more widely. The Education Subcommittee has taken the summaries to the UW-Extension for preparation of farm-related articles on groundwater research/monitoring results. More work needs to be done to target interested audiences and distribute summaries and final reports more widely.

* **Identify tools that can be used to better predict Wisconsin's groundwater susceptibility to contamination:** Studies have demonstrated the need for developing statewide data layers that would facilitate better groundwater vulnerability assessments. These data layers include land use, soils, regional groundwater flow, hydrogeologic characteristics such as aquifer materials, and potential point sources of contamination such as underground storage tanks and pesticide spills. The studies also illustrate the importance of locational data for contaminant sources. In FY 96 and FY 97, the Planning & Mapping and Monitoring & Data Management Subcommittees began to prioritize, promote, and help facilitate the development of data layers as part of a larger data integration initiative. This work should continue and may result in improved predictive capabilities.

* **Continued evaluation of alternatives to on-site septic systems:** Although the DNR and COMM have recently funded monitoring projects in this area, additional work is needed to find state-of-the-art private sewage system technologies that provide efficient, cost-effective options.

* **Investigation of the causes and effects of nitrate in groundwater:** The GCC will support the agencies and the UWS in obtaining information pertinent to the human health implications of consuming nitrate contaminated groundwater and the effect of discharge of this groundwater on surface waters and their ecosystems. In addition, it will continue to facilitate consistent education to provide a clear message on the many causes and effects of nitrate in groundwater for urban and rural citizens.

* **Solutions to groundwater nonpoint pollution problems:** A 1997 DATCP report indicates that 8.5% of Wisconsin's wells still contain detectable atrazine residues. In addition, 10% exceed the nitrate standard. These rates are substantially higher in agricultural areas. Agriculture is the major source of these pollutants. More work is needed to determine how far Wisconsin groundwater will deteriorate without a substantial change in farming practices, and what practices will sustain both agriculture and groundwater quality.

* **Improved communication between local and state government:** The Local Government Subcommittee to the GCC was created in February 1993 to provide a line of communication between local and state governmental entities. Further effort is needed to improve dialogue between state and local governments. In FY 97, the subcommittee did begin to address data management needs of local governments. However, subcommittee members are often concerned with regulatory issues that affect their communities while the GCC is a non-regulatory body limited to making recommendations to the appropriate regulatory agencies regarding groundwater issues. To increase the responsiveness of state agencies to local government needs, local government needs must be communicated to the GCC and relayed to the appropriate agencies. An effort must be made by the GCC to increase interest in the GCC by local governments, and to offer opportunities to communicate concerns to regulatory agencies.

* **Investigation of adverse impacts from groundwater withdrawals:** In FY 97, DNR staff with help from the Groundwater Quantity Technical Advisory Committee completed a report on the groundwater quantity issue (see "Condition of the Resource - Groundwater Quantity" for the Executive Summary of this report). In the report, localized areas with groundwater quantity problems are identified and the effects of groundwater withdrawals on surface waters and long-term groundwater availability are discussed. There is a need to further quantify hydrographic relationships of surface and groundwater. The GCC should continue to encourage research efforts that will provide information useful in addressing this issue.

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WISCONSIN GROUNDWATER COORDINATING COUNCIL
MEETING MINUTES - AUGUST 23, 1996
Revised November 22, 1996

Members Present: Susan Sylvester (DNR), James Robertson (WGNHS), Nick Neher (DATCP), John Alberts (Commerce), Bob Pearson for Carol Cutshall (DOT), Chuck Warzecha for Henry Anderson (DHFS); Evan Norris for Al Beaver (UWS).

Others Present: Lisa Morrison (DATCP); Ron Hennings and Ken Bradbury (WGNHS), George Blondin (UWS), Chris Mechenich (CWGC), Mike Lemcke, Mark Giesfeldt, Sally Kefer, Dave Lindorff and Jeff Helmuth (DNR), Mike Kakuska (Dane County Regional Planning Commission).

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

1. **General Business** - Introductions were made. John Alberts, new Administrator for the Department of Commerce Division of Environmental Regulatory Services, was welcomed as a new member of the Council. It was noted that the Monitoring & Data Management and Planning & Mapping Subcommittee reports would be combined. The minutes of the May 17th meeting were approved.

2. **DNR Reorganization** - Susan Sylvester said that the placing of non-represented employees was "on hold" due to grievances filed from several sectors. The Administration is attempting to make quality matches and has created team leader and program expert positions for non-represented people to fill. All non-represented positions should be filled this fall. In the field the switch to the new structure should occur in late October. The pilot region period ended on Labor Day and a report should be out soon. In the central office the new sections are in place. One area of overlap will be contaminated sediments which will concern both the Air and Waste Division and the Water Division. The Groundwater Section, though moved to the new Bureau of Drinking Water and Groundwater, is largely intact and should benefit from being in a more integrated program. Ron Hennings asked how information and education (I&E) had been affected. Susan said that the Governor had not allowed as many positions in I&E as there had been. Much of what was previously done by the Bureau of I&E will now be integrated into the individual programs. Susan asked that people have patience because the reorganization was a very large undertaking that its completion would be gradual.

3. **Education Subcommittee Report** - Chris Mechenich reported that, at their July 24th meeting, the subcommittee had discussed opportunities for encouraging the use of Wisconsin Unique Well Numbers (WUWNs). The subcommittee will work to overcome obstacles to the use of WUWNs as educational and groundwater management tools. Chris also reported that she and Ron Hennings had worked with Pam Seelman (UWEX) to produce a second news release based on results from projects funded through the joint solicitation. The news release was on nitrogen crediting and will be distributed mainly to county newspapers. The subcommittee is beginning to plan for next year's Farm Progress Days. Chris reported that the subcommittee had 2 membership changes: 1) Cathy Cliff would not be able to continue due to additional responsibilities at the DNR's Bureau of Communication and Education; and 2) the new DPI representative was Dean Gagnon. Nick Neher suggested that, at the next GCC meeting, there be discussion of ways of recognizing members when they leave subcommittees. The subcommittee also discussed whether there was a need for groundwater education for decision-makers involved in atrazine prohibition area recisions. They had decided, with some reservations, that there was no appropriate role for the subcommittee at that time. Nick Neher posed the question as "whether the subcommittee should take a more generic or more proactive approach" to groundwater education. Jamie Robertson suggested offering to provide information to committees, boards and commissions at their creation. Susan Sylvester encouraged the subcommittee to be proactive and to communicate with the Monitoring & Data Management and Planning & Mapping Subcommittees. Mike Lemcke noted that communication between the subcommittees will be facilitated by having the three meet on the same day in the same place. All 3 are scheduled to meet on October 24th at the DATCP building.

