WISCONSIN GROUNDWATER COORDINATING COUNCIL

REPORT TO THE LEGISLATURE

August 1991

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GROUNDWATER
Wisconsin's
buried treasure

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IN REPLY REFER TO: 3230

The Honorable Governor Tommy G. Thompson
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Assembly Environmental Resources, Utilities and Mining Committee
Assembly Natural Resources Committee
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Secretary Alan T. Tracy - Department of Agriculture, Trade and Consumer Protection
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State Geologist Juergen Reinhardt - Wisconsin Geological and Natural History Survey

Enclosed is the 1991 Groundwater Coordinating Council Report to the Legislature as required by state law. The Council was formed to help state agencies coordinate non-regulatory activities and the exchange of information related to groundwater. Among the accomplishments during the past year have been:

- successful completion of a joint solicitation for project proposals to conduct research and monitoring on groundwater, pesticides and alternatives to onsite wastewater disposal systems. Thirty projects were selected for funding.

- a successful conference titled, "Working Together to Manage Wisconsin's Groundwater - Next Steps?" to provide an opportunity for local and state officials and other interest groups to discuss groundwater management issues.

- winning the Robert Rodale National Award for Environmental Achievement from Renew America for the Wisconsin Groundwater Study Guide.

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

Sincerely,

Lyman F. Wible

Lyman F. Wible, Chair
Groundwater Coordinating Council

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EXECUTIVE SUMMARY

This is the Report to the Legislature by the Groundwater Coordinating Council (GCC) as required by s. 15.347, Wis. Stats. The report describes the condition of the groundwater resource and its management and summarizes the Coordinating Council's activities for fiscal year 1991.

In 1984, the Legislature enacted Wisconsin Act 410 with the intention of improving the management of the state's groundwater. The GCC is directed by ch 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); Industry, Labor and Human Relations (DILHR); Agriculture, Trade and Consumer Protection (DATCP); 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 had the following major accomplishments:

1. The GCC assisted in the planning and implementation of a conference titled "Working Together to Manage Wisconsin's Groundwater - Next Steps?" held in Stevens Point in March of this year. The objectives of the conference were to assess the groundwater management experience in Wisconsin and make recommendations for improving management of this valuable resource. The conference brought together representatives of state and local governments and other interests. The proceedings of the conference are contained in Appendix 1 of this Report to the Legislature.

2. The Coordinating Council and the University of Wisconsin System Groundwater Research Advisory Council initiated procedures to coordinate groundwater research and monitoring among state agencies on an annual basis. A joint solicitation for groundwater-related monitoring and research project proposals was distributed in November, 1990. A copy of the joint solicitation is contained in Appendix 2. A total of 47 project proposals were received. Twenty nine projects were

selected for funding by one or more of the following agencies: UWS, DATCP, DNR and DILHR. The projects funded are listed in Table 1. The GCC endorsed the UWS groundwater research plan as required by s. 160.50(1m), Stats.

3. Wisconsin's Groundwater Study Guide received the prestigious Robert Rodale National Award for Environmental Achievement in Groundwater Protection. The Groundwater Study Guide was designed to introduce groundwater concepts into the state public school curriculum and was selected for the award from 1,200 entries. The award was presented by Renew America, a coalition of 28 leading environmental organizations.

4. 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 U. S. Soil Conservation Service (SCS), U. S. Agricultural Stabilization and Conservation Service (ASCS) and the U. S. Geological Survey (USGS) attend GCC meetings and serve as ex officio subcommittee members.

5. The GCC reviewed a Legislative proposal to expand the Council membership and responsibilities to include nonpoint source functions in addition to its groundwater activities. The Coordinating Council expressed several concerns with this proposal which were forwarded to the Legislature.

INTRODUCTION

PURPOSE

The Groundwater Coordinating Council is required by s. 15.347, 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 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 fiscal year 1991.

The following section, "Summary of Agency Activities" and Appendix 1 describe groundwater management programs and implementation of ch. 160 by the individual state agencies. The activities of the Groundwater Coordinating Council and its subcommittees are described under "Coordination Activities" and in the minutes which are contained in Appendix 2. The recommendations of the Council are contained in "Directions for Future Groundwater Protection." Appendix 1, "Working Together to Manage Wisconsin's Groundwater - Next Steps?, Conference Proceedings" describes the condition of the groundwater resource. "Groundwater Monitoring and Research" provides information on monitoring and research activities to address groundwater issues in Wisconsin.

SUMMARY OF WISCONSIN'S GROUNDWATER LEGISLATION

Wisconsin has a long history of groundwater protection. That history is summarized in the paper, "The Framework for Groundwater Management in Wisconsin - an Historical Overview," contained in Appendix 1. The culmination of this effort has been the adoption and implementation of 1983 Wisconsin Act 410, Wisconsin's comprehensive Groundwater Protection Act which was signed into law on May 4, 1984. This law greatly 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, 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) <u>Standards.</u> Under Chapter 160, Stats., the Department of Natural Resources (DNR) is required to establish state groundwater quality standards based on advice from the Department of Health and Social Services. Standard setting is a continuing process based upon a priority list established

by the DNR in conjunction with other state agencies. The state groundwater standards are contained in Chapter NR 140, Wisconsin Administrative Code.

2) Regulatory Programs. Once standards are established, all state agencies must manage their regulatory programs to comply. Each state regulatory agency must have 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 Department of Natural Resources (solid and hazardous waste, industrial and municipal wastewater, spills); the Department of Industry, Labor and Human Relations (septic systems, petroleum product storage tanks); the Department of Agriculture, Trade and Consumer Protection (pesticide use and storage and fertilizer storage); and the Department of Transportation (salt storage). The implementation of the groundwater standards by the state agencies is described under "Summary of Agency Activities" and Appendix 1.

3) Aquifer Classification. One of the most important features of Wisconsin's groundwater law is something that is not in it. At the same time Wisconsin was debating the groundwater protection legislation, the 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 use, value or vulnerability and then would be protected to that classification. This entailed the "writing off" of 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 is capable of being used for people to drink and must be protected to assure that it can be.

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, 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 University of Wisconsin System (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 in the 1989-1991 biennial budget. During the past year, the UWS and three state agencies participated in a joint solicitation for groundwater-related research and monitoring proposals for funding during fiscal year 1992. See the "Groundwater Monitoring and Research" discussion 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 presence of a solid or hazardous waste disposal facility.

Local groundwater management issues are described in more detail in Appendix 1.

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

Appendix 1, "Working Together to Manage Wisconsin's Groundwater - Next Steps?, Conference Proceedings", contains papers by state agencies describing agency responsibilities and accomplishments, interaction with local government and perceptions of gaps in state programs and laws. The following summary describes the groundwater management efforts undertaken by the member agencies of the Groundwater Coordinating Council during the past year. As these summaries show, Wisconsin continues to have a strong commitment to protection of the groundwater resource.

DEPARTMENT OF NATURAL RESOURCES

The Department of Natural Resources (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. In addition to the establishment of groundwater quality standards, DNR has specific regulatory programs.

DNR regulatory programs to protect groundwater fall into one of three categories: water supply, wastewater and solid and hazardous waste management. In addition, the Groundwater Management Section (GMS) assists in coordinating groundwater activities within the DNR, as well as with other state agencies. The GMS is responsible for adoption of groundwater standards contained in ch. NR 140, Wis. Adm. Code, development of an annual groundwater monitoring plan, coordination of the solicitation, review and management of groundwater monitoring projects and maintenance of a data management system for groundwater data.

In the past year, the DNR, in conjunction with the Department of Health and Social Services (DHSS), adopted amendments to ch. NR 140, Wis. Adm. Code to add groundwater standards for 12 additional substances and modified the standards for 7 substances. The DNR held hearings in March to amend ch. NR 140 to add standards for 17 new substances and modify the standards for 1 substance.

The Department received the prestigious Robert Rodale National Award for Environmental Achievement in Groundwater Protection for its Groundwater Study Guide. The Groundwater Study Guide was designed to introduce groundwater concepts into the state public school curriculum and was selected for the award from 1,200 entries. The award was presented by Renew America, a coalition of 28 leading environmental organizations.

The Department continued its groundwater monitoring program which includes problem assessment monitoring, at-risk well monitoring, management practice monitoring and regulatory monitoring. During fiscal year 1991, approximately $350,000 was awarded to 21 projects

for the management practice monitoring program. This program is described in more detail under "Groundwater Monitoring and Research" in this report. In order to promote sharing of monitoring information, the DNR published summaries of 55 completed monitoring projects which have been funded through the management practice monitoring program since 1985. That report, "Wisconsin Groundwater Management Practice Monitoring Project Summaries," is available from the DNR Groundwater Management Section.

The DNR is currently working on plans for a wellhead protection program. Amendments to the Safe Drinking Water Act (SDWA) of 1986 established the first nationwide program to protect groundwater used for public water supplies from a wide range of potential contamination sources through the establishment of state wellhead protection programs. The development of this type of program would be an important step in providing protection of the state's public water supplies.

DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION

Protection of Wisconsin's groundwater is of the highest priority for the Department of Agriculture, Trade and Consumer Protection (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 is responsible for managing pesticides and pesticide practices to assure that established groundwater standards for contaminants are not exceeded. This can include prohibition of certain activities including pesticide use. The agency has a further objective to manage practices to "minimize" groundwater contamination to the extent "technically and economically feasible". Pesticide practices regulated by DATCP include storage, handling, use and disposal. DATCP also regulates the storage of bulk quantities of fertilizer.

$100,000 was provided (1990) to fund pilot Agricultural Clean Sweep projects in three counties for collection and disposal of waste pesticides and containers. More than 29,000 pounds of these wastes were collected from farm sites reducing the potential for leakage and environmental damage. DATCP has requested funding to continue this effort during the 1991-93 Biennium.

Enforcement standards have been established in Wisconsin for several potential groundwater contaminants including 21 pesticides. Standards for additional pesticides have been proposed. In response to concerns about atrazine contamination, DATCP prepared administrative rule Ag 30 to manage the use of atrazine in an effort to reduce or eliminate the potential for further groundwater impacts. Annual rule revisions are anticipated to respond to additional groundwater detects. Rule revisions for 1992 that

create additional atrazine management areas and prohibition areas have already been proposed to address groundwater findings available as of April 1991. DATCP has requested additional funding and positions in the 1991-93 biennium to allow adequate DATCP response to groundwater contamination.

DATCP through it's soil and water resource management program provides funding to counties to assist in the protection of these resources. An increasing portion of this funding is dedicated to the development and implementation of better nutrient and pesticide management practices.

$60,000 has been provided to fund portions of projects in three counties to develop and demonstrate better management practices for nutrients and pesticides. This funding level is expected to increase. Funding has been provided to Dane County to assist in development of a county wide geographic information system (GIS) to evaluate hydrogeologic factors and land use practices with potential for groundwater contamination.

DATCP funded six pesticide research projects at a total cost of $131,000 during the past year. Approximately $125,000 is available annually through fees from pesticide manufacturers as a result of the pesticide law. Although the research projects aren't required to address groundwater issues, all dealt with groundwater in some fashion.

In 1990, DATCP completed a statewide survey of rural wells. The Rural Well Survey was a voluntary public service effort involving 2187 wells. This survey confirmed previous monitoring which showed atrazine to be a major groundwater contaminant impacting an estimated 12 percent of the State's private wells.

DEPARTMENT OF INDUSTRY, LABOR AND HUMAN RELATIONS

The Department of Industry, Labor and Human Relations regulates three major activities that impact groundwater. Through the Department's Bureau of Petroleum Inspection and Fire Protection, the agency regulates the installation and operation of over 140,000 underground petroleum storage tank systems and manages the Petroleum Environmental Cleanup Fund (PECFA). The Department's Bureau of Building Water Systems regulates over one-half million septic systems statewide. These programs are currently undergoing change.

The Bureau of Petroleum Inspection and Fire Protection is implementing the newly-enacted ILHR 10 provisions. The revisions to ILHR 10, the Flammable and Combustible Liquids code, became effective on May 1, 1991. A complete rewrite of the existing code was completed during 1989-1990. These provisions detail the installation, operation, and closure of petroleum storage tanks. The revised administrative rule provides for significant protection

of the environment while still dealing with issues of fire prevention. It also provides new tools for dealing with petroleum storage systems which have ongoing code violations or are suspected of leaking.

The Petroleum Environmental Cleanup Fund Act (PECFA) program has been in operation since late 1988. The fund is designed to satisfy Environmental Protection Agency (EPA) requirements that tank owners be financially responsible and able to fund the costs of a site cleanup.

The creation of the fund has largely been responsible for the massive surge in cleanup activity that has occurred in the last 18 months. The program processed $24 million in claims in FY 1991. The claim load is expected to double or triple in FY 1992. Even with the 57 million dollar cap which has been authorized, claim demand will likely exceed available funding.

PECFA is funded out of a state petroleum inspection fee. The petroleum inspection fee has generated enough funds to allow the program to pay, through June 1991, $29,319,734 in claims. Currently, the fund is paying approximately $2,500,000 per month. The fund has paid on over 562 sites.

The PECFA program's spiraling costs is a major issue currently facing the Department. The number of claims and the cost of cleaning up a site are both quickly rising. The projections for state fiscal year 1992 indicate a possible claim load of 55 to 77 million dollars. Escalating costs relating to site cleanup indicate that action is needed.

Through its plumbing and platting codes, DILHR is responsible for the siting, design, installation, and operation of private sewage systems. There are approximately 500,000 septic systems statewide, ranging in output capacity of 450 to 50,000 gallons per day. Septic systems are managed through a joint effort with county code administrators.

Two separate codes regulate septic systems. ILHR 83 regulates small and large septic systems. ILHR 85 regulates the platting of unsewered subdivisions. DILHR has been criticized in the past for failing to modify the codes to require septic systems to meet the requirements and standards set forth in the groundwater law and NR 140, respectively. Currently approved inground system designs do not meet the standards, primarily for nitrate at the point of discharge, and rely on treatment in the soil and dilution in groundwater. There are no proven designs that consistently meet the standards. Given the strict standards in the rules and the difficulty in producing affordable complying septic designs, DILHR is concerned that full implementation of all standards would create a de facto ban on inground septic systems. DILHR believes that the Legislature did not intend to ban septic systems when it passed the

groundwater law in 1984.

