

The Education Subcommittee regretfully accepted the resignations of two long-time members, Bob Pearson of DOT and Jane Larson of DATCP, because of additional responsibilities assigned to their positions, but welcomed Randy Zogbaum as the new DATCP representative.

Local Government Subcommittee

The Local Government Subcommittee (LGS) was formed in 1993 to represent local units of government and organizations representing local units of government. The subcommittee was created by the GCC in response to recommendations from the 1991 conference "Working Together to Manage Wisconsin's Groundwater - Next Steps?" The purpose of the Subcommittee is to serve as a means of communicating local government issues and concerns about groundwater protection to the state agencies that make up the GCC, as well as to allow the GCC and its subcommittees to share information and get input about documents and publications.

The Subcommittee has met infrequently in recent years because there haven't been issues requiring its attention. It did meet on October 10, 2000 to discuss how best to utilize the Subcommittee to meet the needs of local governments. There was a consensus that the Groundwater Summit being discussed by the GCC could serve as an impetus for providing new directions for the LGS, as well as identifying new people or groups to become involved. It was decided that the group would wait to meet until the results of the conference could be evaluated. The Groundwater Summit was held October 30, 2001.

The Subcommittee met by conference call on May 1, 2002 to provide updates on current activities and get input from Subcommittee members. Some new members and additional persons were invited to participate in the call. The Subcommittee heard updates on follow-up to the Groundwater Summit, progress on comprehensive planning and groundwater fact sheets, the source water assessment program, Comm 83 and other activities. The Subcommittee provided comments on the directions for Groundwater Summit follow-up, the fact sheets and future directions for the Subcommittee. Participants agreed to meet in the fall of 2002 and focus on ways the Subcommittee could be involved in promoting discussion of groundwater quantity issues and options for regionalization of water management.

SUMMARY OF AGENCY ACTIVITIES

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

DEPARTMENT OF NATURAL RESOURCES

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

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

1. **Bureau of Drinking Water and Groundwater** – Regulates public water systems, private drinking water supply wells, and high capacity wells. The Groundwater Section assists in coordinating groundwater activities of the DNR, as well as other state agencies. In particular, the Groundwater Section is responsible for adoption of groundwater standards contained in ch. NR 140, Wis. Adm. Code; development of an annual groundwater monitoring plan; coordination of the joint solicitation for groundwater-related monitoring and research proposals; review and management of groundwater monitoring projects; coordination of groundwater components of basin plans and of nonpoint source priority watershed projects; coordination of wellhead protection and source water assessment activities; and maintenance of a data management system for groundwater data. <http://www.dnr.state.wi.us/org/water/dwg/index.htm>
2. **Bureau of Waste Management** - Regulates and monitors groundwater at proposed, active, and inactive solid waste facilities and landfills. The Bureau reviews investigations of groundwater contamination and implementation of remedial actions at active solid waste facilities and landfills. The Bureau also maintains a Groundwater and Environmental Monitoring System (GEMS) database of groundwater quality data from over 600 solid waste facilities and landfills and uses reports from GEMS to evaluate whether sites are impacting groundwater quality. <http://www.dnr.state.wi.us/org/aw/wm/index.htm>
3. **Bureau for Remediation and Redevelopment** - Oversees response actions at spills, hazardous substance release sites, abandoned containers, brownfields (including the Site Assessment Grant program), "high priority" leaking underground storage tanks, closed wastewater and solid waste facilities, hazardous waste corrective action and generator closures, and sediment cleanup actions. A significant amount of the RR program's work relates to groundwater contamination. <http://www.dnr.state.wi.us/org/aw/rr/index.htm>
4. **Bureau of Watershed Management** - Regulates the discharge of municipal and industrial wastewater, by-product solids and sludge disposal from wastewater treatment systems and wastewater land treatment/disposal systems. The Bureau also issues WPDES permits for discharges associated with clean-up sites regulated under the authority of the Bureau for Remediation and Redevelopment. The Bureau also has primary responsibility for regulating stormwater and agricultural runoff as well as managing waste from large animal feeding operations. <http://www.dnr.state.wi.us/org/water/wm/index.htm>

Bureau of Drinking Water and Groundwater

Groundwater Standards. Chapter 160, Wis. Stats., requires the DNR to develop numerical groundwater quality standards, consisting of enforcement standards and preventive action limits, for substances detected in, or having a reasonable probability of entering, the groundwater resources of the state. Chapter NR 140, Wis. Adm. Code,

establishes these groundwater standards and creates a framework for their implementation. There are currently groundwater quality standards for 122 substances of public health concern, 8 substances of public welfare concern and 15 indicator parameter substances in ch. NR 140.