4. **Monitoring & Data Management and Planning & Mapping Subcommittee Reports** - Lisa Morrison reported that the joint meeting held on July 25th focused on the need for data standardization and multi-agency groundwater data integration. The two subcommittees have begun to identify what the agency data needs are. Lisa passed out a list of data integration issues that the subcommittees had produced. Lisa emphasized the need for an integrated groundwater database and stated that the Groundwater Retrieval Network was not originally designed to do all that is now needed. Lisa added that there was a need for a historical perspective. Bob Pearson said there was a need for general guidelines for data collection. A subgroup has been set up to address the issues. Mike Lemcke added that a timeline for addressing the issues will be brought to the next meeting. John Alberts noted that at Commerce there was a major information technology (IT) budget request for funding to track underground storage tanks and asked how other agencies funded IT. Susan Sylvester said that DNR IT was funded from internal reallocation. Lisa said that 5-year IT planning for agencies was occurring so it would be a good time to "plant the seed" for data integration growth. There was consensus that there is a need for data coordination at the statewide level for efficiency. Furthermore, Susan Sylvester clarified that it is part of the GCC's statutory responsibilities to assist state agencies in coordination of groundwater data management. Nick Neher suggested that once it is determined what data and systems are necessary, the next steps should be implementation and policy setting. Chuck Warzecha suggested developing a plan for the Department of Administration soon, to be of use in IT initiatives now being discussed. Chuck also suggested seeking existing funds to use for groundwater data integration. James Robertson suggested that an easily understood explanation of the value of data integration be prepared for use in convincing decision-makers of its importance.

5. **FY 97 Joint Solicitation Funding Concerns** - Susan Sylvester gave updates on solutions to two problems that came up regarding funding of two FY 97 groundwater research/monitoring projects.
The first problem involved Warren Porter's question of why his proposal was not funded by the University when it outscored a proposal that was funded. Susan and George Blondin explained that this was largely due to Porter's proposal clearly being a continuation project, which violates a UW funding criterion. It was agreed that the joint solicitation package should clarify that each agency has a different funding process and describe the selection process more carefully.

   The second issue pertained to funding non-state affiliated contractors through the joint solicitation. A DOA rule affected COMM's funding of a project at the Marshfield Medical Research Foundation, which is not affiliated with the State. The project may not be funded by COMM as was previously thought because the DOA rule requires a competitive bid process for all work not provided by a state affiliate that costs $25,000 or more for completion. Several options are being explored for the project to secure funding for this year. There was a consensus that language should be added to the joint solicitation package to clarify the rule. Jeff Helmuth said he had asked for DOA assistance to prepare appropriate language to include in the FY 98 Joint Solicitation package.

6. **FY 98 Joint Solicitation Timeline**- Jeff Helmuth presented a timeline for activities associated with the FY 98 Joint Solicitation. The proposed timeline would result in funding decisions announced by mid-March, a month earlier than in previous years. The GCC approved the timeline.

7. **Groundwater Quantity** - Dave Lindorff gave some background on the Groundwater Quantity issue. Dave is coordinating completion of a report on the issue for the GCC. Comments from the Groundwater Quantity Technical Advisory Committee have been incorporated into the report. Recommendations are being finalized and will be reviewed internally. Council members should receive a copy of the report a few weeks before the November meeting. The Executive Summary of the report will be very similar to the groundwater quantity discussion in the GCC Report to the Legislature.

8. **Contaminated Site Closure Flexibility** - Mark Giesfeldt outlined revisions to chs. NR 140, NR 722, NR 724, and NR 726, Wis. Adm. Code, which allow greater flexibility in closing cases where groundwater contamination exceeds the Preventive Action Limits or Enforcement Standards. The revisions were a response to concerns about the groundwater law not being flexible enough and the high costs of the PECFA program. The revisions made needed revisions to the 700 series rules relative to remediation but did not change the groundwater law. Natural

attenuation is now listed as a potentially acceptable response action and may be a final remedial response provided specific criteria are met. The Preventive Action Limit (PAL) must not be exceeded at the property boundary, both the source of contamination and any gross contamination must be removed and the site must be shown to be conducive to natural attenuation. One gray area is the definition of gross contamination. Public comments on the rule generally supported the rule but many showed concern about how the DNR would implement the rule, applicability to landfills, and local ordinance changes required by use restrictions on groundwater use. If groundwater contaminant levels are above the Enforcement Standard then a groundwater use restriction applies. Sally Kefer clarified that a groundwater use restriction dictates well construction but doesn't prohibit use. The guidance for groundwater remediation is currently being revised to reflect the changes. Savings resulting from the new rule is projected to be $800 million over 17 years. The new rule will force people to look at alternatives to engineered remediation. One drawback to the rule is that lenders may perceive liability as long as the PAL and ES are still exceeded. The Natural Resources Board (NRB) adopted the rule in June. John Alberts said that there was really no alternative to deed restrictions. PECFA claims are coming in at $17 million/month and there is only $84 million/year to pay them. Ron Hennings was dismayed at the acceptance of the practice of selling land with contaminated groundwater but John Alberts and others agreed that efforts to change the groundwater law had been handled wisely and effectively. Susan Sylvester thanked Mark and Sally Kefer for their efforts and energy in handling the rule revisions and asked for an update on the rules effectiveness at some later date. Mark said the rule would probably become effective in November and that there would be an report to the NRB next spring .

9. **Comments on and Approval of FY 1996 Report to the Legislature** - Jeff Helmuth asked for approval of the draft GCC Report to the Legislature with two changes: 1) replacing Bennette Burks with John Alberts as the Commerce representative; 2) addition of a paragraph presented by George Blondin on information technology to the UWS Activity Summary. As a third change Nick Neher asked that the GCC's request that the Wisconsin Land Information Board encourage potential grantees to include geologic and hydrologic data needs in their grant proposals be included in the Coordination Activities section. Nick also suggested that in subsequent years the report include a description of groundwater research completed under other research programs such as the Fertilizer Research Board. There was agreement that this fourth change should be implemented in the FY 97 report. The 1996 Report to the Legislature with the first three changes above was unanimously approved. Jeff Helmuth said he would make the changes and distribute the final report.

10. **Dane County Hydrologic Study and Wellhead Protection Delineations** - Ken Bradbury outlined the goals, and results of the first county-wide hydrologic study conducted of Dane County since 1965. The study was funded by Dane County Regional Planning Commission, the Madison Metropolitan Sewerage Commission, and the City of Madison. The DNR funded the wellhead protection delineations. Products of the study include 1;24,000 scale water table maps, a 1:100,000 scale potentiometric surface map of the deep sandstone aquifer, a 1:100,000 scale map of depth to bedrock and hydraulic properties of the shallow sand and gravel, and maps of capture zones for most municipal supply wells in the County. Ken reviewed a hydrologic cross-section and a water table map of the county for the Council and explained some key elements. Notably the groundwater and surface water divides are not entirely coincident. In some cases they may differ by several miles. Also, the absence of shale in the northeastern part of the county indicates that deep pumping there may affect the shallow aquifer. The cone of depression around Madison indicates that flow is now out of the lakes into the aquifer.

    Ken explained that a groundwater flow model was constructed to integrate the data into a workable tool that can be used to simulate many features of the County's groundwater flow system, including the effects of new and existing wells, groundwater flow to lakes, streams, and wetlands, and the effects of major land use changes. Although confirmation is difficult, the model can be used for many applications related to predicting groundwater flow direction and rates, predicting how the system will respond to future water use changes, and understanding groundwater - surface water interactions.

    Modeling results indicate that drawdown at the water table within the cone of depression is 10 - 40 feet and that the amount pumped is approximately equal to the amount lost from surface water discharges. Most water supply

wells have capture zones that are entirely within Dane County. The interference between capture zones shows the value of large-scale modeling - a smaller scale model might not include interfering wells. Ken noted that water use has not kept up with population growth as would be expected. However, a future scenario modeled to show the drawdown in the year 2020 showed a significant impact on water resources in West Madison. Additionally, Madison water use was shown to be impacting the Sugar River watershed.