In order to meet the spirit of the law, DILHR continues to modify its codes to provide for improved septic treatment rather than creating severe limitations on septic system use. Recent actions include approval of aerobic treatment units, phasing out the percolation test in favor of soil evaluation criteria, and modification of siting criteria in sandy soils.

Three committees have been formed to recommend modifications to the current codes. The decision of whether to regulate large systems by a separate code or within the current ILHR code is under review.

Two strategies will be used to promote the improvement of septic design: first, the rules will be modified to remove barriers and create incentives for the introduction of new designs developed by private industry and other government agencies. Second, the state-sponsored research will be conducted through research funds and grants.

To address research, the Legislature has appropriated $50,000 per year for four years for research on alternatives to onsite disposal systems. Fiscal year 1991 was the first year DILHR had money available. Two projects were funded to begin to provide answers to this problem.

DILHR has committed these funds to investigating nitrate-removal systems that can be installed in individual residences. The agency plans to have a test facility constructed by November 1991 and intends to public its findings in June 1993.

DILHR is also engaged in a joint program with the DNR to examine a decentralized wastewater management program on Washington Island. The program includes two key elements of future codes: third party management of individual septic systems and research into septic systems that may potentially meet groundwater protection standards.

DEPARTMENT OF HEALTH AND SOCIAL SERVICES

Chapter 160, Stats., directs the Department of Health and Social Services (DHSS) to prepare draft groundwater standards for substances of health concern and specifies the protocol for developing the recommended standards. Groundwater standards recommendations are developed by DHSS for the substances at the top of a prioritized list identified by the DNR. DHSS sends the recommendations to the DNR which then proceeds through the rule-making process to amend ch. NR 140, Wis. Adm. Code.

The DHSS prepared and sent to the DNR draft recommendations for groundwater standards for 17 new substances and one revised standard in November, 1990. The DNR took the DHSS recommendations

through the rule-making process to amend ch. NR 140, Wis. Adm. Code.

The DHSS also distributed money to local public health agencies this past year for projects requiring the use of DHSS funding at the State Laboratory of Hygiene (SLOH). The DHSS covered the costs of sampling materials and laboratory analysis at the SLOH, and will assist in the interpretation of the results. The projects focussed on human health issues of local concern, including groundwater monitoring. This is the second year that money has been available. It is hoped that this effort can be incorporated into the annual joint solicitation by the UWS, DNR, DILHR and DATCP.

DHSS staff review advisory letters sent to well owners by DNR representatives. DHSS often provides additional advice and health risk information to owners of wells which are seriously contaminated with volatile carcinogenic compounds such as benzene. These letters explain the health effects of the specific contaminant and advise the homeowner regarding continued use of the water for bathing, laundry, etc. Owners of wells with nitrate levels in excess of 100 milligrams/liter (mg/l) also receive letters from DHSS. The purpose of these letters is to stress the importance of not feeding nitrate-contaminated water to infants under 6 months of age. These letters also describe the health effects and symptoms known to occur following consumption of water containing high nitrate levels.

DHSS staff are listed on literature distributed by other agencies as resources for health risk information and handle several telephone calls each week answering questions about the health risks associated with consumption and household use of contaminated water.

GEOLOGICAL AND NATURAL HISTORY SURVEY

The Geological and Natural History Survey (GNHS) 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 GNHS groundwater program is complemented by geology, soils, and climate programs that provide maps and research-based information essential to the understanding of groundwater occurrence, quality and movement. Survey personnel are presently preparing groundwater-related maps (such as water-table maps) at a scale of 1:100,000 for the following counties: Racine, Kenosha, Marathon, Grant, Waukesha, Dane, Ozaukee, Washington, Sauk, Fond du Lac, La Crosse, Clark, Buffalo, Trempealeau, Pepin, Eau Claire, Wood, Polk, Burnett, Pierce, St. Croix, Taylor, Oconto, and Forest.

In FY 1991, the GNHS responded to an increased number of 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 for a hydrogeologic review of the environmental impact assessment for the proposed Flambeau mine near Ladysmith.

The public information, records, and research results that the GNHS 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 GNHS continues to review, sort and catalog about 12,000 well logs per year (in cooperation with the Department of Natural Resources), measure monthly groundwater levels in a monitoring network of 210 wells (in cooperation with the U. S. Geological Survey), collect and describe geologic samples from 300 wells per year, and collect and analyze approximately 600 groundwater samples per year for nitrate, chloride and several other basic parameters.

Research projects that have been completed this year or are in progress include the following:

- groundwater flow and quality in fractured dolomite in Door County;
- hydrogeologic and engineering properties of glacial materials;
- groundwater recharge in Central Wisconsin;
- effects of drainage ditches on ground flow;
- age, origin and movement of groundwater in low-permeability materials;
- wellhead-protection techniques in fracture rock settings;
- pesticides in groundwater near grade-A dairy farms in Western Dane County;
- soils, geologic, and hydrogeologic influences on lake water quality in northwestern Wisconsin;
- detailed water-table map of upper Black Earth Creek;
- impact of a barnyard run-off site on groundwater quality in Door County;
- delineation of hydrogeologic units throughout Wisconsin;
- extent of atrazine contamination in the Lower Wisconsin River valley; and
- soils, geologic and hydrogeologic setting for atrazine movement in Dane County.

Groundwater-related publications for FY 1991 include the following:

Geology of Juneau County, Wisconsin, 16-page report with full-color geologic map and cross sections (scale 1:100,000)
Geology of Sauk County, Wisconsin, 68-page report with full-color geologic map and cross sections (scale 1:100,000)
Geology of Wood County, Wisconsin, 18-page report with full-color geologic map and cross sections (scale 1:100,000)
Ice Age Geology of Devils Lake State Park, 28-page pocket guide

with two-color geologic map (scale 1:24,000)
Soil-attenuation-potential map of Pepin County, Wisconsin, two-color map (scale 1:100,000)
Generalized water-table elevation map of Pierce County, Wisconsin, two-color map (scale 1:100,000)
Groundwater Levels in Wisconsin, Annual Summary 1990 (4-page brochure)
Precipitation Summary for 1990 (4-page brochure)
Glaciation of Wisconsin (two-color, 4-page brochure)
Groundwater Quality Regulation: Existing Governmental Authority and Recommended Roles, 109 pages
Groundwater Protection through Local Land-Use Controls, 48 pages
Field Investigations and Numerical Studies of Groundwater Recharge through Unsaturated Sand: A Methodology Applied to Central Wisconsin, 70 pages

DEPARTMENT OF TRANSPORTATION

The Department of Transportation regulates the storage of highway salt under ss. 85.17 and 85.18, Wis. Statutes for the purposes of protecting the waters of the state from harm due to contamination by dissolved chlorides.

Highway salt is stored at various sites by suppliers, counties, cities, villages and private companies. Annual inspections and reports are made of salt storage sites to insure that the piles are covered by buildings, structures, or other impermeable coverings as required by Chapter Trans 277.

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 being tested which give a more positive verification of the coverage. In addition, electronic controls will also record the exact amount spread at each location along the highway for better review and check.

County snowplow operators are given training and review of proper snowplowing and salt spreading techniques each fall. Counties furnish daily reports of salt usage which are compiled for better regulation and control.

UNIVERSITY OF WISCONSIN SYSTEM

The University of Wisconsin System has research and information/education responsibilities. This is a largely artificial division because close cooperation has been achieved between research and extension personnel in the dissemination and implementation of groundwater research findings.

Research - During the past year the UWS has conducted a broad-based program of groundwater research, which included basic and applied,

and long- and short-term projects. Research projects have been initiated or are being conducted to resolve many of the priority needs of Wisconsin. Among the categories of groundwater research are:

1. Sorption effects on contaminant transport
2. Pesticides and their metabolites in groundwater and improved management of agricultural chemicals
3. Short-circuiting of contaminant transport by preferential water flow
4. Hydrogeology - field measurements and computer simulations
5. Remediation of contaminated soils and water
6. Effect of groundwater contamination on property values
7. On-site wastewater disposal

The research program of the UWS is described in more detail in "Groundwater Monitoring/Research Coordination" of this report and in Appendix 2.

Information and Education - The UWS has been and continues to be involved in a wide variety of groundwater education activities. In cooperation with other agencies, groups and individual citizens, the UWS has created and delivered innovative and comprehensive problem-solving education programs on groundwater resources.

Through publications, meetings, teleconference network programs, water testing, and other assistance, the UWS has worked to get groundwater information to officials and the public at the local level. One of the highlights of this effort was the statewide conference in Stevens Point in March entitled, "Working Together to Manage Wisconsin's Groundwater - Next Steps?" which provided a forum for interaction among the array of interest groups concerned with groundwater. The Proceedings of this conference is Appendix 1 of this report.

The UWS has also been instrumental in developing a farmstead assessment system (FAS) to help farmers assess the relationship of their farmstead structures, management practices and site vulnerability to groundwater pollution potential. The FAS is being field tested currently and a national FAS project will be implemented in the near future.

The UWS is also involved in a U. S. Department of Agriculture Water Quality Demonstration Project in the East River Watershed (Green Bay) and a hydrologic unit project in the Stevens Point area. Both projects are intended to increase farmer adoption of research-based practices that will protect and improve groundwater and surface water quality while maintaining or increasing farm profitability. They are joint efforts of state and federal agencies. The demonstration project will be completed in 1995 and the hydrologic unit project will be finished in 1993.

The UWS has long worked with state agencies on the Nonpoint Source Water Pollution Abatement Program. The program works to improve water quality in watersheds by providing educational assistance, technical assistance and cost-sharing for best management practices (BMPs) to improve water quality. Groundwater quality has been an increasing focus of this program. The program has grown to 51 watersheds.

The UWS Nutrient and Pest Management (NPM) Program, initiated two years ago, is now fully staffed and engaged in a number of activities to work with farmers to disseminate information on BMPs around the state. The NPM program worked with numerous farmers throughout the state on nutrient and pesticide management on-farm demonstrations.

The education program of the UWS is described in more detail in Appendix 2.

GROUNDWATER AUDIT

In September of 1990, the Legislative Audit Bureau (LAB) completed its audit of the state's groundwater protection program. The audit was performed to determine how state agencies have implemented the groundwater protection requirements of 1983 Wisconsin Act 410. The LAB indicated that the state agencies were making progress in implementing Act 410, but the LAB found deficiencies in efforts to monitor groundwater quality and in timely enforcement of groundwater standards violations. The LAB acknowledged the need for additional funding to expand monitoring and enforcement activities. Several recommendations were made by the LAB to improve groundwater protection by state agencies. The affected state agencies are addressing the recommendations of the report.

GROUNDWATER MONITORING AND RESEARCH

CONDITION OF THE RESOURCE

The condition of our groundwater resource is described in Appendix 1 of this report, "Working Together to Manage Wisconsin's Groundwater - Next Steps?"

GROUNDWATER MONITORING/RESEARCH COORDINATION

Four state agencies have money available for groundwater-related monitoring or research. Those sources of money include:

1. DNR Management Practice Monitoring - The Department of Natural Resources has approximately $350,000 available each year to support groundwater monitoring studies evaluating existing design and/or management practices associated with potential sources of groundwater contamination. The intent of these studies is to reduce the impacts of potential sources of contamination by changing the way land activities which may impact groundwater are conducted.

2. DATCP Pesticide Research - Since 1989, the Department of Agriculture, Trade and Consumer Protection has had approximately $125,000 available annually through fees from pesticide manufacturers as a result of the pesticide law to fund research on pesticide issues of regulatory importance.

3. UWS Groundwater Research - Approximately $300,000 is available annually for groundwater research administered by the University of Wisconsin System (UWS).

4. DILHR Septic System Research - The Department of Industry, Labor and Human Relations has received an appropriation of $50,000 for four years to fund research on alternatives to current septic system technology. The research, which will include groundwater monitoring, focuses on designs, products, and management practices that minimize nitrate contributions from septic systems.

In order to provide consistency and coordination among the four state agencies (DATCP, DNR, DILHR and UWS) in funding groundwater monitoring and research to meet state agency needs, there have been discussions among the involved agencies through the Groundwater Coordinating Council (GCC) for some time. At the request of the GCC, the UWS in 1988 created a Groundwater Research Advisory Council (GRAC) to establish a long-range groundwater research plan and develop a groundwater research decision item narrative (DIN) for inclusion in the University's biennial budget. The GRAC consists of university, state agency and public representatives.

Based on discussions with the GCC, the GRAC prepared a groundwater research decision item narrative (DIN) for inclusion in the University's 1990-1992 biennial budget request. The GCC endorsed the DIN at its October 14, 1988 meeting. The DIN was included in the governor's budget and was approved by the Legislature at a level of $500,000 for the FY 90-92 biennium for groundwater research. 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 Memorandum of Understanding (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 the past biennium with concurrence from the GCC. During the summer of 1990, the GRAC and GCC developed and endorsed a plan to coordinate the solicitation of funds in fiscal year 1992 and future years. The mechanism provides for only one submittal of project proposals, rather than four as has been the case. The intent of the plan is to determine the most appropriate funding source for funding a particular project.

The plan was initiated in the fall of 1990 to solicit project proposals for funding beginning in fiscal year 1992. The joint solicitation for project proposals was distributed in November, 1990. A copy of the joint solicitation is enclosed in Appendix 2. The deadline for proposals was January 15, 1991. A total of 47 proposals were received for review. Thirty three requested funding from the DNR, thirty three requested funding from the UWS, thirteen from DATCP and four from DILHR.

Each agency reviewed the proposals independently. The MOU was followed in the project solicitation, review and selection process for UWS proposals. In addition, the Research and Monitoring & Data Management Subcommittees met jointly in February to discuss and provide ratings for the proposals. Representatives of the four agencies met in March to discuss funding of projects which ranked high by more than one agency. The projects selected by each of the agencies are listed in Table 1.

In order to comply with statutory language, the GCC met via a teleconference on April 5, 1991 and approved the UWS proposed groundwater research plan. The GCC also approved an additional UWS project at its May 10 meeting.

In addition to the projects listed in Table 1, the DNR will fund four projects in FY 1992 which were funded in FY 1991. The total cost of these four projects is $51,650. The above four agencies will spend a total of approximately $820,000 during the coming fiscal year on groundwater-related monitoring and research.