Amendments are currently being proposed to ch. NR 140 to add groundwater quality standards for 2 substances,alachlor ESA (ethane sulfonic acid) and molybdenum, and to revise existing groundwater quality standards for 3 substances: butylate, dacthal and naphthalene. All of these substances are potentially of public health concern. At its June 2002 meeting, the Natural Resources Board authorized public hearings on these proposed amendments to NR 140. These hearings have been scheduled for the end of August and early September of 2002.

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

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

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

The Groundwater Section published revisions to the DNR's Groundwater Sampling Desk Reference and Field Manual in 1996. These documents provide detailed instructions on how to consistently collect high quality, representative groundwater samples and make accurate monitoring measurements. Both the Groundwater Sampling Desk Reference and Field Manual have been widely distributed and well received by both environmental professionals and the regulated community. The two documents are available on the Bureau of Drinking Water and Groundwater's web page at <http://www.dnr.state.wi.us/org/water/dwg/gw/sample.htm>. They are among the top most downloaded documents on the Bureau's web page.

Groundwater Monitoring and Data Management. DNR continues to administer funds for management practice monitoring projects. During FY 02, \$436,285 was spent on 14 projects selected during the joint solicitation process described under *Groundwater Monitoring and Research* in this report. Approximately \$128,000 was awarded to 6 projects for management practice monitoring during FY 03. Two projects are new studies selected during this year's joint solicitation process (see Tables 1 and 2).

Under direction of the GCC, the UW Water Resources Institute (WRI) and the Groundwater Section continued to distribute the findings of groundwater monitoring and research funded through the joint solicitation process. Final reports and 2-page research summaries are available for most projects. Almost 100 summaries are available electronically on the following WRI web page (<http://www.wri.wisc.edu/wgrmp/wgrmp.htm>).

Final reports received by the DNR in FY 02 include:

Bahr, J.M. and L. Parent. 2002. An Improved Hydrogeologic Model for the Token Creek Watershed.

Benson, C.H. and T. Lee. 2002. Using Waste Foundry Sands as Reactive Media in Permeable Reactive Barriers.

Connelly, J., D. Dinsmore, T. Hegeman, B. Shaw, R. Stephens, N. Turyk, and J. Schultz. 2002. Evaluating options for changing groundwater monitoring requirements for landfills to reduce mercury used by laboratories.

Eaton, T.T, K.R. Bradbury, and H.F. Wang. 2002. Verification and Characterization of a Fracture Network within the Maquoketa Shale Confining Unit, Southeastern Wisconsin.

Groundwater Section staff continue to implement NR 141 Groundwater Monitoring Well Requirements. Activities include consultation on well construction with Remediation and Redevelopment, Waste Management, Watershed Management and Department of Commerce staff, consultants and drillers. Additional educational efforts on code application involve inspections of drilling operations and training sessions at Department of Commerce PECFA staff meetings. Random inspections of environmental drilling operations help educate drillers and consultants about NR141 requirements and enhance compliance with the code. Review of new technologies and their application also continue to be a priority.

The DNR's Well Forms Program continues to provide users the ability to electronically data enter, print, export, and import information from eight Department related well forms. The software includes the following forms: Monitoring Well Construction Form 4400-113A, Monitoring Well Development Form 4400-113B; Well/Drillhole/Borehole Abandonment Form 3300-5B; Soil Boring Log Information Form 4400-122 and 122A; Groundwater Monitoring Well Information Form 4400-89; Groundwater Monitoring Inventory Form 3300-67; First Water Quality Report Form (3300-77); and the Drinking Water Well Construction Report Form (3300-77A). Several upgrades were completed this past year to several of the forms to add additional capabilities based on user requests.

The Well Forms Program software was originally introduced in conjunction with special Wisconsin Unique Well Number (WUWN) tags specifically designed for monitoring wells. Since 1988, all drinking water supply wells were assigned a WUWN. Now all wells, public, private and monitoring, constructed in the state of Wisconsin require a WUWN be associated with it.