Ken said that to remain useful the model would need to be updated with new data and that the detail and calibration could be continuously improved thus leading to more accurate simulations. Mike Lemcke added that the products should be valuable to the County for planning purposes. Lisa Morrison suggested giving the presentation to the WLIB to which Ron Hennings added that it should be done after the strategic planning process. Nick Neher said he would take the idea to the WLIB. Susan thanked Ken for the presentation.

The meeting adjourned at 3:00. The next meeting is scheduled for 12:00, in the Board Room of the Department of Agriculture, Trade and Consumer Protection, November 22nd, 1996 (changed from November 15th).

Respectfully submitted,

Jeff Helmuth, Groundwater Specialist
Department of Natural Resources

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WISCONSIN GROUNDWATER COORDINATING COUNCIL
MEETING MINUTES - NOVEMBER 22, 1996

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

Others Present: Jane Larson (DATCP); Jean Bahr (UW), Barb Lensch (NRCS), Mike Lemcke, Dave Lindorff and Jeff Helmuth (DNR).

The meeting was held in the board room of the DATCP building in Madison, beginning at noon.

1. **General Business** - Introductions were made. Jeff Helmuth proposed two corrections as suggested by Steve Karklins to item 8 on page 3 of the minutes for the August 23rd meeting. The corrections are: 1) (8th sentence) If groundwater contaminant levels are above ~~between the PAL and~~ the Enforcement Standard then a groundwater use restriction applies; and 2) (13th sentence) One drawback to the rule is that ~~there will be no final closure for~~ lenders may perceive liability as long as the PAL and ES are still exceeded The minutes were approved as corrected and will be reprinted and distributed.

2. **CDC Report** - Jeff Helmuth distributed copies of the final draft of "A Survey on the Quality of Water Drawn from Domestic Wells in Nine Midwestern States". Chuck Warzecha will send Wisconsin's comments to CDC before the December 2nd deadline. Jeff asked that comments be submitted to Chuck or Tom Anderson at DOH, 1414 E. Washington Ave., Rm. 96 before the deadline.

3. **Education Subcommittee Report** - Jeff Helmuth reported that, at their October 24th meeting, the subcommittee had recognized the need for access to groundwater data for education/information purposes. The Subcommittee recommended that the GCC make policy on access to data. Jeff also reported the following statewide acreages released from the CRP program in Wisconsin and some nearby states: WI-11,911; MN-135,500; IA 96,946; and ND 57,735. The subcommittee developed a process for informing new boards/committees and new members of existing committees about groundwater. Groundwater publication lists for each agency and the "Groundwater: Protecting Wisconsin's Buried Treasure" publication will be distributed to targeted individuals. Each agency will be asked to prepare a cover sheet highlighting pertinent publications and issues. Additionally, Education Subcommittee members will be available to make presentations to new boards and committees. The subcommittee also heard a presentation on changes in bacteria test reporting language from Jon Standridge of the State Lab of Hygiene. The proposed changes have merit but would result in different interpretations than the rest of the nation and from EPA and so should be considered carefully. Of special concern is the "microbiologically at-risk" interpretation of total coliform presence. The subcommittee made several suggestions for language changes. Since the October 24th meeting, Jeff became aware of the academic standards being developed by the DPI. He will forward the draft standards to subcommittee members for their comments, which if significant will be distributed to GCC members for comment.

4. **Monitoring & Data Management and Planning & Mapping Subcommittee Reports/Wisconsin Unique Well Number (WUWN) Strategy** -Mike Lemcke distributed the new WUWN brochure and commented that it was the first Drinking Water and Groundwater brochure to have the new DNR regions on the back cover map. Mike also reported that the joint subcommittee meeting held on October 24th focused on a list of data integration issues that the subcommittees had produced. Mike went through the issues for the GCC. Data access was identified as a top priority. Each issue was broken into several tasks which were each assigned a due date. The dates correspond to GCC meeting months so that the subcommittees can present their work to the GCC for endorsements or comments. Work group members were listed for each issue. The list will be distributed to subcommittee members not present at the joint meeting to give them the opportunity to be involved in the work groups.

5. **FY 98 Joint Solicitation** - Jeff Helmuth reported that the FY 98 Joint Solicitation package had been distributed.

The cover letter, however, misstated the due date (Dec. 11, 1997 instead of Dec. 11, 1996) so Jeff had sent out a memo correcting the error and reminding investigators that this year's due date is one month earlier than it was in previous years.

6. **Groundwater Sampling Guidance** - Mike Lemcke passed around copies of the new Groundwater Sampling Desk Reference and Groundwater Sampling Field Manual. The guidances are the first revision since 1987 and have been very well received. They are available for sale through DOA Document Sales and will be available on the Remediation and Redevelopment Bulletin Board and the Drinking Water and Groundwater world-wide website.

7. **Groundwater Quantity Report** - Dave Lindorff gave some background on the groundwater quantity issue and Groundwater Quantity Report. The report had been prepared by the Groundwater Section in conjunction with a Groundwater Quantity Technical Advisory Committee. Recommendations had been developed after internal review by DNR staff and include establishing teams or workgroups of DNR and other agency staff to address the issues. GCC members received a copy of the report before the meeting.

   Henry Anderson asked what the source was for withdrawals (Figure 7 p. 21.) Dave responded that the figure had been published by the USGS using 1990 data. Mike Lemcke added that the 1995 figures would be available in February 1997.

   Susan Sylvester asked if time permitted review of the report by appropriate non-government people. Mike Lemcke suggested that the report be reviewed by the Local Government Subcommittee and finalized by February or May at the latest. Nick Neher suggested asking regional planners to review the report also. Dave Lindorff asked that people send him names of people that they think should review the report. Al Beaver asked that the report be sent to all GCC subcommittee members for review. Dave added that he had extra copies of the report available and that people should send their comments to him (Dave Lindorff, DG/2, DNR - GEF 2). Susan thanked Dave for the report, saying that it had been needed for a long time and that it was sure to be well utilized.

   Jack Metcalf asked about the make-up of the Local Government Subcommittee and suggested that the Mayor of Dodgeville, Jim McCauly, be added to the group. Jack spoke highly of Mr. McCauly's success in handling sewerage problems in Dodgeville

8. **Dane County Drinking Water Task Force Report** - Susan Sylvester noted that the Task Force Report had been sent to GCC members in October and that she was interested in discussion on appropriate actions, if any, that might be taken in regard to it. Susan suggested that the Local Government Subcommittee review the report to consider if endorsement was appropriate. Al Beaver and Nick Neher questioned if the GCC should endorse it. Nick asked if the GCC's role was to check for accuracy and whether there was a need for more education. Al said he didn't feel comfortable with the GCC getting involved in endorsing county activities. James Robertson agreed that the Local Government should review the report and the GCC could respond with a letter saying that the GCC is pleased with the process that led to the report without endorsing the specific recommendations of the report. Bob Pearson reported that Carol Cutshall felt that the GCC should not endorse political actions. There was a consensus that a letter should be sent to the task force thanking them for the report, endorsing the process that produced it, and saying that it had been referred to the Local Government and Education Subcommittees. After review by the subcommittees the GCC will respond further if necessary.

   Bob Pearson said he noticed that there was little emphasis on non-point source groundwater pollution problems. Susan Sylvester agreed and added that there was little discussion of potential development of recharge areas.