GROUNDWATER DATA MANAGEMENT

The Wisconsin Department of Natural Resources (DNR) has the responsibility of groundwater protection in the Division of Environmental Quality. The collection and coordination of groundwater data exchange within the DNR and with outside agencies has been increasingly important as an issue externally as well as internally within DNR. The DNR is currently in the middle of a renewed effort to coordinate the collection and retrieval of all groundwater data, as a result of DNR funding, inter-agency responsibilities, and cooperative agreements.

The DNR currently has a computer system called the Groundwater Information Network (GIN). The system's intent is to bring all DNR collected groundwater well inventory information and sample collection and results data under one common system format. Groundwater data from a variety of sources, including non-point source basin studies, county sampling projects, DNR management practice monitoring projects, DNR regulatory monitoring, and DATCP pesticide projects are some of the current data sources being brought together.

This GIN computer system is currently in the process of being migrated from the state regional computing facilities to the Department VAX network system. As part of the migration process, the GIN system is being renamed the Groundwater Retrieval Network (GRN). The new system will focus on data integrity and ease of use for the end users.

Access to the system for other state agencies will be a high priority for the new GRN system. The system will be under the Department's supervision and access can be granted more freely than has currently existed. The sharing and exchange of information between agencies dealing with groundwater should be greatly enhanced by GRN.

Table 1 - Groundwater Projects Funded Through the Joint Solicitation for FY 1992

Projects to be funded by the DNR

Remediation of Soils Contaminated by Leaking Underground Storage Tanks by Vapor Extraction and in situ Biostimulation. Hickey and Bubenzer. $22,666

Nitrate Analysis and Drainfield Regeneration with Aerobic Wastewater Treatment in Individual Residential Systems. Deckert and Meyer. $3,391.

Evaluation of Denitrification Systems for Improving Groundwater Quality from On-site Waste Disposal Systems. Shaw, Schmidt and Kaminski. $29,044

Municipal Wastewater Absorption Pond Renovation for Enhanced Nitrogen Removal. Gilbert and Oman. $37,700

Investigation of Potential Groundwater Impacts at Demolition Landfills, Deer Pits and Yard Waste Compost Sites. Connelly. $23,216

Arsenic as a Naturally Elevated Parameter in Water Supply Wells in Eastern Winnebago and Outagamie Counties, Wisconsin. Stoll. $23,039

Spatial Attributes of the Soil-Landscape Groundwater System of the Lower Wisconsin River Valley. McSweeney, Madison, Attig and Bohn. $22,918

Preliminary Comparison of a Discrete Fracture Model with a Continuum Model for Groundwater Movement for Fractured Dolomite. Bradbury and Muldoon. $8,880

Evaluation of NURE Hydrogeochemical Data for Use in Wisconsin Groundwater Studies. Mudrey, Bradbury and Kammerer. $14,760

Distribution of Radionuclides in Wisconsin Groundwater. Mudrey, Bradbury and Fitzgerald. $5,000

Variability of Hydrologic Conductivity in the Horicon Formation: The Effects of Scale and Testing Methods in a Uniform Media. Mickelson and Bradbury. $9,656

Evaluations of Barnyard Improvements on Groundwater Quality. Shaw. $10,456

Assessing the WDNR's Program for Monitoring Active Non-Approved Landfills. Gear. $5,217

GIS Mapping of Groundwater Contaminant Sources Quality and Contamination Susceptibility for Door County. Stoll. $34,369

Projects to be funded by the UWS

Use of Tire Chips to Attenuate VOCs. Edil and Park. $25,030

Effects of Complex Leachate Mixtures on the Transport of Hydrophobic Organic Pollutants. Grundl, Cherkauer and Edgington. $20,605

Role of Mobile Colloids in Groundwater Contaminant Transport. Armstrong. $32,665

Tracking Contaminant Pathways in Groundwater with a Geologically Based Computer Model for Outwash Deposits. Mickelson. $28,975

Effects of Transient, Cross-stratification Flow on Contaminant Dispersion. Bahr. $24,160

The Convective Flux of Chemicals Across a Sediment-Water Interface. Green. $18,420

Near Source Transport of Contaminants in Heterogeneous Media. Hoopes. $35,820

Living Mulch Systems for Nitrate Trapping in Vegetable Production. Harrison. $24,260

Geographical Information System for Subsurface Characterization. Bosscher, Adams and Joeres. $24,025

New Approaches to Measuring Biologic Effects of Groundwater Contaminants. Porter, Carlson, Hinsdill, Olson and Weiler. $15,000

Projects to be funded jointly by UWS and DATCP

Herbicide and Nitrate Movement in a Sandy Soil in the Lower Wisconsin River Valley. Lowery, McSweeney and Stoltenberg. $45,000

Estimating the Spatial Distribution of Groundwater Recharge Rates Using Hydrologic, Hydrogeologic and Geochemical Methods. Potter, Bowser and Bradbury. $37,365

Distribution, Transport and Fate of Major Herbicides and Their Metabolites. Chesters and Harkin. $68,675

Project to be funded jointly by DNR and DATCP

Dane County Atrazine/Land Management Project. Conners, Bohn and Ventura. $38,600

Project to be funded by DILHR

Nitrogen Removal from Domestic Wastewater in Unsewered Areas. Otis, Boyle and Converse. $93,000

COORDINATION ACTIVITIES

GROUNDWATER COORDINATING COUNCIL

The Groundwater Law, 1983 Wisconsin Act 410, established the Wisconsin Groundwater Coordinating Council to advise and assist state agencies in coordinating nonregulatory programs and exchanging groundwater information. The Groundwater Coordinating Council (GCC) consists of the heads of all state agencies with some responsibility for groundwater management plus a Governor's representative. The state agencies include the Departments of Natural Resources; Industry, Labor and Human Relations; Health and Social Services; Agriculture, Trade and Consumer Protection; Transportation; State Geologist (Geological and Natural History Survey) and the University of Wisconsin System (UWS).

The GCC had four meetings during the past year; the GCC also met once via teleconference. The meeting minutes are included as Appendix 2. Much of the focus of the GCC's activities during the past year has been related to the joint solicitation for groundwater research and monitoring to meet state needs described in the previous section. The joint solicitation was the culmination of a long period of discussion among state agencies through the GCC regarding groundwater research. The process is described in more detail in the previous section.

The GCC met by teleconference on April 5 and unanimously approved the proposed UWS groundwater monitoring program. Of the 47 project proposals submitted for review, the UWS agreed to solely fund 10 projects and jointly fund 3 other projects with DATCP. The DNR agreed to fund 15 new projects, one of those jointly with DATCP. DILHR agreed to fund one project. Table 1 lists all the projects which are being funded in FY 1992. This will be an annual process and will allow better coordination of groundwater monitoring and research in Wisconsin.

The GCC was active in planning for a conference on groundwater management, "Working Together to Manage Wisconsin's Groundwater - Next Steps?", held March 15 and 16 in Stevens Point. The conference brought together local and state government officials and various interest groups to assess the groundwater management experience in Wisconsin and recommend ways to improve management of the groundwater resource. The proceedings of that conference is Appendix 1 of this report. The conference was part of a national Groundwater Policy Education Project funded by the Kellogg Foundation.

Wisconsin's Groundwater Study Guide received the prestigious Robert Rodale National Award for Environmental Achievement in Groundwater Protection. The Groundwater Study Guide was designed to introduce groundwater concepts into the state public school curriculum and was selected for the award from 1,200 entries. The award was

presented by Renew America, a coalition of 28 leading environmental organizations. More than 20,000 copies of the study guide have been distributed in the United States and abroad. Over 50 workshops have also been held to acquaint teachers with the materials.

The GCC continued to maintain dialogue on groundwater issues with federal agencies. Representatives from the Soil Conservation Service (SCS), Agricultural Stabilization and Conservation Service (ASCS) and the U. S. Geological Survey (USGS) have attended Council meetings and are ex officio subcommittee members.
The GCC reviewed a Legislative proposal to expand the Council membership and responsibilities to include nonpoint source functions in addition to its groundwater activities. The Council expressed concern that an expanded Council would dilute groundwater duties and jeopardize the successful inter-agency coordination that presently exists. These concerns were forwarded to the Legislature.

The subcommittee reports which follow summarize the actions taken by each subcommittee.

SUBCOMMITTEE ACTIVITIES

Research and Monitoring & Data Management Subcommittees - The two subcommittees reviewed the priorities for the DNR's groundwater management practice monitoring program for fiscal year 1992. The revised priorities were then included in the joint solicitation distributed by the UWS, DNR, DILHR and DATCP in November, 1990.

The two subcommittees met again in February to review the proposals which had been received by as part of the joint solicitation. Subcommittee members made recommendations which were used by the four agencies in deciding which groundwater-related proposals to fund for fiscal year 1992.

Planning and Mapping Subcommittee - Much of the focus of the Planning and Mapping Subcommittee has been on vulnerability or susceptibility mapping. Responses have been received from a questionnaire that was distributed to find out what other states have done regarding susceptibility mapping.

A draft document on vulnerability mapping is being developed by the Subcommittee to provide uniformity in preparing susceptibility maps so that information can be transferred easily from one map to another. The Subcommittee identified a need for field verification of vulnerability mapping as a priority topic for the joint solicitation. The Subcommittee organized a seminar in May to allow three European hydrogeologists to discuss the groundwater protection programs in their respective countries.

Education Subcommittee - The Education Subcommittee worked on

producing a directory of groundwater information and education activities in Wisconsin. The Groundwater Education Resource Directory is complete and includes a quick agency guide to state agency responsibilities, a listing of available groundwater information resources, and a listing of programs or contacts. The intent is to distribute this publication to resource agents rather than to the general public. It is Appendix 3 of this report.

The Subcommittee also expressed concern regarding the lack of state grant money to promote groundwater information and education activities.

DIRECTIONS FOR FUTURE GROUNDWATER PROTECTION

PRIORITY ISSUES THAT NEED TO BE ADDRESSED

There are three priority issues that need to be addressed. One is the need for better communication between local and state government. This was well documented during the Conference on Working Together to Manage Wisconsin's Groundwater - Next Steps? (see Appendix 1). This conference and other mechanisms are needed to bridge the communication gap and address problems of mutual concern.

Another need is for a statewide data base and a central data catalog or clearinghouse. This need was identified both at the conference in March and in the Legislative Audit Bureau report. There need to be better efforts at collecting data and making it available in a uniform format. The DNR is currently in the middle of a renewed effort to coordinate the collection and retrieval of all groundwater data, as a result of DNR funding, inter-agency responsibilities, and cooperative agreements. It is hoped that this effort will eventually allow access to DNR data by state and local government agencies.

A third need is for the Legislature to evaluate the proposed legislation to enlarge the GCC and give it nonpoint source responsibilities in addition to its groundwater duties as a renamed Water Resources Management Council. The GCC believes that there is the potential of losing the successful inter-agency coordination focus of the council. Groundwater issues may also be diluted with the addition of nonpoint responsibilities. The Groundwater Coordinating Council is working well and would like the successful inter-agency coordination to continue.

RESEARCH/MONITORING NEEDS

The Groundwater Coordinating Council has identified two topics as high priorities for the joint solicitation for groundwater-related monitoring and research for fiscal year 1993. One is research on alternatives to on-site septic systems. As described under "Summary of Agency Responsibilities," there are currently no proven designs or installations of septic systems that consistently meet the nitrate standard. Although both the DNR and DILHR have funded monitoring projects in this area, additional work is needed to find solutions to this problem.

Another high priority topic is field verification of susceptibility or vulnerability mapping data. Based on information from the Planning and Mapping Subcommittee, little work has been done to date to verify whether susceptibility or vulnerability information is accurate. These topics should be prioritized for the joint solicitation for fiscal year 1993.

DHSS was unable to participate in the joint solicitation for FY 1992. DHSS has money available to local public health agencies to fund the analytic costs through the State Laboratory of Hygiene. It is hoped that DHSS will be able to participate in the joint solicitation for FY 1993.

There has been considerable interest in providing an opportunity for researchers to share their findings periodically with interested individuals. The Coordinating Council recommends that a meeting or conference be held periodically to allow groundwater researchers funded by state agencies to discuss the results of their monitoring or research. This would promote better communication among the varied parties with an interest in groundwater protection.

AVAILABILITY OF APPENDIX MATERIALS

Appendix 1 is "Working Together to Manage Wisconsin's Groundwater - Next Steps?, Conference Proceedings." Appendix 2 contains the minutes of the Coordinating Council meetings during the 1991 fiscal year, a copy of the joint solicitation for groundwater monitoring and research proposals and a summary of UWS research and education activities. Appendix 3 is the Groundwater Education Resource Directory prepared by the Education Subcommittee. To obtain a copy of any of the appendices, contact David Lindorff, Department of Natural Resources, Bureau of Water Resources Management, P. O. Box 7921, Madison, WI 53707 (608-266-9265).

Wisconsin Groundwater Coordinating Council

Report to the Legislature

August 1991
Appendix 2

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Meeting Minutes - August 10, 1990

Meeting Minutes - November 9, 1990

Meeting Minutes - February 8, 1991

Teleconference Meeting Minutes - April 5, 1991

Meeting Minutes - May 10, 1991

Meeting Agenda - August 9, 1991

Joint Solicitation Package

University of Wisconsin System Report on Groundwater Research

University of Wisconsin System Report on Groundwater Education

Wisconsin Groundwater Coordinating Council
Meeting Minutes
August 10, 1990

Members Present: Lyman Wible (DNR); Ron Hennings for Meredith Ostrom (WGNHS); Ruth Robertson (UW); Bennette Burks for Michael Corry (DILHR); Jeff Postle for Nick Neher (DATCP); Henry Anderson (DHSS) and Ted Stephenson (DOT).

Others Present: Gary Jackson (UW); Michael Lemcke and Bruce Baker (DNR); Linda Knobeloch and Jay Goldring (DHSS); Robert Sommerfeld (Legislative Audit Bureau); Phil Kammerer (USGS); George Kraft (Central Wisconsin Groundwater Center); Jeff Wyman and Larry Binning (UW-Nutrient and Pest Management Program) and Byron Shaw (UW-Stevens Point).

1. **Introductions**

Introductions were made.

2. **Agenda Review and Changes**

No changes were made.

3. **Approval of Minutes**

The minutes of the May 11, 1990 Coordinating Council meeting were approved as written.