Wellhead Protection. The DNR is the lead state agency for developing and implementing the Wisconsin Wellhead Protection (WHP) Plan. The specific goal of Wisconsin's plan is to achieve groundwater pollution prevention in public water supply wellhead areas consistent with the state's overall goal of groundwater protection. To achieve this goal the DNR, working with other state and federal agencies and extensive citizen input, developed a two-part state WHP Program that was approved by the USEPA in 1993. A WHP plan must be developed for any new municipal water supply well constructed since May 1, 1992. The plan must be approved by the DNR's Public Water Systems Section. A WHP Plan is voluntary for any public water supply well approved prior to May 1, 1992; the DNR promotes and encourages but does not require wellhead protection planning for existing wells.

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

- *Teacher training.* Department staff worked with the Central Wisconsin Groundwater Center (CWGC) and the Wisconsin Geological and Natural History Survey to sponsor three groundwater workshops for teachers in February. Teachers from 24 school districts were given training in the use of the groundwater sand tank model and given the models to take back to their schools. Forty-eight teachers took part in the workshops held in Eau Claire and Green Bay. In addition to the models, teachers were given a variety of educational materials and an assignment to report how they used the model in their classroom. The intent is to provide information for teachers to educate students –and their parents – to protect groundwater in their own communities.
- *Working with local communities on WHP planning.* Three Groundwater Section staff share responsibility for assisting communities with preparing wellhead protection plans. Staff meets with communities, provide information, and make presentations to promote the WHP program. The DNR also works with the Wisconsin Rural Water Association in providing assistance. Information is shared with local communities through a spring and fall wellhead protection newsletter.

- *WHP publications.* The DNR makes publications available to assist communities in their wellhead protection efforts. Work has been completed on three fact sheets to assist communities in addressing groundwater in their comprehensive plans. The three fact sheets (*Groundwater and Its Role in Comprehensive Planning*, *Resources to Help You Protect Your Drinking Water Supply* and *Residential Development and Groundwater Resources*) will be available in paper copy and through the web. An effort will be made to share these fact sheets with local units of government. The publication "Determining Wellhead Protection Area Boundaries - An Introduction" has recently been added to the WHP web page (next item).
- *Upgrading the DNR's WHP web pages.* The Department continues to update its WHP web pages (<http://www.dnr.state.wi.us/org/water/dwg/gw/whp.htm>) as new information becomes available. It currently includes general information on WHP, an annotated bibliography, a list of contacts for more information, a list of available publications, example WHP ordinances, and past and present issues of the Wisconsin Wellhead Protection News. Several DNR publications have been added to the web page in viewable and downloadable formats. In 2001, the example ordinances were updated and a listing of the 168 communities with wellhead protection plans was placed on the web page.
- *Keeping track of wellhead protection activity.* The Department has developed a database to keep track of communities working on wellhead protection planning, whether required or voluntary. The Department is working to incorporate into the Department's Public Water System database a tracking system for both wellhead protection and source water assessment activities.
- *Promoting the Groundwater Guardian Program.* The Department contracted with the Central Wisconsin Groundwater Center (CWGC) to hire a person to promote the Groundwater Guardian program statewide. The person prepared materials, made presentations to encourage local governments to become Groundwater Guardian communities, worked with existing Groundwater Guardian communities and organized the second annual statewide meeting of Groundwater Guardian communities.
- *Coordinating efforts with the Source Water Assessment Program.* The WHP Team continues to work closely with the Source Water Protection Team to provide consistency and continuity between the two programs. One area where the teams are working together is promoting advanced WHP Area delineations. In order to provide the most accurate information available to assist in WHP planning, the DNR has funded or is funding regional groundwater modeling projects in all or parts of 24 counties (see Source Water Assessment discussion below). In addition to providing a valuable planning tool for communities in these counties, the projects will provide delineations of the 5, 50 and 100-year capture zones for each of the municipal wells in these areas. Communities can use these delineations in their WHP planning process.

With the source water assessment set-aside funds from EPA set to expire next year, the Department plans to request wellhead protection set-aside funds from EPA to complete the source water assessments and provide help to communities in using their assessments to develop wellhead protection plans.