9. **Triazine Herbicide Interactions** - Nick Neher showed how atrazine, cyanazine and simazine break down into common metabolites and how this is causing regulatory problems. Two of the three atrazine metabolites included in the total chlorinated residue used for the atrazine Enforcement Standard (ES) are not unique to the parent atrazine. This has resulted in some wells in the Lower Wisconsin River Valley exceeding the ES in 1996 despite there being an atrazine prohibition area there since 1991. The increasing metabolite concentration is probably from cyanazine

use in the area. Additionally, cyanazine is less effective on certain types of weeds than is atrazine so farmers typically use other pesticides to supplement cyanazine. These findings have come from the Atrazine Rule Effectiveness Survey at a time when the DATCP board has asked for a generic policy to rescind atrazine prohibition areas. Henry Anderson said that the EPA was currently having discussions on appropriate MCLs for these compounds and that Wisconsin was the only state using metabolites in groundwater standards due to the health risk studies needed. Nick said he could give a more detailed presentation at the February meeting.

10 **Meeting Schedule for 1997** - The following meeting dates were approved: February 28, May 30, August 15, November 21. All meetings are on Fridays, starting at noon.

11. **Field and Modeling Studies of Groundwater Contaminant Transport** - Jean Bahr talked about several projects that she and her research assistants have received funding for through the joint solicitation process. Jean started by addressing some common physical and chemical processes that affect shallow groundwater quality. She mentioned complex flow in discharge areas, subsurface heterogeneities, chemical heterogeneities in discharge areas and microbially mediated contaminant degradation as significant factors she had addressed in her projects.

Jean talked about a project studying flow to agricultural drainage ditches in the Central Sand Plain that addressed complex flow in discharge areas. It was hypothesized that these ditches serve to limit the spread of agricultural chemicals. Flow paths were traced using ionic tracers and mini-multilevel monitoring wells. The delineated capture zone extended to 12 feet below the water table but was shown to vary from year to year depending on climate. Capture zone depth was also shown to depend on anisotropy. Breakthrough curves showed differing groundwater velocities despite relative homogeneity around the ditch. Jean mentioned that modeling of heterogeneities had been studied by modeling flow paths in a 3-dimensional matrix mapped during quarrying. Modeling showed that heterogeneities greatly affected the shape of capture zones.

Local groundwater chemistry variability was studied at Allequash Creek where Ca, pH, Fe, sulfate and O_2 concentrations were modeled. At the Central Sand Plain site, dissolved organic carbon presence was shown to allow rapid nitrate degradation which was inhibited in the presence of dissolved O_2. At another study site at Fort McCoy nitrate was introduced as an alternative electron acceptor to accelerate biodegradation. Breakthrough curves showed significant nitrate utilization in contaminated areas. In collaboration with Bill Hickey (UW Soils) Jean is currently looking at the types of microbial communities involved in the degradation.

Active remediation was studied at a site near Trout Lake where an air sparging system had been installed to remediate a benzene plume moving towards the lake. Modeling was conducted to determine the roles of biodegradation and volatilization. Sparging was found to mostly affect the unsaturated zone. Biodegradation was too slow to accelerate remediation below the water table. The radius of influence of sparging wells was found to be highly uncertain. Post sparging monitoring was recommended to document the equilibrated system. Jean recommended that the best way to accommodate uncertain radius estimates was by over-design.

Eric Scott asked what could be expected from natural attenuation. Jean noted that at Fort McCoy toluene degraded faster than benzene, iron was mobilized, sulfate levels decreased and that there may also be some MTBE loss. Eric also asked if there was a relationship between ditch depth and capture zone depth. Jean answered that the relationship was more complicated and that gradient was a factor.

The meeting adjourned at 2:55. The next meeting is scheduled for 12:00, in the Conference Room of the Wisconsin Geological and Natural History Survey at 3817 Mineral Point Road in Madison, February 28, 1997.

Respectfully submitted,

Jeff Helmuth, Groundwater Specialist
Department of Natural Resources

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WISCONSIN GROUNDWATER COORDINATING COUNCIL
MEETING MINUTES - FEBRUARY 28, 1996

Members Present: Susan Sylvester (DNR), James Robertson (WGNHS), Nick Neher (DATCP), Henry Anderson (DHFS), Frances Garb for Al Beaver (UWS), Eric Scott for John Alberts (Commerce), and Carol Cutshall (DOT).

Others Present: Jim Vanden Brook (DATCP); Chuck Warzecha (DHFS), Maureen Muldoon (WGNHS), George Blondin (UW), Ray Schmidt (WCCA), Barb Lensch (NRCS), Dave Lindorff and Jeff Helmuth (DNR).

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

1. **General Business** - Introductions were made. Susan Sylvester noted that Al Beaver had accepted a new position as Interim Chancellor of the University of Wisconsin-Extension and welcomed Fran Garb as the official proxy for the UWS. Fran noted that she had come from UW-Stout, had a biology background and was interested in groundwater protection.

   Susan reported the loss of Becky Wallace who had headed the DNR's Nonpoint Source (NPS) Section. Becky had recently died in a tragic auto accident. Susan said that Becky was a caring person with a great sense of humor who would be missed by many DNR, DATCP and County staff.

   Jeff Helmuth requested that approval of the UW Groundwater Research Plan be added to the agenda. The minutes from the November 22, 1996 meeting were approved.

2. **Results of the Lieutenant Governor's Evaluation of the GCC** - Susan Sylvester announced that the Lieutenant Governor had recommended that the GCC be continued. Continuation was recommended for only 63 out of 144 councils evaluated. Sunset dates or transfer of functions were recommended for the remaining 81. The Legislature must act to sunset councils or transfer functions. Susan noted Jack Metcalf's key contribution to the evaluation process and said she would contact Jack to thank him and ask if it would be appropriate for the GCC to formally thank the Lieutenant Governor.

   James Robertson added that he had found that many legislators had not heard of the GCC and suggested that members should mention the GCC in their contacts with Legislators and others to increase awareness of the GCC. Nick Neher noted that the Pesticide State Management Plan mentioned the GCC and said he thought that the Water Resources Center website containing the research/monitoring summaries was a good way to publicize the GCC too. Chuck Warzecha suggested that a 1-page summary of the membership, program contacts, and responsibilities of the GCC could be distributed.

3. **DNR Reorganization** - Susan Sylvester handed out a map of the new DNR Geographic Management Units (GMUs) with Water Division contacts for each GMU. Susan said that a number of 1 to 2 year projects would be focused on showing results from integrating programs. An example is the DNR's assistance to the Farm Service Agency and National Resources Conservation Service in preparing over 800 Conservation Reserve Program (CRP) contracts that expire within a 5 week period this spring. Assisting the CRP sign up is an effective way for the DNR to attain its NPS goals.

4. **Wisconsin Geologic and Natural History Survey Centennial** - James Robertson reported that the WGNHS would celebrate its 100th birthday on April 22nd, Earth Day. The WGNHS has published a calendar commemorating the occasion and will be hosting the North Central Section of the Geological Society of America's annual meeting in May. The meeting will include a presentation with photos on the history of the WGNHS and former state geologists. Field trips to geological sites of interest in Wisconsin and workshops will be offered.