4. **Report to the Legislature**

Mike Lemcke (DNR) reported that draft Report to the Legislature had been circulated twice to the Council members since the last meeting. The last draft copy contained the comments which were received from the other agencies which were proposed for the final report. Mike then proposed changes to this draft report which the DNR thought appropriate. Henry Anderson (DHSS) proposed alternative language for the description of nitrates on page 17. The Council approved the DNR's and DHSS's changes to the report and recommended that the report be finalized and sent to the Legislature.

5. **Report on the UW Nutrient and Pest Management Program (NPM)**

Larry Binning and Jeff Wyman (NPM) provided an overview of the UW Nutrient and Pest Management Program which has been in operation for approximately one year. It is primarily to facilitate the information sharing between farmers and researchers documenting the profitability and practicality as well and the environmental consequences of crop production strategies. The program informs Wisconsin farmers of the potential impacts of agricultural practices and natural resources and human health. It also outlines

Best Management Practices which may reduce the potential for natural resource degradation. A NPM goal statement sheet is attached.

During the NPM's first year its staff has risen from 2 Madison based personnel to 14 staff statewide. It has also set up 24 demonstration sites for the farming industry to show how best management practices affect economic profitability, yield and the environment. In addition, it has launched an educational campaign to the farming community.

6. **Central Wisconsin Groundwater Center**

George Kraft new director of the Central Wisconsin GroundWater Center gave an overview of the Centers goals. The Center primarily provides groundwater information and education to citizens and technical assistance to local governments. The Center is located in Stevens Point but does not restrict it efforts to the central part of the state.

Projects of the Center have in the past focused on drinking water programs, wellhead protection, sustainable agriculture and data management. These types of assistance programs will continue to be offered and the center is eager to cooperate in other ventures.

7. **Long Range Research**

Byron Shaw (UW-Stevens Point) and Ron Hennings (WGNHS), representing the Monitoring and Data Management Subcommittee, discussed the issue of the need for long range funding dollars. The problem is that research or monitoring projects can only be funded for up to two years. This short time frame seldom is long enough to produce conclusive data on which to base sound scientific recommendations.

An associated issue is that many of the past projects have left groundwater monitoring wells in the ground. These unabandoned monitoring wells could allow for future monitoring but also allow for potential channels of contamination. This is another issue that needs to be coordinated and addressed at the state level.

Ted Stephenson (DOT) related that his agency has over 300 wells and would be able to provide some research assistance if a long term monitoring strategy was outlined and approved by the Council.

The Council referred these issues to the GRAC and the Monitoring and Data Management Subcommittee to identify

priorities which should be addressed at the state level.

8. **Atrazine Briefing**

Jeff Postle (DATCP) reported on the background and the proposed atrazine rule. Past results of triazine testing has indicated that a large portion of the groundwater of the state contains atrazine. Surprisingly, about 1/2 of the detects of atrazine are from non-farm wells.

The proposed atrazine rule is four tiered with increasing amounts of protection for more vulnerable areas of the state. The Board of Agriculture authorized taking this rule to public hearing at its meeting at the State Fair in early August. This proposed rule will go to public hearing during the middle two weeks in October.

9. **Education Subcommittee Report**

Gary Jackson (UW) reported that the Education Subcommittee met on July 12. At the meeting four proposals to the Kellogg Foundation were discussed. They were:

- The DNR's teacher training proposal which asked for funds for workshops to instruct teachers on how to teach their peers. This initiative will support the new educational material targeted at grades 6 to 9 developed by the DNR.

- The UW-Extension's Farmstead Assessment system which has been accepted, in concept, by the Kellogg Foundation.

- The Central Wisconsin Groundwater Center's leader training program. This proposal is to support training community leaders about groundwater and in turn have them return to their communities to educate their peers.

- The GCC proposal to fund a position to support the GCC and coordinate information initiatives. This proposal which was rejected by the Kellogg Foundation.

The first three of these proposals were supported by the subcommittee.

Gary also reported that Jim Baumann of the DNR spoke at the meeting on well water testing and groundwater education in nonpoint source priority watersheds. Jim stated that now that the introduction of a groundwater component into the priority watershed system has begun its evolvement is inevitable.

10. **Resolution of Appreciation for Meredith Ostrom**

A formal certificate for the resolution of appreciation for Meredith Ostrom was read, endorsed and signed.

11. **Budget Initiatives**

Henry Anderson (DHSS) said that they have asked for funds for additional lab support to be put into the budget.

Ruth Robertson (UW) informed the council that the UW is requesting a DIN for Research and Public Service to support air and water quality projects.

Ron Hennings (WGNHS) said that the survey may be requesting a position to support their county assessment program. This request is included in the UW's DIN for Research and Public service.

Jeff Postle (DATCP) said that they have requested 1½ positions to support work on pesticide container disposal and to expand their groundwater program.

Lyman Wible (DNR) explained changes to the Departments initiatives since May (see attached).

12. **Next Meeting**

The next meeting is in Madison at DATCP, in the board conference room, on November 9th at 12:00 p.m.

The meeting was adjourned at 2:50 p.m.

Respectfully submitted,

Michael Lemcke
Groundwater Management Section
Department of Natural Resources
c:\ml\gwcc\81090gcc.min

GROUNDWATER COORDINATING COUNCIL
RESOLUTION OF APPRECIATION

WHEREAS, Dr. Meredith "Buzz" Ostrom is retiring after 31 years of distinguished service with the Wisconsin Geological and Natural History Survey.

WHEREAS, Dr. Ostrom has served as the State Geologist for the past 18 years. Under his dedicated leadership, the Geological and Natural History Survey has grown to meet the needs of today's society.

WHEREAS, for the past 6 years, Dr. Ostrom has been a representative on the Groundwater Coordinating Council. He has provided keen insight on groundwater issues and has been a strong supporter of groundwater education and protection.

WHEREAS, throughout his career, Dr. Ostrom has been an advocate for the protection of Wisconsin's resources, particularly Wisconsin's groundwater resources.

NOW, THEREFORE, be it resolved that:

The Groundwater Coordinating Council extends its appreciation to Dr. Meredith "Buzz" Ostrom for his many years of dedicated service and countless contributions to the protection of Wisconsins' groundwater resources.

Dated at Madison this tenth day of August, 1990.
The Groundwater Coordinating Council.

By:

Lyman F. Wible, Chair
Department of Natural Resources

Ted Stephenson, Department of Transportation

Nick Neher, Department of Agriculture, Trade and Consumer Protection

Michael Corry, Department of Industry, Labor and Human Relations

John Metcalf
Governor's Representative

Henry Anderson, Department of Health and Social Services

Ruth Robertson, University of Wisconsin System

Wisconsin Groundwater Coordinating Council
Meeting Minutes
November 9, 1990

Members Present: Lyman Wible (DNR); Ron Hennings (WGNHS); Gordon Chesters for Ruth Robertson (UW); Michael Corry (DILHR); Nicholas Neher (DATCP); Henry Anderson (DHSS); Jack Metcalf (Governor's Representative); and Dan Peerenboom for Ted Stephenson (DOT).

Others Present: Bennette Burks (DILHR); Jay Goldring and Lynda Knobeloch (DHSS); Kevin Kessler, Mike Lemcke, Russ Dunst and David Lindorff (DNR); Robert Sommerfeld (LAB); Jim Krohelski (USGS); Jim Kaap (SCS); Gary LeMasters and Jeff Postle (DATCP); William Holland (Wisconsin Land Information Board); and Gary Jackson (UW Extension).

1. **Introductions**

Introductions were made.

2. **Agenda Review and Changes**

No changes were made.

3. **Approval of Minutes**

The minutes of the August tenth meeting of the Groundwater Coordinating Council were approved as written.

4. **Status Reports**

Planning and Mapping Subcommittee Meeting - Ron Hennings (WGNHS) summarized the meeting of the Planning and Mapping Subcommittee held on October 22nd. The Subcommittee had talked about several initiatives to look at vulnerability mapping, including a possible workshop next spring in Madison. The Coordinating Council suggested further consideration of the objectives and timing of such a workshop. The USEPA may be a source of funding and expertise for a vulnerability mapping workshop. Mr. Hennings also expressed his appreciation for the Coordinating Council resolution for Dr. Meredith Ostrom's retirement.

Wisconsin Land Information Board - Mr. William Holland, Director of the Land Information Board, provided an overview of the Board's responsibilities and activities. The Board was created in 1989 to facilitate the sharing of land information. The Board is to act as a clearinghouse of all land information generated for Wisconsin. Funding is being generated from County recording and filing fees to fund the Board's activities and promote modernization of local land records. Approximately $4 million will be generated this year and about $6 million in following years. Mr. Hennings

has been working with the Mapping Committee of the Board on mapping issues.

Education Subcommittee Meeting - Gary Jackson (UW Extension) reported on the last meeting of the Education Subcommittee held on September 12th. At that meeting, the Subcommittee had discussed three proposals being prepared for submittal to the Kellogg Foundation for funding consideration. Mr. Jackson asked whether the Coordinating Council could send the Kellogg Foundation a letter of support for the proposals. After some discussion, it was decided that the Education Subcommittee should prepare a summary of each proposal and a draft letter of support for consideration by the Coordinating Council at its next meeting. Mr. Wible indicated that any of the subcommittees can call a meeting of the Coordinating Council to address issues that need to be addressed before the next regularly scheduled Council meeting.

Mr. Jackson also indicated that the Subcommittee will evaluate information and education needs and determine how best to meet those needs in a coordinated manner. The Subcommittee will use a draft report prepared in 1988 as a starting point. The next Subcommittee meeting is November 14th.

Conference on Local Groundwater Management Issues - David Lindorff (DNR) provided a brief summary of the work to date on a conference to be held next March 15 and 16 in Stevens Point. The intent is to bring state and local officials together to discuss issues of groundwater management at the local level. Some materials regarding the conference are attached.

5. **Joint Solicitation**

Dr. Gordon Chesters summarized the efforts by the University of Wisconsin System and state agencies to send out a joint solicitation for pesticide, septic system and groundwater monitoring and research proposals. The Departments of Natural Resources; Agriculture, Trade and Consumer Protection; Industry, Labor and Human Relations; and the University of Wisconsin System have money for monitoring or research. Each agency has a different focus for their program. The intent is to send out the joint solicitation by November 15th for projects to be funded starting July 1, 1991.

6. **Legislative Audit Bureau Report**

Kevin Kessler (DNR) handed out copies of the Legislative Audit Bureau Report on Wisconsin's groundwater protection program which was issued in September. Mr. Kessler indicated that the DNR was following through on the report

recommendations. Mr. Robert Sommerfeld (LAB) thanked the Coordinating Council for their cooperation during the audit.

7. **Pesticide Issues**

Atrazine Update - Mr. Nicholas Neher (DATCP) reported that the hearings on the proposed atrazine rule had been completed and that he was fairly certain that there would be an atrazine rule in place for the next growing season.

Mr. Gary LeMasters (DATCP) summarized the results of the rural well sampling survey conducted this year by DATCP in conjunction with the DNR and Ciba-Geigy. DATCP offered a triazine screening to the public to determine the presence of nitrates and triazine herbicides like atrazine. A handout summarizing the objectives, methods and results is attached. Most of the wells sampled were in the southern third of the state and western Wisconsin. 351 of the 2187 wells sampled had triazine detects. Atrazine was found in 200 of 399 follow up samples taken by the DNR. There was good agreement between this study and the earlier grade A dairy well survey. Mr. LeMasters indicated a summary report should be available by January.

Triazine sampling - Russ Dunst (DNR) reported that the State Lab of Hygiene (SLOH) has been working on developing the capability to do the triazine analysis and should be able to start doing the analysis for state agencies by December. Not all of the details have been worked out for the test implementation; however, the SLOH intends to begin running the test for the public beginning about February 1, 1991. The SLOH will have a tollfree phone number for this service. Information will be collected to identify the location so that the results can be incorporated into the DNR's data base. The cost to the public will be approximately $16 per sample.

Atrazine metabolites - Dr. Gordon Chesters summarized some of his work on atrazine and its metabolites or breakdown products. His work has determined that the half-life of atrazine varies from 50 days to 5 years and is very sensitive to the amount of soil organic matter. From his work in Dane County, he has primarily found deethylatrazine in groundwater, generally at two to three times the concentration of the atrazine parent compound. He has found small amounts of deisopropylatrazine as well. Dr. Chesters indicated that the triazine analysis is not very sensitive to the atrazine metabolites.

Dr. Henry Anderson (DHSS) reported that laboratory studies of atrazine in animals show that animals metabolize atrazine in their liver to the chlorinated metabolites. Therefore, the health information from animal studies reflects the effects of both atrazine and metabolites. Because of the

detects of atrazine metabolites in groundwater and the potential health impacts, a total chlorinated atrazine residue standard will be proposed to include the parent compound and metabolites of health concern.

Mr. Russ Dunst indicated that the SLOH is now able to analyze for deethylatrazine and deisopropylatrazine on a routine basis. The DNR will be sampling wells for metabolite analysis to determine how significant a problem the atrazine metabolites are. The data will provide information to determine what additional sampling may be necessary.

8. **Schedule of Coordinating Council Meetings for 1991**

The Coordinating Council approved meetings for February 8 at the DNR, May 10 in Dodgeville, August 9 at DATCP and November 8 at the DNR. There is also likely to be a Council meeting in late March to approve the groundwater monitoring and research proposals.

The meeting was adjourned at 2:55 pm.

Respectfully submitted,

David Lindorff, Hydrogeologist
Groundwater Management Section
Department of Natural Resources

Wisconsin Groundwater Coordinating Council
Meeting Minutes
February 8, 1991

Members Present: Kevin Kessler for Lyman Wible (DNR); Ken Bradbury for Ron Hennings (WGNHS); Ruth Robertson (UW); Bennette Burks for Michael Corry (DILHR); Jeff Postle for Nicholas Neher (DATCP); Henry Anderson (DHSS); and Bill Bordihn for Ted Stephenson (DOT).

Others Present: Jay Goldring (DHSS); Mike Lemcke, Bob McHenry and David Lindorff (DNR); Phil Kammerer (USGS); and Steve Born (UW).

1. **Introductions**

Introductions were made.

2. **Agenda Review and Changes**

No changes were made.

3. **Approval of Minutes**

The minutes of the November ninth meeting of the Groundwater Coordinating Council were approved as written.