5. **Education Subcommittee Report** - Ron Hennings reported that, at its January 30th meeting, the Subcommittee had identified many state boards and committees that could be targeted for groundwater education. Subcommittee members will continue this identification and will also compile lists of available publications to be sent to new boards and new appointees for existing boards. The next step will be preparation of a cover sheet by each agency highlighting especially pertinent publications and groundwater issues especially important to that agency. The subcommittee had also helped Chris Mechenich develop a pamphlet for Farm Progress Days. The pamphlet contains a map showing booths with specific groundwater-related information and will be distributed at several booths during Farm Progress Days. Ron also announced that "Tools for Drinking Water Protection", a national video conference, would be followed by a statewide Educational Teleconference Network session on March 26th focusing on wellhead and source water protection. Ron also noted that the subcommittee plans for National Drinking Water Week include press releases and appearances on public radio and at schools. The subcommittee also reviewed the Groundwater Quantity Report and agreed with the report's recommendation to promote education about groundwater recharge and wise use of Wisconsin's groundwater resources.

6. **Monitoring & Data Management and Planning & Mapping Subcommittees Report** - Chuck Warzecha reported that the two subcommittees had met jointly on January 29th to discuss progress on data integration issues. The Confidentiality work group decided to keep data as close to the generator as possible to avoid misuse and expects to have draft policy language by the May GCC meeting. The Database work group is looking at updating the Directory of Groundwater Databases in some form and will report to the GCC on that topic in May. The Wisconsin Unique Well Number (WUWN) work group had cross-referenced WUWNs for municipal wells with WGNHS well numbers and other well identifiers. Susan Sylvester asked to be updated on the number of WUWN brochures distributed at the May meeting. Ron Hennings reported that the Well Construction Report (WCR) work group had documented the process by which WCR data are coordinated between WGNHS and DNR and was seeking input from others on streamlining the process and/or data quality control. Criteria are needed to decide how much effort to put into locating a well from information found on its WCR. Chuck Warzecha reported that members of the Electronic Data Submittal work group had met with DNR staff and identified 5 forms (well construction, well/drillhole/borehole abandonment, monitoring well development, soil boring log information, and monitoring well information) for possible electronic submittal and had initiated work on them. Bill Rock had begun a pilot with the well construction report with certain drillers. Chuck Warzecha reported that he was working on identifying and prioritizing groundwater data needs of local governments with the Local Government Subcommittee. A directory or web page may be needed to direct local government staff to data stewards.

7. **Local Government Subcommittee Report** - Dave Lindorff, the new subcommittee chair, reported that the subcommittee had reviewed the Dane County Safe Drinking Water Task Force Report to determine if it should be distributed to local governments. The subcommittee agreed that, despite the Dane County-specific recommendations, the process that produced the report could serve as a model and that the report should be distributed to local governments with a lead-in letter summarizing the Task Force's process. Dave said Steve Born would write the lead-in letter .

   Dave reported that the subcommittee had discussed strategies for identifying groundwater data needs of local government entities, including local data access issues (see item 4 above). Subcommittee members showed interest in obtaining available data and there was consensus that the subcommittee was interested in helping with the data integration issue. Dave said there would be a subcommittee conference call in late April and a report at the May GCC meeting regarding the data needs of local governments. Dave also reported that the subcommittee would meet in person twice a year with conference calls at other times.

   Dave also reported that the subcommittee had reviewed the Groundwater Quantity Report and found that it raised many important issues and contained valuable information for local governments, regional planning commissions and private planning organizations. Subcommittee members showed concern that fewer funds were being allocated to the collection of stream gage, and monitoring well data and that high capacity well pumping data are no longer collected at all. The subcommittee indicated that local government decisionmakers value these data and

need to know what other data are available and where they can be found. Subcommittee members were glad to see a report summarizing the state of the problem and were aware of numerous local groundwater quantity issues. Ray Schmidt advised that local government staff have valuable expertise in data collection too.

Susan Sylvester thanked the subcommittee members for their good work and emphasized their importance in the GCC's accomplishments. Ron Hennings added that agency staff from other states were impressed with the level of interagency coordination in Wisconsin. Ron and Chuck Warzecha acknowledged that the GCC's staff support was very helpful to their subcommittees.

8. **Groundwater Quantity Report (see above item also)** - Dave Lindorff reported that the Groundwater Quantity Report had been reviewed by regional planning commissions, the Local Government Subcommittee, and others and handed out a list of the changes made to the report since the last draft. Dave said that 400-500 copies of the finalized version would be printed by April. Henry Anderson suggested sending the Executive Summary to local governments. James Robertson suggested preparing a fact sheet for the press and counties. Ron Hennings suggested a 2-4 page insert for the Natural Resources Magazine.

9. **FY 98 Joint Solicitation/UWS Groundwater Research Plan** - Jeff Helmuth reported that the FY 98 Joint Solicitation was on schedule and proposal authors would be notified of funding status by March 15th. The UW Groundwater Research Advisory Council (GRAC) had met and project selection was completed for all agencies. George Blondin reviewed the proposed UWS Groundwater Research Plan and summarized the project selection process. The plan included funding 6 new projects at $147,000 and 5 projects continued from FY 97 for $134,400. One new project would be co-funded with DATCP. The budget also requested $18,600 in administrative and reporting funds to compensate for reductions in the federal operating budget of the Water Resources Center. The GCC unanimously endorsed the recommended UWS groundwater research plan for FY 98 and the transmittal of that endorsement to the Department of Administration for release of funds. Letters of endorsement will be sent to the UWS and the Department of Administration.
Two issues of importance to the GCC came up at the GRAC meeting. First, only 22 proposals were received this year, compared to 35 last year and 40 the year before. This was attributed to the new proposal due date of December 11, just before final exams. To remedy this conflict the GRAC suggested moving the due date about 2 weeks earlier for the FY 99 solicitation. There were no objections to this change. The second issue involved the relevance of research proposals to groundwater problems in the state. Some GRAC members felt that there were some gaps in the areas of brownfields, natural attenuation and remediation that should be supported. George Blondin noted that the FY 98 UWS Research Plan included funding for four remediation projects, all continuation projects from FY 97. Nick Neher and Henry Anderson added that GRAC members felt that industry may be able to alert state agencies as to what is needed in the long-term and that a statewide conference had been suggested to address this issue. There was consensus that this should be an agenda item for the May meeting.

10. **Research/Monitoring Summaries on the Web** - George Blondin presented several access statistics for groundwater summaries on the UW Water Resources Center web site. During the period from December 15 to January 31 the home page had been visited 92 times and individual summaries were visited 157 times. Pesticides, Sampling, Analysis & Monitoring, and On-Site Wastewater summaries were the most popular categories. The summaries most often visited were listed. George noted that a search engine would be mounted at a later date. There was consensus that the web site seemed very useful. Susan Sylvester said that it was valuable to have information on how useful the summaries and research are. Nick Neher said that information should be shared with the Legislature.