4. **Status Reports**

Education Subcommittee Meeting - Mike Lemcke (DNR) reported on the last meeting of the Education Subcommittee held on January 30th. At that meeting, the Subcommittee agreed to prepare a resource guide of groundwater information and education publications available from any state agency. Each agency will abstract their own publications and Chris Mechenich of the Central Wisconsin Groundwater Center will put the publication together. Gary Jackson indicated at the subcommittee meeting that if the U. S. Department of Agriculture funds him to promote the farmstead assessment system nationwide, he would have to step down as chair of the subcommittee. Ruth Robertson indicated that the newly created Wisconsin Environmental Education Board may have money for groundwater projects in the future. the Kellogg Foundation a letter of support for the proposals.

Conference on Local Groundwater Management Issues - Steve Born (UW) provided a brief summary of the agenda for the conference to be held March 15 and 16 in Stevens Point. The intent is to bring state and local officials together to discuss issues of groundwater management at the local level. It is important to identify what problems may exist and determine what can be done to solve those problems. State agency staff will make presentations to set the stage for

workshops to be held on the fifteenth and will prepare reports to be included in the conference proceedings.

5. **Joint Solicitation**

David Lindorff (DNR) summarized the efforts by the University of Wisconsin System and the Departments of Natural Resources; Agriculture, Trade and Consumer Protection; and Industry, Labor and Human Relations to jointly solicit proposals for pesticide, septic system and groundwater monitoring and research. A joint solicitation was sent out in November. A total of 46 proposals were received for review. A meeting of the four agencies was held before the Coordinating Council meeting to coordinate review of the proposals. All the proposals will be reviewed at the joint meeting of the Research and Monitoring & Data Management Subcommittees on February 26th.

The Coordinating Council agreed to hold a teleconference on April 5th at 11:45 to discuss and approve the proposed list of projects for funding by the agencies involved.

6. **Atrazine Rule Update**

Although the Coordinating Council doesn't normally consider regulatory issues, Jeff Postle (DATCP) briefed the Council on the status of the Ag 30 rule which contains atrazine regulations. Ag 30 was approved by the DATCP Board on December 13th and sent to the Legislature on January tenth. Jeff indicated that a hearing was held by the Senate Agriculture, Corrections, Health and Human Services Committee on January 30th. The Assembly Natural Resources Committee held a hearing on the proposed rule February sixth. The Legislature may change the rule, particularly that portion dealing with atrazine management areas.

Jeff indicated that DATCP has worked with Ron Doersch (UW) regarding publicizing the rule. The State Lab of Hygiene (SLOH) can now do the triazine analysis and both the SLOH and DATCP lab are routinely analyzing for deethyl and deisopropylatrazine as well as parent atrazine.

7. **Status of DNR groundwater data management system**

Bob McHenry (DNR) reported on the status of the DNR's groundwater data management system. The existing system, GIN, is still on the Hill Farms Regional Computer Center (HFRCC). The new system will go on the VAX system at the DNR. The present timetable is for the groundwater system to go on the VAX by the end of the year.

The system is also being designed to get data to other state agencies; it's not clear at this point how and when that

will be accomplished. It is DNR's intent to make that happen.

8. **Next meeting of the Coordinating Council**

The next meeting of the Coordinating Council will be May 10 in Dodgeville starting at noon.

The meeting was adjourned at 1:35 pm.

Respectfully submitted,

David Lindorff, Hydrogeologist
Groundwater Management Section
Department of Natural Resources

Wisconsin Groundwater Coordinating Council
Teleconference Meeting Minutes
April 5, 1991

Members Present: Lyman Wible (DNR); Ron Hennings (WGNHS); Ruth Robertson (UW); Michael Corry (DILHR); Ned Zuelsdorff for Nicholas Neher (DATCP); and Jack Metcalf (Governor's Representative).

Others Present: Kevin Kessler and David Lindorff (DNR); Bennette Burks (DILHR) and Gordon Chesters (UW).

The only agenda item for the teleconference was to review the proposed University of Wisconsin System (UWS) groundwater research plan for fiscal year 1992 which begins July 1, 1991. Gordon Chesters (UW) provided an overview of the process that was followed in selecting the projects for UWS funding.

Dr. Chesters indicated that the method of soliciting and selecting projects for funding followed the Memorandum of Understanding signed by the UWS, GCC and the UW Groundwater Research Advisory Council (GRAC) in July of 1989. The solicitation was part of a joint solicitation by the UWS and DATCP, DNR and DILHR. A total of 47 proposals were received, 32 of which were targeted at the UWS.

The UWS proposals were reviewed by the Research and Monitoring and Data Management Subcommittees of the GCC, outside reviewers and the GRAC. Dr. Chesters indicated that the 16 highest rated UWS projects would be funded. Nine would be solely funded by the UWS, 3 would be jointly be funded by UWS and DATCP, and 4 would be funded by the DNR.

Dr. Chesters said that, except for the preproposals, the process went very smoothly. He suggested that that portion of the process be reevaluated before the next joint solicitation. Lyman Wible suggested that it be discussed at the next GCC meeting.

Jack Metcalf (Governor's Representative) voiced his support for the excellent job of coordination by all involved. He would like to see the Legislature provide even more money for this important topic. He suggested that studies which provide immediate results would be helpful in convincing the Legislature of the need for more money for groundwater research.

Mr. Corry (DILHR) indicated that DILHR was pleased to be part of the joint solicitation process. He felt that there were not enough proposals for UWS funding related to alternatives to on site septic systems. Mr. Corry agreed to discuss this further at the next GCC meeting.

Ron Hennings (WGNHS), Ruth Robertson (UWS), Ned Zuelsdorff (DATCP) and Lyman Wible (DNR) all expressed their support for the

process and their gratitude to all who worked to make the process go so well.

Ruth Robertson made a motion that the GCC endorse the recommended UWS groundwater research plan outlined by Dr. Chesters and forward that endorsement to the Department of Administration for release of funds. The motion was seconded by Jack Metcalf and was approved unanimously.

The next meeting of the GCC will by May 10, 1991 at the DNR Area Office in Dodgeville starting at noon. A van will be available for those who would like a ride to Dodgeville. Please contact David Lindorff at (608) 266-9265 if you need a ride on May tenth.

The meeting was adjourned at 12:05.

Respectfully submitted,

David Lindorff, Hydrogeologist
Groundwater Management Section
Wisconsin Department of Natural Resources

Wisconsin Groundwater Coordinating Council
Meeting Minutes
May 10, 1991

Members Present: Lyman Wible (DNR); Ron Hennings (WGNHS); Jack Metcalf (Governor's Representative); Ruth Robertson (UWS); Michael Corry (DILHR); Nick Neher (DATCP); Henry Anderson (DHSS); Tom Martinelli for Ted Stephenson (DOT).

Others Present: Kevin Kessler and David Lindorff (DNR); Gary Jackson, Jim Peterson and Jerry Tyler (UW); Bennette Burks (DILHR); and Jim Kaap (SCS).

1. **Introductions**

   Introductions were made.

2. **Agenda Review and Changes**

   No additions or changes were made to the agenda.

3. **Approval of Minutes**

   The minutes of the February 8, 1991 Groundwater Coordinating Council meeting and April 5, 1991 teleconference were approved as written.

4. **Subcommittee Reports**

   a. Education Subcommittee - Gary Jackson (UW) handed out the minutes from the April 3 meeting of the Education Subcommittee as well as a draft of the "Groundwater Education Resource Directory" which was prepared by the Subcommittee. The Directory is a summary of the resources, programs and contacts for groundwater education programs in Wisconsin. The Directory is nearly finished. Gary asked that Coordinating Council members or their staff review the draft Directory and send comments to Gary by May 30th. The Directory will also be discussed at the next Education Subcommittee meeting in June before it is finalized.

      Gary indicated that the Directory will be published in the "Keeping Current" newsletter with a distribution of about 400 copies. He asked that each state agency give him an estimate of the number of additional copies needed by the end of May. The Coordinating Council was willing to endorse the Directory subject to the endorsement of the Education Subcommittee at its June meeting. The Council suggested that the Subcommittee consider the need to periodically update the Directory.

Gary indicated that he is resigning from the Education Subcommittee to work on implementation of the Farmstead Assessment Program at the national level. Ron Hennings (WGNHS) expressed his appreciation for the excellent job Gary did as Chair of the Subcommittee. Lyman Wible asked the University of Wisconsin System to consider (1) replacement of Gary Jackson as Chair of the Education Subcommittee, (2) addition of a second person on the Subcommittee from the UW System and (3) the addition to the Subcommittee of Chris Mechenich from the Central Wisconsin Groundwater Center.

b. Planning and Mapping Subcommittee - Ron Hennings reported on the April 3rd meeting of the Subcommittee which focused on vulnerability mapping. Alex Zaporozec (WGNHS) is inventorying what has been done in other states and other countries. Alex hopes to have a summary available that could be incorporated into the 1991 Report to the Legislature. Three Europeans visited Madison recently at Alex's invitation and they led a seminar to talk about groundwater activities in Europe.

Ron also indicated that work is being done in Dane County to compare atrazine detects with vulnerability information. There is interest by the Subcommittee in field verification of vulnerability information as a priority topic for monitoring/research as part of the joint solicitation.

5. **Joint Solicitation**

a. Ruth Robertson (UWS) summarized her May first memo to GCC Members regarding partial funding by the UWS of a toxicological study by Prof. Warren Porter as part of the joint solicitation. The decision to provide $15,000 for this project was made after the GCC teleconference at which the other UWS groundwater research projects were approved by the GCC.

The Council expressed concern that it wasn't clear what would be accomplished for the $15,000. Ruth said that the UWS would get a revised proposal for $15,000 from Prof. Porter and would share that with the GCC. Ruth also made it clear that the $15,000 was only for one year and did not guarantee future funding. Ruth also suggested that an appeal process may be necessary to handle complaints by researchers.

The GCC unanimously approved the $15,000 for the Warren Porter project with a recommendation that the UWS review the selection and funding process.

b. Ruth Robertson reported that the Groundwater Research Advisory Council (GRAC) will meet in the next few months

to consider minor revisions to the MOU, particularly the section on pre-proposals.

c. Michael Corry (DILHR) led a discussion of the need for research by DILHR on alternatives to onsite septic systems. The present septic systems cannot meet the NR 140 standard for nitrate. DILHR is considering what to do, but is concerned that there hasn't been enough research, particularly by the UW on alternative septic systems.

Jerry Tyler (UW) identified a number of problems in getting researchers to study alternative septic systems. Jerry indicated that the research is very applied and generally needs teamwork and long-term research to be successful. He indicated that there are some pre-treatment options available, but they are costly and/or management intensive.

Lyman Wible reported that, for the DNR, a big concern is crossroad communities with a small number of homes. A package treatment is not reasonable in these situations, so another alternative is needed. Kevin Kessler (DNR) said that the need is for research on nitrate treatment technology, not groundwater impacts from septic systems.

Ron Hennings suggested monitoring of septic systems in non-sandy environments to determine if there are situations where the nitrate standard could be met with existing septic systems. Ruth Robertson said that greater incentives are needed to push researchers into this topic.

The Council agreed to ask the Research Subcommittee to prepare a white paper on this issue, looking at the barriers to septic system research, alternatives to address the barriers and a recommendation on how to address this issue in the joint solicitation. Jerry Tyler expressed a willingness to work with the Research Subcommittee.

6. **1991 Groundwater Coordinating Council Report to the Legislature**

David Lindorff (DNR) discussed the draft outline for the 1991 Report to the Legislature. It would make use of the reports prepared by various state agencies for a conference on Local Groundwater Management held in March. A number of useful suggestions were made. The DNR will prepare the first draft and send it to GCC members for comment in early July. This report is due in August.

7. **Water Resources Management Council Legislative Proposal**

Kevin Kessler handed out and discussed a Legislative proposal to add members to the GCC and create a Water Resources Management Council. The enlarged council would focus on non-point source issues in addition to groundwater concerns. The legislation has not yet been introduced. Although not supportive of creating new committees, GCC members expressed concerns with the effectiveness of an expanded council and its ability to adequately address groundwater issues. Lyman agreed to prepare a letter to the Legislature to express the concerns of the GCC towards the proposed new council.

8. **Status of the UW Nutrient and Pest Management Program**

Kevin Kessler reported that funding for the UW Nutrient and Pest Management Program is in jeopardy. It was created during this biennium with a one-time appropriation. There is no money for this program in the Governor's budget. It is an excellent program, so hopefully money can be found to continue the program.

9. **Personnel Matters**

Ron Hennings reported that the new State Geologist, Juergen Reinhardt, will start July 1. Hopefully, he will be able to come to the next GCC meeting in August. Ruth Robertson indicated this was her last day with the GCC and UWS. She will be replaced by Al Beaver. Lyman offered a resolution of appreciation to Ruth for her active participation in the work of the GCC. The resolution was approved unanimously and is attached to the minutes.

10. **Next Meeting**

The next meeting is at the office of the Department of Agriculture, Trade and Consumer Protection in Madison on August 9th starting at noon.

The meeting was adjourned at 3:10 p.m.

Respectfully submitted,

David E. Lindorff
Groundwater Management Section
Department of Natural Resources

Resolution of the Wisconsin Groundwater Coordinating Council
In Recognition Of
Ruth Robertson

May 10, 1991

Whereas the Wisconsin Groundwater Coordinating Council (WGCC) is created under s. 15.347(13), Wis. Stats., to include the President of the University of Wisconsin System (UWS), the Secretaries of state agencies with groundwater management responsibilities or their designees and the Governor's representative; and

Whereas the Wisconsin Groundwater Coordinating Council has the responsibility under s. 160.50, Wis. Stats., to "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,...public information and education,...research activities and the appropriation and allocation of state funds for research"; and

Whereas Ruth Robertson has served as an active member of the WGCC representing the UWS for the UW System President; and

Whereas she has applied her skills at listening and at articulation as an active participant in WGCC deliberations; and

Whereas she has played a key role in the development of a UWS groundwater research program and in developing and implementing a process for integration of state agencies' needs with the University's research priorities; and

Whereas she has repeatedly demonstrated her abilities as a creative problem solver;

Now, therefore, be it resolved that:

The Wisconsin Groundwater Coordinating Council hereby extends its appreciation to Ruth Robertson for her many contributions and wishes her well in her new endeavors.

Dated at Dodgeville, Wisconsin, this 10th day of May, 1991.

Groundwater Coordinating Council

By:

Lyman F. Wible, Chair

GROUNDWATER COORDINATING COUNCIL MEETING

Noon on August 9, 1991

Location: Board Conference Room, Department of Agriculture, Trade and Consumer Protection, 801 W. Badger Road, Madison

Agenda

1. Introductions

2. Agenda review and changes

3. Approval of minutes from May 10, 1991 meeting

4. Status Reports
   Education Subcommittee - Ron Hennings
   Research Subcommittee - Michael Corry/David Lindorff

5. Annual Report to the Legislature - David Lindorff

6. Joint Solicitation - David Lindorff

7. Award for Groundwater Study Guide - David Lindorff

8. Next meeting November 8 at DNR (room 511, Gef 2) at noon

9. Adjourn

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES
Carroll D. Besadny, Secretary
Box 7921
Madison, Wisconsin 53707
TELEFAX NO. 608-267-3579
TDD NO. 608-267-6897

November 29, 1990

Interested researchers:

Enclosed is information on the State of Wisconsin joint solicitation for project proposals to conduct research and monitoring on groundwater, pesticides and alternatives to onsite wastewater disposal systems for funding in fiscal year 1992. This solicitation is a coordinative effort of the University of Wisconsin System; the Wisconsin Departments of Natural Resources; Agriculture, Trade and Consumer Protection; and Industry, Labor and Human Relations. Each of these agencies has funding available for monitoring or research to meet specific agency needs or objectives as described in the enclosure.

This cooperative solicitation allows interested individuals to prepare project proposals which can be submitted to several different funding sources simultaneously and eliminates the need to submit similar proposals several times for different solicitation efforts. Under this new process, an investigator can effectively save time, effort and money by submitting multiple project proposals to one central location for consideration by multiple agencies.

The University and each of the state agencies has prepared guidance on the specific priorities for monitoring and/or research and other pertinent information relative to their request for proposals. You are invited to review the enclosed materials and decide if you wish to submit one or more proposals. The deadline for submittals is January 15, 1991.

It is our intent that this joint solicitation will make it easier for interested researchers to prepare proposals, promote coordination among state agencies and among researchers, and enhance the state agencies ability to meet their objectives.

Sincerely,

Lyman F. Wible

Lyman F. Wible, Chair
Groundwater Coordinating Council

Joint Solicitation of Groundwater and
Related Research/Monitoring Proposals

November 1990

The University of Wisconsin System (UWS), Wisconsin Department of Natural Resources (WDNR), Wisconsin Department of Agriculture, Trade and Consumer Protection (WDATCP) and Wisconsin Department of Industry, Labor and Human Relations (WDILHR) are jointly soliciting research/monitoring proposals dealing with groundwater, pesticides and alternatives to onsite wastewater treatment systems. The reasons for this joint solicitation are to:

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

Joint-funding of some projects may be appropriate, but it is not the purpose of this solicitation to jointly fund all projects. Each agency has its own designated role to play and its own priorities. Contributors to this solicitation and their roles are:

- University of Wisconsin System (UWS) through its Water Resources Center (WRC). The WRC with oversight from the UWS Groundwater Research Advisory Committee has about $600,000 of funds available in the biennium, which includes FY 92 and 93. The funds are restricted for use by faculty within the UWS. Projects of fundamental and applied research will be supported on all matters relating to groundwater including natural science, engineering, social science and law. Projects will be considered for long- and short-term support, but each project will be approved for a MAXIMUM of 2 years during any solicitation cycle.
- The Wisconsin Department of Natural Resources has approximately $200,000 available in FY 92 to fund new groundwater monitoring projects. Proposals must be for groundwater monitoring or related activities. WDNR is also helping WDILHR fund projects that focus on the performance of currently-approved onsite wastewater treatment systems. The purpose is to establish and improve management practices which will allow the state to meet the groundwater quality standards

enumerated in NR 140, Wisconsin Administrative Code. Although no restrictions are placed on who may apply for these funds, preference will be given to UWS and state agency contractors. Contracts will be approved on an annual basis, and no out-of-state submittals will be accepted.

- The Wisconsin Department of Agriculture, Trade and Consumer Protection will administer about $135,000 of research funds in FY 91 for inclusion in this joint solicitation. Investigators should take careful note that the focus of the WDATCP program is on pesticide research which includes but is not limited to groundwater issues. Proposals may be submitted by any college or university, research foundation or individual having a demonstrated capacity in pesticide or other applicable research.
- The Wisconsin Department of Industry, Labor and Human Relations has approximately $50,000 of funds available in FY 92 to support research on alternatives to current onsite wastewater treatment systems. Special emphasis is placed on designs, products and practices to minimize nitrate contributions to groundwater.

Please read the solicitation carefully, it contains a description of the priorities for each agency program and other pertinent information. Capital items may not be purchased with these funds, and faculty salaries will be limited to a maximum of 10% of an individual grant (for a $50,000 grant, a maximum of $5,000 can be allotted to faculty salaries).

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

Those university faculty who submitted preproposals will receive written reviews soon. If a preproposal was <u>NOT</u> prepared, any eligible person may still submit a complete proposal.

Attached is the description of each agency's guidelines, the outline for a cover page, and a detailed format for the proposal. Other than budgets and biographical information, proposals should be no longer than 10 double-spaced, single-sided pages.

The deadline for submittal of proposals is January 15, 1991. There will be a minimum of two reviews of each proposal, one of which will be from out-of-

state. Funding decisions will be made in April 1991, if possible.

If you have any questions please call the following contacts at the individual agencies.

Gordon Chesters	262-3838	University of Wisconsin-Madison
Bennette Burks	266-0056	Wisconsin Department of Industry, Labor and Human Relations
David Lindorff	266-9265	Wisconsin Department of Natural Resources
Jeffrey Postle	266-9959	Wisconsin Department of Agriculture, Trade and Consumer Protection

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

Mr. David Lindorff
Bureau of Water Resources Management
Wisconsin Department of Natural Resources
P.O. Box 7921
Madison, WI 53707

PROPOSAL FORMAT (Original and three copies)

Deadline for Submission: January 15, 1990

A. Cover Page--Sample copy is appended.

B. Project Summary (not to exceed 2 double-spaced pages)

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

C. Proposal Narrative (not to exceed 10 double-spaced pages)

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

D. Principal Investigators

Include 2-page resume (including recent publications) of each investigator and state the time each will spend on the project. A recent reprint or offprint of a key publication should be submitted when available. If any project personnel will receive training, state its nature.

E. Budget using order shown in sample form

1. Salaries and wages.
2. Fringe benefits.
3. Supplies--list office, laboratory, computer and field supplies separately. Fabrication of equipment should be listed as separate item.
4. Travel to support field operations only. Travel to meetings is excluded because of the limited funding.
5. Publication costs.
6. Total direct costs.

SAMPLE COVER PAGE

Project Title

PRINCIPAL INVESTIGATOR:

Name Title and Affiliation Address Telephone

CO-PRINCIPAL INVESTIGATOR(S):

Name Title and Affiliation Address Telephone

Location of Research

Desired Start-up Date and Duration of Project:

Agency(ies) to which this proposal is targeted:

UWS	WDNR	WDATCP	WDILHR

(If proposal is appropriate for more than one agency rank highest (1) to lowest (4).

Date of Submittal

SAMPLE BUDGET PAGE

Budget Period from July 1, 1991 to June 30, 1992
(Make a separate page for each year of support)

		Time, %	Cost, $
1.	Salaries and Wages Name and title if known a. b. c. d.		
2.	Fringe Benefits % of which salaries		
3.	Supplies a. Ofice b. Laboratory c. Field d. Computer e. Fabrication of equipment		
4.	Travel only for support of field operations Detail transport, meals, hotels and number of persons involved.		
5.	Publication Costs.		
6.	Total Direct Costs		
7.	On a separate sheet, indicate the level of current or pending support. See attached example.		

Current and Pending Support Where Applicable (SAMPLE)

Support Agency	Project Title	Amount, $ Year	Start and Expiration Date	Time of Investigator, %
		Principtal Investigator (Name)		
		CURRENT		
		PENDING		
		Co-Principal Investigators (Name)		
		CURRENT		
		PENDING		

University of Wisconsin System (UWS) Projects funded through the Groundwater Research Advisory Council

As part of the joint solicitation for groundwater and related research monitoring proposals the UWS seeks short- and long-term projects of a fundamental or applied nature on any aspect of groundwater research either in the natural sciences, engineering, social sciences or law.

Application Requirements: The principal investigator must be a faculty member on any campus in the University of Wisconsin System.

Budgetary Considerations: Projects will not be approved in any one budget cycle for a period of more than 2 years, although a continuation project will be considered for funding in a subsequent solicitation. No capital equipment (more than $1,000/item) will be purchased. Travel for attendance at scientific meetings will not be accepted. The maximum faculty salary to be paid from any individual project will be a maximum of 10% of the total grant. Grants will not be considered for more than $75,000 per year.

Priorities:

- Chemical and biological degradation of pollutants in surface soils, subsoils and groundwater, including identification of degradation products.
- Transport of pollutants in soil and groundwater, including elucidation of soil and hydrologic factors controlling movement, and development of predictive models.
- Impact of waste management practices on groundwater contamination.
- Impact of agricultural management practices on groundwater contamination.
- Characterization of geologic factors affecting groundwater movement.
- Examination of the economic impact of groundwater contamination.
- Evaluation of policy alternatives for controlling contamination.

Proposal Format: Is fully outlined in the joint solicitation.

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

DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION

PESTICIDE RESEARCH PROGRAM

RESEARCH GRANTS PROGRAM FOR 1991
SOLICITATION OF APPLICATIONS

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

DATCP RESEARCH PRIORITIES FOR 1991

High Priorities

1) **Evaluation of the Environmental Fate and Remediation Alternatives for Contaminated Soil and Water at Pesticide Mixing/Loading Sites.**

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

2) **Refinement of Application Methods for Metham Sodium Soil Fumigants to Reduce Environmental and Public Health Problems.**

   This research should focus on how different application methods and environmental conditions affect the potential for volatilization or leaching of metham sodium or the breakdown product MITC.

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

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

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

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

Additional Priorities

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

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

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

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

7) **Pesticide Use Surveys**

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

8) **Evaluation of the Effect of Irrigation Management on Pesticide Contamination in Groundwater.**

This project should evaluate current irrigation management practices and assess their effects on pesticide leaching.

9) **Identify Pesticide Use Practices on Commercial Cranberry Marshes which will Minimize the Potential for Pesticide Discharges to Surface Water.**

Projects on this topic may evaluate the environmental impacts of specific pesticide use practices at cranberry marshes and make recommendations on how practices can be modified to reduce any adverse impacts.

DEPARTMENT OF INDUSTRY, LABOR AND HUMAN RELATIONS

RESEARCH OBJECTIVES

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

- Directed towards minimizing nitrate loadings to protect groundwater and surface water quality;
- Result in onsite sewage treatment that is consistent with the provisions of the Groundwater Protection Law, particularly as it relates to the nitrate standard;
- Be affordable by the average owner of an onsite sewage system; and
- Be practical for the climate and soils of Wisconsin.

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

Budgetary Constraints: The Department is limited to a budget of $50,000 per year, and existing projects may receive continued funding for another year. Applicants are encouraged to seek additional funding from the DNR, or other sources, where projects also meet funding priorities of other agencies.

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

Review: Each project will be review individually.

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

GROUNDWATER MANAGEMENT PRACTICE MONITORING PROGRAM

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

Applicant Requirements

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

Budget Considerations

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

A number of projects which are being funded in fiscal year (FY) 1991 will continue into FY 1992. As a result, some money will be set aside to fund continuing projects.

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

Contractual Requirements

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

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

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

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

All groundwater quality monitoring data shall be collected on forms or in a computer format provided by the Department and shall be reported to the Department within two (2) weeks after the data has been received by the contractor. Computerized data shall be verified by the contractor.

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

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

Abandonment of monitoring wells shall be the responsibility of the contractor. Wells shall be abandoned in accordance with Department regulations (Chap. NR 141, Wis. Adm. Code) and approved procedures upon completion of the project, unless alternative prior arrangements have been made with the Department.

Review of Proposals

All proposals will be reviewed by DNR staff, the Monitoring and Data Management and the Research Subcommittees of the Groundwater Coordinating Council. Projects given high rankings will be those that address identified priority concerns and appear to have a high probability of successfully obtaining their stated goal.

The project must involve either groundwater monitoring or activities conducted to support groundwater monitoring. Support functions can include, among other things, laboratory analysis technique development, well drilling and construction methodology development and definition of geologic and hydrogeologic conditions for groundwater management purposes.

It is also important that the proposal address a priority monitoring topic as listed below. Other considerations include project cost, proposed timeline, whether the proposed project methodology will meet the objectives stated, whether the resources requested are adequate to carry out the project, and whether the project investigators have the abilities to complete the proposed project.

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

Priority Monitoring Topics

For state fiscal year 1992, the following priority topics for groundwater management practice monitoring have been selected

based on input for a number of state agency staff and university researchers to identify priorities to meet state needs. This list of priority needs is not in any specific order.

1. Nutrient management. Examples: monitoring to determine the percentage of fertilizer (either chemical fertilizer or manure) applied to the land surface which reaches groundwater and the factors that affect the amount of leaching that occurs; monitoring to correlate groundwater quality with the extent of land owner implementation of best management practices in environmentally sensitive areas; monitoring to evaluate the impacts of animal waste management practices including barnyards, storage design and operation and manure application on groundwater quality; monitoring to distinguish nitrate contamination caused by chemical fertilizer application from nitrate contamination from other waste sources.

2. Pesticide management. Examples: monitoring to determine if changes in pesticide application procedures and/or tillage practices have significant potential for reducing pesticide impacts on groundwater, especially projects focusing on atrazine, alachlor (lasso) and metolachlor (dual) and the potential reduced groundwater impact from pesticide use under low input agricultural practices; monitoring to identify the soil and geologic conditions under which pesticides contamination is likely to occur, particulary fractured bedrock conditions plus loam and clay soils; evaluation of the extent of groundwater contamination from agricultural and nonagricultural pesticide use and handling in various geologic settings; contamination potential and possible health impacts of pesticide metabolites; monitoring at pesticide loading facilities to evaluate the effectiveness of the facility to protect the surrounding soils and groundwater from contamination; development of laboratory procedures for analyzing metabolite concentrations in water and soil.