11. **Atrazine Rule Evaluation** - Nick Neher introduced Jim Vanden Brook to discuss DATCP's recently completed evaluation of the atrazine rule. Jim handed out copies of Groundwater Protection: An Evaluation of Wisconsin's Atrazine Rule and A Survey of Atrazine in Wisconsin Groundwater. Jim outlined the components of the rule and the studies used to evaluate the rule including: The Atrazine Rule Evaluation Survey, The Exceedence Survey, The Paired Well Survey and other studies. The studies showed that concentrations in contaminated private water supply wells decreased nearly 45 percent. Jim attributed this to use restrictions. Concentrations decreased in 84

percent of wells that were above the atrazine enforcement standard. The time interval between samples was between 1 and 5 years. Atrazine level declines were likely due to use prohibitions around these wells. Jim also mentioned the acetochlor monitoring well project where 15 out of 25 sites in Wisconsin received atrazine and 3 of these sites exceeded the atrazine enforcement standard. Jim said that atrazine use declined statewide in 1991 and 1993 when the use rates for atrazine were restricted by the Atrazine Rule. Most farmers follow application guidelines and the atrazine rule. The Exceedence Survey carried out in prohibition areas showed that 50 percent of farmers with ES exceedences still use their contaminated wells and 25% installed new wells. DATCP's recommendations are 1) to continue limits on atrazine use, 2) continue to identify areas where atrazine contamination exceeds the standard, and 3) conduct the Atrazine Rule Evaluation Survey again to evaluate the effectiveness of the rule. Nick Neher emphasized that the important points were the overall decline in atrazine levels and the 98 percent compliance of farmers with the rule.

12. **Triazine Herbicide Interactions** - Nick Neher continued his presentation from the November meeting on how atrazine, cyanazine and simazine break down into common metabolites and how this is causing regulatory problems. Atrazine metabolites included in the total chlorinated residue used for the atrazine enforcement standard (ES) are not unique to the parent atrazine. Specifically, simazine and cyanazine both degrade into deisopropyl and diamino atrazine which are as toxic as atrazine. The use of cyanazine to replace atrazine has resulted in increased metabolite concentrations in some wells in prohibition areas. In some cases the metabolite concentrations have resulted in enforcement standard exceedences. These findings have come from the Atrazine Rule Evaluation.

13. **Tracing Groundwater Flow Through Fractured Rock in Door County** - Maureen Muldoon talked about some of the work she has done to characterize groundwater movement and contaminant transport in fractured dolomite. Her study "Tracer Study for Characterization of Groundwater Movement and Contaminant Transport in Fractured Dolomite", funded by the UWS through FY 96, followed other related projects focusing on groundwater flow in fractured dolomite in Door County. Maureen explained that the karst terrain in Door County poses many problems for groundwater protection. Rapid recharge down vertical fractures can cause serious groundwater contamination. Even worse, complicated fracture networks make it very difficult to trace contamination movement or predict groundwater flow direction. Maureen noted that in one 35 foot borehole the hydraulic conductivity was found to vary by 6 orders of magnitude. To get a better understanding of this type of environment Maureen selected a small site near Sturgeon Bay for detailed study and installed numerous multilevel sampling systems. Slug tests with packers isolating specific intervals of interest were conducted. Hydraulic conductivity measurements showed a bimodal distribution due to both low-conductivity matrix blocks and high-conductivity fracture and dissolution zones. Tracer tests showed complicated flowpaths with detections in both fractures and matrix blocks, rapid downward flow through vertical fractures, and rapid lateral transport and significant tracer dilution in large horizontal fractures. Maureen concluded that hydraulic data alone are poor predictors of transport. Detailed characterization, though costly and time-consuming, is necessary for prediction of transport. Maureen advised that prevention of groundwater contamination is even more important in fractured rock settings than in porous media and recommended that potential contamination sources be limited in those types of settings.

The meeting adjourned at 3:15. The next meeting is scheduled for 12:00, in the Conference Room of the Wisconsin Department of Natural Resources Area Office in Dodgeville on May 30, 1997.

Respectfully submitted,

Jeff Helmuth, Groundwater Specialist
Department of Natural Resources

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WISCONSIN GROUNDWATER COORDINATING COUNCIL
MEETING MINUTES - MAY 30, 1997
Revised August 15, 1997

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

Others Present: Jim Krohelski (USGS); Mike Lemcke and Jeff Helmuth (DNR).

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

1. **General Business** - Introductions were made. The minutes of the February 28th meeting were approved. Susan Sylvester reported that the Legislature had not yet acted on the Lieutenant Governor's recommendations regarding continuation of councils and boards.

2. **Outline for 1997 GCC Report to the Legislature** - Jeff Helmuth proposed that the report be structured as it had in the past but with two changes: 1) The "Condition of the Resource: Groundwater Quantity" section would consist of the Executive Summary of the Groundwater Quantity Report and would refer to the full report; and 2) Research/monitoring web page activity would be reported in the UWS "Summary of Agency Activities" Section. The outline was approved. Jeff said that he would send out agency activity summaries to be updated on diskette as he had in the past. Susan Sylvester asked that the Groundwater Quantity report be made available on the DNR web page.

3. **Subcommittee Reports**

   Local Government Subcommittee - Mike Lemcke reported for Dave Lindorff that the Groundwater Quantity Report had been distributed to County Code Administrators and others. Also, a letter had been sent to a variety of county officials encouraging use of the process used by the Dane County Safe Drinking Water Task Force to protect groundwater. Jeff Helmuth reported that several requests for the Task Force report had been received. Ron Hennings suggested that the report would be of interest to the Wisconsin Land Information Board. Nick Neher noted that the WLIB may soon be sharing staff with the Land Use Council.

   Mike Lemcke reported that there had been good participation by subcommittee members at their February 12 teleconference. Although several subcommittee members felt that data access was not as big of a local groundwater management issue as fragmented jurisdiction, they agreed to work on the data integration issue. Led by Chuck Warzecha, the subcommittee produced a document summarizing their ideas on the data needs of local governments. Jeff Helmuth distributed the document and asked the GCC to direct their comments on the document to Chuck Warzecha, Dave Lindorff or himself. The subcommittee felt that it would be worthwhile to update the Directory of Groundwater Databases. Mike noted that several of the subcommittee members were not previously aware of the directory.

   Monitoring & Data Management and Planning & Mapping Subcommittees - Mike Lemcke reported that the Data Confidentiality Workgroup had prepared a paper and that the issue was clearly statutorily driven. Mike also reported that Randell Clark of the Database Workgroup would begin revising the Directory of Groundwater Databases. Jeff Helmuth reported that the Wisconsin Unique Well Number (WUWN) brochure had been sent to public health departments, DNR regional Private Water staff, land conservation departments, food safety and animal health inspectors, and well drillers. Ron Hennings reported that the Well Construction Report (WCR) Workgroup had looked at various ways of copying and storing WCR information and found that microfiche still looked liked the most cost effective alternative. George Blondin suggested using .pdf files for storage and referred to a local company for more information.

Susan Sylvester gave a quick update on the status of the use of intrusive pitless adapters which the Natural Resources Board felt should not be regulated because they were not a health and safety issue. Susan noted that the well drillers, through organized lobbying, will probably succeed in having the adapters banned by legislative action. This led to discussion on well driller and well inspector certification.

Education Subcommittee - Ron Hennings reported for Chris Mechenich on the subcommittee's May 1st meeting. First Ron clarified that the subcommittee did not commit to do education specifically about groundwater quantity. The subcommittee is interested in using the Groundwater Quantity Report as one of many resources to educate new members of state agency boards and committees about groundwater.

The subcommittee addressed the February GCC discussion on UWS research priorities. Ron reported that subcommittee members had commented that the UWS has funded relatively few projects on social science and education topics whereas many remediation projects have been funded.

The subcommittee also discussed several ways of increasing the visibility of the GCC. Jeff Helmuth added that he had looked into the possibility of a Natural Resources Magazine insert but that the magazine was interested in material of more interest to the general public.

Ron reported that the subcommittee was concerned over the use of 50% of the enforcement standard (ES) as a target in DATCP's proposed revisions to Chapter ATCP 31, Wis. Adm. Code. Some subcommittee members favored use of the preventive action limit (PAL) as the target. Ron also reported that the subcommittee would help the State Lab of Hygiene develop test result range-based language to accompany triazine screen results. Nick Neher said that there was a regulatory dilemma regarding the point at which a test result enters the regulatory system. Ron said that the subcommittee would ask Jeff Postle to participate in future discussions of the reporting language.

Ron also reported that the subcommittee had discussed agency plans for Farm Progress Days and subcommittee membership. New members include Chuck Dunning (USGS), Bob Pearson (DOT), Bob Manwell (DNR) and Jim Kaap (NRCS). Mike Lemcke added that there was a need to recognize service by subcommittee members who have stepped down. Susan asked that a certificate of appreciation be designed. Susan also asked that a letter regarding nitrate contamination of groundwater near Stevens Point be distributed to the Education Subcommittee for their consideration regarding nitrate education. Susan commended the subcommittee for their productivity.

4. Status Reports

ATCP 31 Proposed Rule Revisions - Nick Neher handed out an information sheet and gave some background on the proposed ATCP 31 revisions. Nick explained that the revisions consist of eligibility requirements that a pesticide prohibition area (PA) must meet to be considered for prohibition removal, and other provisions. If a PA meets the requirements, DATCP would hold public hearings on its removal. DATCP could also continue to monitor the groundwater quality in the area or change ways that growers are allowed to use a pesticide. Nick explained that the use of 50% of the ES as a trigger was the result of splitting the difference between the PAL and the ES and that this level might be changed. Substance-specific levels were considered. Henry Anderson observed that it could take a long time before PAL levels were attained as a result of natural attenuation alone. Nick said that monitoring would show how groundwater quality would improve after application slows. Susan Sylvester said that DATCP and DHFS must work closely on the trigger level setting process.

Nick noted that most of the public comments received at that time had been against the proposed revisions but that few farmers had responded. The revisions would probably go back to the DATCP Board in June. Henry Anderson asked if aldicarb was found to exceed the ES. Nick said it had in some wells. Ron Hennings suggested that an understanding of the groundwater flow system was needed to understand pesticide level declines. Henry agreed that dilution and movement would be more significant than degradation.

FY 98 Joint Solicitation - Jeff Helmuth reported that letters to Katherine Lyall (UW) and Mark Burgher (DOA) had been sent to release the funds appropriated by the Legislature for groundwater research to the UW System to carry out the FY 98 groundwater research plan and that principal investigators had been informed of their funding status.

George Blondin reported on the GCC Research Summary Worldwide Web site statistics for the period between 12/15/96 and 4/30/97. Downloads increased to a high of over 250 in April.

George compared joint solicitation timetables from the past two years and suggested that the lower number of proposals in the last year was probably due to the proposal deadline falling immediately before final exams. The GCC agreed with the UW Groundwater Research Advisory Committee's (GRAC) decision that the best potential solution to this problem would be to move the deadline forward two weeks to approximately December 1. George offered an alternative timetable with a December 30th proposal due date. Jeff Helmuth noted that this later date would not allow funding decisions to be made before spring recess. Susan Sylvester asked that a survey of the last 3-4 years of proposal authors be conducted before the next meeting to determine preferences regarding the proposal deadline.

Relevance of research/monitoring proposals to groundwater problems of the State - Susan Sylvester gave some background on the proposal relevance issue that first came up in the March GRAC meeting and asked if people were comfortable with how the GCC was handling the joint solicitation. George Blondin noted that the GRAC members who brought the issue up had a history of arguing for more funding for remediation projects. George added that a large number of remediation projects had been supported in recent years but many were not completed yet. Henry Anderson summarized that out of the reams of data generated by site investigations, little of it had been utilized for policy or technology evaluation and that agencies should reach out to private groups to see the potential for public/private partnerships. Nick Neher suggested that the Brownfields initiative could be helped by a combination of site-specific and more general research. Carol Cutshall added that there were many important questions regarding brownfields that remained unanswered. Eric Scott noted that in past legislative committees, there were discussions regarding the PECFA program reimbursing costs for research. However, PECFA funds could not be used for research (only actual remediation) and that the GCC should be aware of any such proposals and may want to encourage the funding of such research.

Linkage of research and monitoring programs to those in other states - Susan Sylvester stated that she felt that it was important to connect with other states with groundwater research programs to prevent research duplication and to make efficient use of our limited research funds. Jeff Helmuth handed out a strategy for Interstate Coordination of Groundwater Research which consisted of 1) identifying contacts in surrounding states that are involved in their states groundwater research programs; 2) Sending each contact an explanatory letter, the 1996 GCC Report to the Legislature with tabs indicating sections relevant to the state groundwater monitoring and research programs, and the summary web page address; and 3) Repeating 2) in subsequent years. George Blondin added that there is a Water Resources Center in every state and that they might be a good starting place for contacts. Ron Hennings suggested that state geological surveys may be useful and noted that investigators are typically aware of other work in the field through regional and national conferences. Nick Neher added that the EPA played a role in interstate communication. Susan asked that several agencies be contacted in each state.

5. **Optimum Management of Groundwater Resources in the Lower Fox River Valley** - Jim Krohelski summarized the groundwater quantity problems in the Lower Fox River Valley resulting from the increasing use of the sandstone aquifer in the Brown County area. Due to decreased well yields, surrounding communities are considering building a one hundred million dollar pipeline to Lake Michigan. The USGS, in cooperation with the DNR, conducted this study to determine if managed pumping scenarios could minimize drawdown and eliminate the need for the pipeline. This is one of the first such studies to be conducted in the U.S.

Jim gave some background on three previous studies the USGS had conducted with the WGNHS to understand the regional groundwater flow system. The 1000 foot thick aquifer is confined over much of the area but the

confining unit pinches out to the west. The location of the western groundwater divide was carefully studied because most of the recharge enters the system west of where the confining unit pinches out. A groundwater flow model was developed, refined, and calibrated in these previous studies.

Jim also discussed historic and projected potentiometric surfaces in the area. Due to severe declines in the potentiometric surface, the City of Green Bay switched to Lake Michigan water in 1957. This caused a groundwater level rebound of over 300 feet. Due to pumping by surrounding communities levels have since dropped to near-1957 levels with a 400 foot cone of depression. Modeling with projected future pumping rates predicted a saturated thickness in the sandstone of only 100 feet in 2050.

Jim explained that optimization modeling consists of mathematical formulations to determine pumping rates and specified wells. It can be used to minimize or maximize heads or drawdowns at selected locations and is constrained by specified conditions (e.g. head or drawdown limits). The solution procedure is an iterative process using the flow model and optimization package. Jim explained that the optimization formulation maximized total well pumpage while maintaining all well rates between 0 and 1,000 gallons per minute. All heads at municipal wells were maintained above the bottom of the confining unit for maximum potential yield from each well. The optimization solution assumed that all the community water systems would be interconnected, a condition that pipeline construction would also require.

The optimization solution minimized well interference and reallocated pumping to yield 16.4 million gallons per day (MGD), almost the 17 MGD projected for 2050. Jim concluded that groundwater is a viable source of municipal water supply into the future if allocated properly. Jim added that the projected water use was only a few percent of the total Brown County recharge and that the USGS will run proposed water management scenarios for the Brown County and East Central Wisconsin Regional Planning Commissions. Model runs are expected to be completed by the end of July and a draft report should be written by the end of September. Mike Lemcke commended the study but commented that land acquisition costs for the pipeline might make it wise to acquire it sooner rather than later. Susan Sylvester thanked Jim and the USGS Wisconsin District for the excellent work and said that she hoped to see more studies addressing groundwater quantity issues.