3. Landfill regulation. Evaluation of current or innovative landfill design, operation or monitoring criteria in relation to compliance with groundwater quality standards.

4. Groundwater remediation. Examples: monitoring of vapor extraction systems to determine their effectiveness in removing volatile organic compounds from various depths and soil types; monitoring various types of bio-remediation methods to determine how effective they are in Wisconsin.

5. On-site wastewater disposal. Monitoring to evaluate the extent to which current and alternative on-site wastewater disposal systems comply with state groundwater quality standards. Examples: Identification and quantification of contaminants in groundwater resulting from wastewater disposal through septic systems; determination of the extent to which current septic system technology prevents

wastewater contaminants from complying with groundwater quality standards in various hydrogeologic settings or varying operating conditions; determination of the performance of new or innovative alternatives to current technology, design criteria or management practices with respect to groundwater quality; field monitoring studies to separate the impacts of septic systems from those from other sources, such as current and previous agricultural practices, lawn fertilizer use, road salt use and nearby commercial operations.

6. Urban nonpoint pollution. Examples: evaluation of infiltration trenches, infiltration basins and grass swales; determination of the constituents of urban discharge runoff water; monitoring in areas of continuous use of fertilizer and pesticide, such as at golf courses or cemeteries.

7. Wastewater land disposal. Monitoring of different types of wastewater land disposal systems to evaluate and, if necessary, revise the design standards for these wastewater disposal systems.

8. Organic chemicals. Evaluation of the extent of groundwater contamination from organic chemicals in various geologic and land use settings.

9. Naturally occurring substances. Evaluation of the distribution and seasonal fluctuation of naturally occurring substances such as radionuclides, sulfates or saline waters.

10. New technology. Development of new laboratory or field technology (or new applications of existing technologies) for determining the characteristics of groundwater and geologic formations for management purposes.

11. Data management. Development of improved methods for managing groundwater monitoring data. Examples: interpretation techniques for comparing groundwater quality data to groundwater standards; methodologies to make groundwater quality or contaminant source data more readily available.

12. Resource definition. Resource definition studies to better describe the geologic and groundwater properties in the state for management purposes.

13. Wellhead protection. Evaluation of techniques used to delineate wellhead protection areas in various geologic settings.

UNIVERSITY OF WISCONSIN SYSTEM PROGRAMS

The University of Wisconsin System (UWS) report is divided into 1. research and 2. information/education sections. This is a largely artificial division because close cooperation has been achieved between research and extension personnel in the dissemination and implementation of groundwater research findings.

1. Research

During the past year the UWS has conducted a broad-based program of groundwater research, which included basic and applied, and long- and short-term projects. University faculty have also prepared a variety of proposals for funding during the next three years from federal and state agencies.

Key research areas in the UWS have been defined by the Groundwater Research Advisory Council as:

- Chemical and biological degradation of pollutants (including remediation) in surface soils, subsoils and groundwater, and identification of degradation products/metabolites.
- Transport of pollutants in soil and groundwater, including elucidation of soil and hydrologic factors controlling solute movement, and development of computer models for predicting contaminant transport.
- Impact of waste management practices on groundwater contamination.
- Impact of agricultural management practices on groundwater contamination.
- Characterization of geologic factors affecting groundwater movement.
- Examination of the economic impact of groundwater contamination.
- Evaluation of policy alternatives for controlling contamination.

Research projects initiated or being conducted to resolve many of the priority needs of Wisconsin have been grouped into categories and are described briefly below.

a. Sorption Effects on Contaminant Transport

These projects deal with the mechanisms and effects of retention of potential pollutants at the surfaces of soil and aquifer material particles. Sorption is particularly important because it affects most other processes which relate to groundwater contamination. For example, sorption slows the loss of volatile compounds from soils to the atmosphere, retards nutrient and toxicant uptake by plants, slows the rate of contaminant movement through soil to groundwater and can slow microbial decomposition of contaminants and may accelerate or retard chemical degradation.

A project dealing with fundamental sorption processes involves an investigation of the sorption of some chlorohydrocarbons, one class of volatile organic compounds (VOCs), by swelling-type clay minerals. Of particular significance is whether the VOCs can be sorbed from the vapor phase in competition with dissolution by water. An intriguing but difficult problem is addressed by another study on whether minute mobile colloidal particles sorb contaminants and transport them over large distances in groundwater; this could help explain how rapidly contaminants thought to be immobile actually disperse. A complementary

investigation on the sorptive/desorptive properties of soils with different organic matter contents will quantify sorption/desorption rates and develop a predictive method for estimating concentrations of chemicals in landfill leachates. This investigation could also hold keys to the success of bioremediation techniques in soils (see Section 1e) by addressing the question of the degree of cleanup required for site rehabilitation.

Another project involves determination of sorption under conditions where oxygen availability is low. This is not important in most surface soils but is crucial in deeper subsoils and in aquifers. Reactivity under conditions of oxygen depletion might clarify whether contaminants can be degraded close to or even below the water table. Also logically included in this category is an investigation to determine spatial and temporal distribution of contaminants from waste spills or leaking landfills. The goal is to develop predictive models of contaminant transport. Sorption coefficients and degradation rates -- chemists' measurements of the tendency of contaminants to stick to solid particles or be broken down in the environment -- are vital components of these models. A predictive technique is urgently needed by regulatory agencies and waste disposal-site operators to indicate where improved management is required and to assist in the siting and regulation of new landfills.

b. Pesticides and Their Metabolites in Groundwater and Improved Management of Agricultural Chemicals

Several studies have been conducted on degradation and transport of herbicides, particularly atrazine. Major field investigations are being conducted 1. on silt loam soils near Waunakee in response to the WDATCP findings of drinking water contamination in their Grade A dairy farm well water survey and 2. near Arena on the sandy soils of the Lower Wisconsin River Valley (LWRV). The Waunakee project provided the impetus to reevaluate the state enforcement standard for atrazine in accordance with Wisconsin's groundwater protection legislation and to include concentrations of selected metabolites as well as of the parent herbicide in the action value. This policy will have far-reaching implications not only in the state but nationally and internationally, particularly in the European Economic Community. At Arena attempts are being made to establish why atrazine movement to groundwater is more rapid in the LWRV than in the Central Sands region; both areas have very similar soils. If this difference can be explained it will go a long way toward determining which factors control the movement of herbicides to groundwater, and improve agricultural chemical use and management. This project also provides a comparison of management techniques aimed at retaining herbicides in the soil's surface rather than allowing them to move through the soil to contaminate groundwater. The project has been extended to include nitrates -- a common contaminant of groundwater.

c. Short-Circuiting of Contaminant Transport by Preferential Water Flow

Many computer simulations of contaminant transport have been poor predictors of field concentrations. Evidence is accumulating that the lack of predictability is related to preferential flow of water and contaminants in soil. Often the preferential flow bypasses a great deal of the soil and the filtering capacity of soils is greatly reduced. One project attempts to predict the path of contaminants accurately -- a difficult problem since the pathway is governed by many factors.

Investigations of pathways of water movement through sandy soils have clearly demonstrated that "funnel flow" occurs in the field. Work under way is using ground-

penetrating radar (GPR) to map cross-bedded structures in deep sandy soils, the sites of funnel flow. After determining how to recognize false or distorted GPR images, GPR is being used to characterize deep soil horizons and to monitor preferential contaminant flow in sandy soils. A related project deals with spatial variability of soil structure as it affects water and contaminant transport, particularly in sandy soils. A component of the project deals with the best ways to transfer the information to colleagues who must disseminate it.

d. Hydrogeology -- Field Measurements and Computer Simulations

Much of the computer simulation by mathematical modeling done in the past has suffered from lack of an adequate verification or validation by "ground truth" or real-world field data against which the models can be tested. In Wisconsin a suitable data base is being assembled, particularly on pesticides and nitrates. Projects have been assembled to deal with transport of contaminants and with sources of pollution, types of pollutants, and rates of pollutant generation and dispersal. For example, one project will track contaminant pathways in glacial outwash using a geologically based computer model. The model will contain a code to simulate transport and deposition of clastic sediment, a code to simulate 3-dimensional groundwater flow, and a code to track conservative contaminants, i.e., materials not removed from the water by sorption or degradation. The model is being tested using a detailed data set from a field study at Chalk River National Laboratory in Canada. The data set contains information on spatial hydraulic conductivity (a measure of the ease with which water can flow through soil or geologic formations) and concentrations of tracers (compounds used to monitor solute dispersal) through time and space. Refinement of the conceptual hydrogeologic model of outwash depositional patterns, such as occur in Central Wisconsin, will utilize data sets from the scientific literature. Another study is following the transport of agricultural contaminants in sand aquifers affected by drainage ditches. Hydrologic factors that control groundwater flow in the vicinity of drainage ditches are being quantified, existing transport models for use in designing hydrologic barriers to contaminant migration are being tested, and the transport behavior of agrichemicals in shallow sand aquifers are being examined to assess degradation and extent of retardation of migration of contaminants by sorption.

Variations in hydraulic conductivity in sandy glacial till are being examined to establish whether variability in contaminant levels measured in the field is really a result of true variability in a site, or in the methods of sample collection and analysis. Hydraulic conductivity is such an important parameter that it must be determined accurately. A variety of methods to measure hydraulic conductivity are being compared, including tracer studies, piezometer tests (to determine water table elevations in relation to aquifer ressistance to flow), and long-term pumping tests. Evaluation of hydraulic conductivity is mandated by Wisconsin law for any site being used for waste disposal and is also of prime importance in hydrogeological modeling.

An investigation is under way which will provide an integrated decision support system for well head protection, i.e., measures to protect groundwater recharge areas and prevent pollution at its source. An education program is envisioned using a short-course format to train municipal and state officials on the use of the system.

A field, laboratory and modeling study will produce a computer model for simulating the Vyredox process for *in situ* removal of iron, manganese and radium from groundwater. Iron and manganese cause staining and have deleterious effects on bathroom fittings. Radium

-- both ^{226}Ra and ^{228}Ra -- have a direct human health risk following ingestion. They also pose an indirect health risk because radon gas -- a nuclear degradation product of radium -- may accumulate to unacceptable levels in residences and other buildings.

e. Remediation of Contaminated Soils and Water

Two projects deal with remediation techniques for water and soil: one is a bioremediation method using consortia of microorganisms to degrade herbicides in research which will evaluate the rates of herbicide degradation to innocuous materials such as carbon dioxide, water and chloride. If dead-end products (i.e. organic compounds that cannot be degraded further) are formed, attempts will be made to manipulate organisms genetically so that these compounds can be degraded. A total mass balance will be attempted for the overall degradation pathway.

The second project deals with photocatalytic and simple chemical methods for renovating pesticide-containing rinse water, a troublesome byproduct of pesticide use on the farm. Present methods of disposal of rinse waters are extremely expensive, particularly if they contain a mixture of pesticides. The photocatalytic process is a novel technology utilizing a ceramic membrane coated with TiO_2. Pesticides adsorbed on the membrane can be degraded to CO_2, H_2O and inorganic ions by exposure to light of the correct wavelength. Rates of these reactions and residual pesticide concentration that can be achieved are of paramount importance in evaluating the technique. The technique is particularly appropriate for dilute solutions found in rinsates and unused portions of tank mixes. A bench-scale model of the photocatalytic system now available is being used for laboratory tests prior to developing pilot-scale remediation techniques for a diversity of compounds and their mixtures. The hi-tech photocatalytic method of degradation is being compared with simple chemical reactions such as oxidation, hydrolysis, etc. which can be conducted safely on the farm using conventional farm chemicals.

Cost effectiveness evaluations for the chemical and photochemical methods are underway and are being compared with costs incurred by shipment for disposal in Alabama or North Carolina hazardous waste sites.

f. Effect of Groundwater Contamination on Property Values

Although little work is being conducted anywhere in the nation on the societal impacts of groundwater contamination, one Wisconsin project is applying sound, quantitative socio-economic methodologies to establish the very important impact of groundwater contamination on property values. This investigation is being supplemented by a long-term investigation on how to get farmers to adopt novel agrichemical management techniques in areas prone to water- quality problems.

g. On-Site Wastewater Disposal

The Small-Scale Waste Management Project has supported continuing laboratory and field research and extension education activities related to satisfactory on-site disposal of small wastewater flows with minimal impact on groundwater quality. Efforts directed at improving underground wastewater disposal and purification through soil absorption have involved comparison of chamber- or gallery-style versus conventional gravel-filled drainfields, use of aeration units instead of conventional septic tanks, segregation for separate disposal

of "grey water" (laundry, shower, kitchen waste streams) from "black water" (toilet waters), and the design and performance-monitoring of Wisconsin mound and at-grade systems, where absorption fields are elevated above or placed in the surface soil, rather than buried at depth as in conventional systems. Research directed at assessing and curbing groundwater contamination from septic systems has investigated the anaerobic conditions prevailing under the gigantic communal drainfields serving small rural townships, the movement of volatile organic chemicals through soil absorption systems, acceleration of contaminant leaching by preferential flow, improvement of effluent quality by combining human and dairy animal wastes, and examination of coliphage viruses as potential indicators of groundwater contamination by septic wastewater.

An investigation is being conducted on the impact of unsewered subdivisions on groundwater quality, particularly in connection with elevation of nitrate levels in drinking water from downgradient domestic wells. Nitrate concentrations in the sand-and-gravel aquifer underlying the Central Sand Plain generally exceed the state and federal standard of 10 mg/L NO_3-N, with septic systems and fertilizers being suspected sources.

h. Pending Projects

Over 50 projects have been written this year by UWS faculty seeking support from State and Federal agencies on problems relating to groundwater. In almost all cases they fall within the priority needs of Wisconsin as determined by the UWS Groundwater Research Advisory Council.

One project of special significance, developed jointly by the Water-Resources and Environmental-Toxicology Centers proposes to determine the health impacts of environmental lead (Pb). The project has major ground- and drinking-water components and requests a budget of $2 million annually for 3 years from the National Institute of Environmental Health Science. Lead is such an extremely important water contaminant of national and state concern that a brief but detailed abstract of the total project follows:

> The multicomponent, interdisciplinary project addresses environmental lead effects on brain and renal pathways that regulate, respectively, behavioral and blood-pressure anomalies associated with Pb exposure. Determination of the mobility and bioavailability of different Pb species in the environment will be coordinated with these biological studies. Several analytical probes will be used to evaluate the different soluble and particulate forms of Pb around selected environmental sites, where Pb contamination presents a problem. These studies aim to provide a more quantitative picture of Pb speciation and the environmental mobility of the different forms that will improve future risk analysis. Studies of Pb toxicity will involve 6 projects each using the same set of rats exposed to Pb in one of several ways. Lifetime (fetus to 26 months) Pb exposures at 25 and 250 ppm in drinking water will be compared with acute administrations (10 umole IP/kg/day for 1-4 days). The potentiating effect of a low calcium diet will be examined. In all studies Pb levels will be compared in blood, kidney and brain with activities of enzymes known to be affected by Pb. The effects of Pb on specific behavioral tests will be correlated with detailed analysis of functional markers in the hippocampus and neostriatum. Pb effects on blood-pressure regulation will be correlated with changes in a novel set of regulatory molecules generated in the kidney by cytochrome P450-

mediated metabolism of arachidonic acid. Changes in brain and kidney function will be related to changes in specific forms of protein kinase C and glutathione transferases which will serve both as novel biomarkers and possible mediators of toxicity. Samples containing ionic, complexed, colloidal and particulate lead from soil and water around Pb-contaminated sites will be extensively analyzed and administered to rats in parallel with lead acetate. Such studies will not only quantify bioavailability of Pb, but may also identify agents in the samples that potentiate or inhibit Pb toxicity. Later studies will address how lead uptake and toxicity are modified by acidity, reducing conditions and the presence of other metals and organic toxicants and the extent to which health effects are reversible by lead depletion therapy.

The UWS has rapidly developed a strong and viable program of groundwater research which is likely to expand as exemplified by the "Pending Projects." The research is of critical concern not only because of public health issues but because of the need to maintain high-quality drinking and ground water while assuring that Wisconsin farming and industries are not placed at a competitive disadvantage compared to their counterparts in neighboring states and other countries with less enlightened and fair-handed environmental-, agricultural- and industrial-support policies.

Report on Groundwater Related Education

Education plays an important role in the protection, management and development of the state's water resources.

In cooperation with other agencies and groups and with individual citizens, the University of Wisconsin has created and delivered innovative and comprehensive problem-solving educational programs on groundwater resources.

Federal, state and county investments have made the University of Wisconsin a national leader in water resources education. With its network of county agents and state specialists it has a unique educational capacity for addressing water-related problems throughout the state.

The educational objectives are to:

1. Develop materials and programs that increase awareness and understanding of the relationships of urban and rural land uses and activities to surface and ground water quality for Wisconsin's citizens, local officials, business managers and property managers.

2. Encourage adoption of management practices designed to lessen the adverse impacts of agrichemical use on water quality while maintaining or enhancing profitability.

3. Provide public policy education opportunities on water related issues.

4. Improve materials and programs that promote better agricultural and non agricultural use, storage and disposal of hazardous substances in the interest of protection of water quality.

5. Develop education materials and programs to improve water management (i.e., irrigation scheduling, drainage, wetland management) in ways that benefit water quality.

PUBLIC POLICY EDUCATION

Because local government in Wisconsin has substantial control over local land use decisions, groundwater public policy educational programs are important for local officials. A pilot groundwater planning program in one county spurred development of a series of publications designed to help local governments tackle groundwater issues. For example, A Guide to Groundwater Quality Planning and Management for Local Governments offers a framework for local action. It covers the planning process; inventory and assessment of local water quality information; potential pollution sources; environmental assessment; management techniques and options, and protection strategies and alternatives. This publication and others like it are primary resources for local officials and citizens undertaking groundwater programs.

In cooperation with regional planning commissions and state agencies, Extension organizes regional meetings for local officials and technical support staff.

An interactive educational tele-conference network program series annually brings groundwater education and program information as well as continuing communication, support and assistance to local officials. Specialists lead the discussion of current issues such as storage tanks, solid waste management, public water supply, ag chemicals, livestock waste, land use controls, etc., using the two-way audio network.

A major statewide conference on groundwater entitled, "Working Together to Manage Wisconsin's Groundwater - Next Steps?" drew upon the many years of interaction among the array of interest groups concerned with groundwater. It was a timely event, coming six years after passage of Wisconsin's pioneering groundwater protection law. A survey of groundwater protection activities, needs, and obstacles to successful local action was conducted in collaboration with the Wisconsin Counties Association and the League of Municipalities. The results of this survey as well as action recommendations are contained in the Proceedings.

Groundwater and public policy educational efforts have helped mobilize community projects throughout the state.

-Four counties have developed comprehensive groundwater protection and management plans.
-Another 34 counties are monitoring, collecting and interpreting basic groundwater, aquifer and land-use information that may lead to the development of comprehensive plans.
-Many counties have adopted specific groundwater protection ordinances targeting immediate problems while an overall plan is being developed.
-Twenty-seven counties have regulated installation of manure holding pits.
-Several other counties and towns have established wellhead protection districts and are regulating underground storage tanks, septic system disposal and non-metallic mining.

LOCAL GOVERNMENT ASSISTANCE

Assistance is provided for design of monitoring programs and evaluation of the results, structuring of planning and zoning activities for groundwater protection, and for development of country groundwater management plans. Recent emphasis has been on wellhead protection, involving delineation of recharge areas, definition of aquifer parameters and description of protection strategies.

Development of geographical information systems which compile soils, ownership, geological, water quality and other data sets into computer-generated overlays is helping provide accurate and useful mapping of resources for county resource management.

DRINKING WATER QUALITY EDUCATION

Home Drinking Water Quality Education Programs help people recognize and understand the relationship of well water quality to the geology and land use in their locale. Analysis of well water for bacteria, nitrate, hardness, conductance, etc. is followed by a presentation to explain the water cycle, groundwater movement, contamination and what individuals can do to protect

water quality. Results of the analyses may be added to a data bank for the county. Laboratory support from the Environmental Task Force and the Geological and Natural History Survey enables agents and specialists to pursue answers to individuals' questions. About 1500 households were involved this year, with an additional 1000 results from individual tests from 20 plus central Wisconsin counties added to the data base. Annual county level reports lead to meetings with county officials to discuss options and plans for groundwater management activities.

WATER TESTING BOOTHS

Groundwater exhibits are used as a backdrop for on-the-spot water testing for nitrate at county fairs, farm shows, garden and home shows and other events. The quick test offers an educational contact as well as an alert for high nitrate concentrations in private wells. About 20 counties included a test booth at their fair last year, staffed by volunteers and county resource and health professionals.

WATER RESOURCE INVENTORIES FOR COUNTIES

A next step beyond awareness of groundwater problems and issues is the development of an inventory of information available. County-level reports collate information on aquifer materials, soils, water use, land uses, bedrock geology and water quality from 500-1500 wells to show vulnerable areas and to help in planning groundwater protection strategies. These WGNHS projects are cost-shared by the county. Very brief summaries of information which is already available on the county's ground water have been completed for about a dozen counties, mostly in the northwest part of the state.

TEACHER EDUCATION

Credit and non-credit sessions for teachers are run at University of Wisconsin campuses, CESA districts, environmental centers and in conjunction with environmental education associations. Topics include principles of groundwater science, curriculum development, water quality activities, use of available materials and infusion of water topics into current units. Follow-up requests for assistance on student projects, field activities, sources for equipment and supplies, loan of a groundwater model and test kits, materials development, etc. indicate a valuable extension of educational effort.

FARMSTEAD ASSESSMENTS

A farmstead pollution assessment system has been developed through a cooperative arrangement with EPA, the North Central Center for Rural Development, and the Extension Service. The farmstead assessment system (FAS) is based upon twelve integrated fact sheets to help farmers assess the relationship of their farmstead structures, management practices, and site vulnerability to groundwater pollution potential. Farmers using FAS can identify groundwater contamination risks from farmstead activities and prioritize actions for minimizing those risks. FAS publications provide information on methods to reduce contamination potential for structures or activities that are evaluated, and provide information on potential health effects to humans and livestocks if certain contaminants reach groundwater. They also identify local resource persons such as county extension staff, DNR, land conservation employees, and SCS staff who could provide assistance in

conducting the assessment and advice in making recommended changes in farmstead management and design of structures. Fact sheets developed to facilitate farmstead pollution assessment evaluation include:

1. Assessing the pollution potential of your farmstead;
2. Evaluating your farmstead sites vulnerability to groundwater contamination;
3. Well condition;
4. Pesticide storage and handling;
5. Fertilizer storage and handling;
6. Petroleum product storage and handling;
7. Farm and household hazardous wastes management;
8. Household waste water treatment;
9. Livestock waste storage;
10. Livestock yards;
11. Silage storage;
12. Milkhouse waste treatment.

Each fact sheet in the FAS series which addresses pollution potential related to structures or activities (sheets no. 3-12) includes: an overview of the problem; groundwater contamination risk ranking table and interpretation; description of potential for activities in ranking to affect groundwater; health affects information; and sources of help in reducing groundwater contamination risks.

FAS is being applied in two Wisconsin counties and two Minnesota counties. Revisions will be made in the fact sheets based on the results. Revised fact sheets will then be used in the USDA demonstration project and hydrologic unit project. A national FAS project has been accepted by EPA, USDA and SCS, and is now underway.

USDA WATER QUALITY INITIATIVE PROJECTS

A. East River Demonstration Project

The East River Watershed has been selected as one of eight USDA Demonstration Projects intended to increase farmer adoption of research-based practices that will protect and improve groundwater and surface water quality while maintaining or increasing farm profitability.

The project is a joint effort of the Soil Conservation Service (SCS), Extension Service (ES), Agricultural Stabilization and Conservation Service (ASCS), Wisconsin Department of Agriculture Trade and Consumer Protection (WDATCP), Wisconsin Department of Natural Resources (WDNR), and Wisconsin Department of Industry, Labor and Human Relations (WDILHR).

Educational components of the project address: cropland management of nutrients and pesticides, farmstead management of nutrients and pesticides, and farmstead management of structures and materials which may contribute to surface and groundwater contamination. Drinking water education programs will be used to improve understanding of existing drinking water quality and how agricultural practices can affect it. These programs will be based on the results of water tests of private wells.

Farm-specific groundwater pollution assessments will use the Farm Assessment System to evaluate groundwater pollution risks related to management activities and structures around the farmstead and in the field. The voluntary project will be coordinated with the priority watershed project (part of the Nonpoint Source Pollution Abatement Program). Intensive one-on-one assistance will focus on approximately 75 farmers in the Bower Creek portion of the watershed. Group planning and educational programs will be a major mechanism of assisting the remaining 480 farmers in the watershed. These programs will be enhanced through the use of six, fully-integrated demonstration farms and numerous farms that have demonstration practices. Intensive monitoring efforts will focus on Bower Creek.

B. Stevens Point, Whiting and Plover Wellhead Protection Project

Goals and objectives are parallel to the East River Demonstration Project. Major components of the wellhead protection project address: Management of nutrients and pesticides for vegetable and cash grain crops, farmstead management of structures, materials and septic systems that may contribute to groundwater and surface water pollution. Drinking water education programs will improve understanding of how agricultural practices affect water quality. These programs will be based on results of private well water tests. Farm-specific groundwater pollution potential assessments will be accomplished by using the voluntary farm assessment system.

Intensive one-on-one assistance will concentrate on approximately 250 farmers in the wellhead protection area. Group planning and educational programs will be conducted with the 2500 residents in the wellhead protection area.

WATER ISSUES EDUCATION STRATEGY

The Final Report of the UW-Extension Water Issues Team, addressing both subject matter and institutional needs related to water resources education, was completed in October 1990. Follow-up meetings have dealt with how to implement the recommendations of the Team. Results of county level educational needs surveys, agency-representative and user group interviews and team members' judgments are the basis for this guide for water resource education. The report is available from the Dean of Cooperative Extension.

PRIORITY WATERSHED PROGRAM

The UW System has a long standing connection with Wisconsin's Nonpoint Source Water Pollution Abatement Program. The program has grown to 51 watersheds. The UW System has encouraged incorporation of more extensive groundwater-related work into the program.

Four Area Water Quality Specialists, a publications editor, an associate editor, a Statewide Nonpoint Source Coordinator and support staff anchor UWEX's nonpoint source team. In addition, staff members in the Nutrient and Pest Management Program (NPM), Agriculture Engineering, Soil Science and Rural Sociology departments continue to have important roles in Best Management Practice (BMP) implementation and landowner surveys.

Activities during 1990 included:

-Production of 55 professional-level newsletters for Priority Watersheds
-Completion of the five-part videotape series, "It All Adds Up", on nonpoint source pollution
-Production of a quarterly, statewide newsletter on water quality
-Production of a bimonthly information-sharing newsletter for water quality professionals
-Numerous ETN and face-to-face meetings on administrative and technical issues with county and area UWEX faculty
-Continued coordination with DNR and DATCP on policy, administrative and fiscal matters
-Demonstrations of the Nonpoint Program's first landowner survey
-Milwaukee River Priority Watershed Project landowner survey
Drafting of information and education plans for the watershed
Organizing urban stormwater management workshops
Coordinating information and education strategies
Coordination of demonstration plots development
-Conducting training for watershed managers on education program planning

Development and publication of a statewide "Information and Education Strategy for watersheds assisted in further improving interagency coordination of education activities.

Increasing state and campus activity in the areas of groundwater and agri-chemical management continues to demand administrative and technical attention. Coordination with the NPM Program continues to improve programs on agri-chemical management in Priority Watersheds.

NUTRIENT AND PEST MANAGEMENT PROGRAM

The NPM program is now fully staffed, and activities are underway to facilitate the development and dissemination of information. Some current activities include:

-Development of corn Best Management Practices
-BMP guidelines for nitrogen, manure, rotations and atrazine
-Protocols for demonstrations and surveys
-Demonstrations of BMPs at sites around the state

Regional staff serve as the primary means of delivery of information to the counties.

OTHER SIGNIFICANT ACTIVITIES OF UNIVERSITY OF WISCONSIN STAFF

-Formal classroom instruction in all aspects of groundwater
-Respond to calls and letters requesting assistance
-Field conservation days demonstrations for schools
-Presentations to professional organizations
-Public service announcements
-Special projects
-Development of the "ant farm" groundwater model and the sand tank model for chemical movement in soils
-Instructional video tapes for models, kits, lectures
-Contributions to committees, task groups, etc. at local, state, regional and national level