The meeting adjourned at 3:05. The next meeting is scheduled for August 15th at the Wisconsin Department of Natural Resources GEF II building in room 611A.

Respectfully submitted,

Jeff Helmuth, Groundwater Specialist
Department of Natural Resources

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TABLE 3 - STATE OF WISCONSIN
GROUNDWATER MONITORING/RESEARCH PROJECTS 1986-1997
(title, principal investigator, years funded, funding agency, project # if assigned)

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

Groundwater Monitoring for Pesticides. J. Postle. 1986-1997. DNR. DNR Project #2.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Groundwater Quality Monitoring - Long Term Effects of Intensive Farming and Sprinkler Irrigation on Groundwater Quality. P. Kammerer. 1986. DNR. DNR Project #15.

The Effect of Construction, Installation and Development Techniques on the performance of Monitoring Wells in

Fine-Grained Glacial Tills. D. Cherkauer, C. Palmer. 1986. DNR. DNR Project #16.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

#40.

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

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

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

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

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

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

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

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

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

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

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

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Improved Detection Limits for Ground Water Monitoring. Sonzogni. 1997. DNR/UWS. DNR # 128

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Molecular Techniques for Detection and Identification of Sewage-Borne Human Pathogens in Soils. Hickey. 1997. COMM.

Holding Tank Effluent and Fecal-Contaminated Groundwater: Sources of Infectious Diarrhea in Central Wisconsin? Borchardt. 1997. COMM.

WISCONSIN FERTILIZER RESEARCH COUNCIL RESEARCH PROJECTS

FY 96 projects

Evaluation of certain non-conventional soil additives for improving crop yields in WI. KeithKelling. $3,800

Development of a variable-rate nitrogen application approach for corn. Larry Bundy. $15,000.

Effect of potassium sources on alfalfa yield and quality at various soil test potassium levels and times of application. Keith Kelling. $7,093.

Factors affecting corn response to starter fertilizer. Larry Bundy. $12,891.

Residue and nitrogen source effects on nitrogen availability. Larry Bundy. $4,571.

Development of a system to accurately determine manure spread rates. Brian Holmes. $6,900.

Carry-over soil nitrate prediction. Bill Bland. $5,300.

Determination of nitrogen, phosphorus, potassium, and pH levels for improving ginseng root yield and quality in WI. Jennifer Parke. $8,310.

Nitrogen tests to predict optimum nitrogen rates for winter wheat. LarryBundy. $9,950

Usefulness of irrigation water and fertigation as nitrogen sources for potatoes. Keith Kelling. $15,760.

Continuing FY 97 projects

Evaluation of certain non-conventional soil additives for improving crop yields in WI. KeithKelling. $3,000

Development of a variable-rate nitrogen application approach for corn. Larry Bundy. $32,000.

Determination of nitrogen, phosphorus, potassium, and pH levels for improving ginseng root yield and quality in WI. Jennifer Parke. $8,310.

Nitrogen tests to predict optimum nitrogen rates for winter wheat. LarryBundy. $10,050

Usefulness of irrigation water and fertigation as nitrogen sources for potatoes. Keith Kelling. $15,760.

New FY 97 projects

Best management practices for starter fertilizer in WI farming systems. LarryBundy. $6,900.

Nitrogen cycling in crop residues and cover crops. Larry Bundy. $2,880

Evaluation of nitrogen tests for site-specific nitrogen recommendations for winter wheat. LarryBundy. $10,790.

Planting date and hybrid effects on nitrogen recommendations for corn. Larry Bundy. $9,450.

Interaction of extended or high rates of calcium or potassium on magnesium needs of WI potatoes. KeithKelling $6,400

Nutrient monitoring in the WI Integrated Cropping Systems Trial. JoshPosner. $9,366.

Development of a system to accurately determine manure spread rates to protect water quality and improve farm profitability. Richard Straub. $7,000.

Improving alfalfa yields in Northwest Wisconsin with sulfur fertilization. KeithKelling. $9,209."

GROUNDWATER EDUCATION ACTIVITIES OF THE DEPARTMENT OF PUBLIC INSTRUCTION

The Department of Public Instruction (DPI), though not a member agency of the GCC does promote and support educational activity related to surface and groundwater quality. DPI is represented on the GCC Education Subcommittee. In FY 97 DPI staff were involved in the following professional development programs:

- During The DPI has made available to agricultural teachers, the video entitled "How to fill and seal a well". Copies of the video were provided by the DNR This video was made available after DPI agricultural education consultants held an in-service workshop for teachers on Friday, January 3,1997 in Stevens Point.

- During the 1996 Wisconsin Association of Vocational Agriculture Instructors Summer Conference, a workshop was conducted by CWGC, WGNHS and DNR staff on use of the Groundwater Study Guide. Approximately 20 people attended this session.

- At the same conference, a workshop taught by DNR staff was offered on well abandonment. The workshop was attended by approximately 15 people

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

GROUNDWATER ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY WATER RESOURCES DIVISION - WISCONSIN DISTRICT

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

* Collecting, on a systematic basis, data needed for the continuing determination and evaluation of the quantity, quality, and use of the Nation's water resources.

* Conducting analytical and interpretive water-resource appraisals describing the occurrence, availability, and physical, chemical, and biological characteristics of surface water and ground water.

* Conducting supportive basic and problem-oriented research in hydraulics, hydrology, and related fields of science to improve the scientific basis for investigations and measurement techniques and to understand hydrologic systems sufficiently well to quantitatively predict their response to stress.

* Disseminating the water data and the results of these investigations and research through reports, maps, computerized information services, and other forms of public releases.

* Coordinating the activities of Federal agencies in the acquisition of water data for streams, lakes, reservoirs, estuaries, and ground water.

* Providing scientific and technical assistance in hydrologic fields to other Federal, State, and local agencies, to licensees of the Federal Energy Regulatory Commission, and to international agencies on behalf of the U.S. Department of State.

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

On-going projects with State and local agencies

1. Ground-water observation well network (WGNHS)
2. Wisconsin water-use data file (DNR)
3. Hydrologic investigations of wetland restoration and creation projects (DOT)
4. Optimum management of ground-water resources in the Lower Fox River Valley (DNR)
5. Characterization of part of the aquifer flow system in the vicinity of the Bad River and Red Cliff Indian Reservations

On-going projects with Federal agencies

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

Completed projects with reports in preparation

1. Hydrogeology and simulation of groundwater flow in the sandstone aquifer, Northeastern, Wisconsin (several Lower Fox River Valley municipalities)
2. Numerical simulation of groundwater in Dane County, Wisconsin (DCRPC, WGNHS)

A summary of the Wisconsin District projects and listing of publications is published annually in "Water-Resources Investigations in Wisconsin." Copies of the summary are available at the Wisconsin District Office or by calling 608/821-3801. For more information please contact Jim Krohelski, USGS, 8505 Research Way, Middleton, Wisconsin, 53562-3581 (608/821-3850), jtkrohel@usgs.gov or visit the Wisconsin District web page (wwwdwimdn.er.usgs.gov).

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.

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