Source Water Assessments. The DNR received USEPA approval of Wisconsin's Source Water Assessment Program (SWAP) Plan in November 1999. The plan was submitted to meet the requirements of the 1996 Safe Drinking Water Act Amendments. The purpose of the program is to assess the risks that potential sources of contamination pose to public drinking water supplies, both groundwater and surface water. The program will: 1) delineate source water protection areas for all public water systems in the state; 2) conduct inventories of significant potential sources of contamination within those areas; 3) perform an analysis of susceptibility for each system; and 4) make the results of the assessments available to the public.

Source water areas for municipal groundwater systems are being delineated through regional groundwater flow modeling studies. These studies are being completed for the Lower Fox Valley, Central Sands Area, and the following counties: Dane, Eau Claire, Fond du Lac, Kenosha, La Crosse, Milwaukee, Ozaukee, Pierce, Racine,

Rock, Sauk, St. Croix, Walworth, Washington, and Waukesha. For the other municipal systems and smaller systems, simple radius delineations are being used.

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

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

Coordination of groundwater components of basin plans and of nonpoint source priority watershed projects.

Groundwater Section staff work with basin teams to develop specific groundwater priorities for watershed basins or Geographic Management Units (GMU). Priorities are based on GRN data, land cover information and information provided by regional DG program staff. For example, the Rock River Coalition Groundwater Issues Team has focused on cataloging data and resources, identifying contaminant sources and karst features, developed an award-winning karst brochure and promoted well abandonment demonstrations.

During FY 01, Geographic Management Units (GMU) around the state began the process of developing State of the Basin reports with direction from Water Division and Land Division guidance on integrated planning. State of the Basin Reports have been completed for all 23 basins in the state. State of the Basin (or GMU) reports provide baseline information on surface water, groundwater and land resources. Their main focus is on priority issues that are identified by the respective GMU team, made up of department staff and partnership groups. The plans identify geographic priorities for the nonpoint source program and will be used to help rank projects eligible for nonpoint source grant funds. The Groundwater Section is involved in integrated planning by providing basic data on groundwater for each GMU and more detailed information as is needed. The Section is uniquely suited to highlight areas in need of management based on groundwater issues and nonpoint source priority areas related to groundwater.

New Runoff Management rules with performance standards for stormwater infiltration will be promulgated in FY 03. Groundwater Section staff are working with Runoff Management staff to make sure the rules comply with chapter NR 140, Wis. Adm. Code. The Section is also participating on a team writing guidance for developers, land use planners and government agencies regarding stormwater practices that will meet the performance standards while preserving groundwater quality.

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

Over the last year work has continued on the Arsenic Study Group recommendations. Efforts included data collection and analysis, public and private well sampling, treatment system testing, developing drilling specifications, health effects studies and educational efforts. Many of the recommendations have been completed, while some studies are ongoing. A web page (<http://www.dnr.state.wi.us/org/water/dwg/arsenic/index.htm>) has been developed to provide DNR staff and public with information and updated recommendations.

On October 31, 2001 EPA announced that the Federal Drinking Water Standard for arsenic would be lowered from 50 parts per billion for public water systems to 10 parts per billion. EPA had previously delayed the rule in order to look at new studies regarding the health effects and to analyze economic issues associated with arsenic especially costs to small systems. The new standard became effective in February 2002 and compliance must be reached by 2006. The arsenic rule affects municipally owned water systems and those that serve an average of at least 25 people daily for six months of the year, among them schools, mobile home parks, apartment buildings, day care centers, and factories.

The Bureau will work with affected water systems to determine what this new standard means for them and what their options are. The Bureau is tracking current and new technologies for treating arsenic that may be possibilities for small water systems in Wisconsin. The DNR will continue to urge EPA to make funding available specifically for arsenic treatment for small systems that will have trouble covering the cost of expensive treatment systems.

Another component of the Department's efforts at implementing the new standard is giving careful consideration to new well construction so as to increase the chance for low-arsenic water, as follows:

- 1) Require a specified well casing restriction zone in order to *protect the aquifer from oxygen introduction*. Wells constructed according to this restriction may not provide water that meets the drinking water standard but are intended to minimize the impact of wells as an additional source of oxygen which exasperates aquifer degradation by arsenic.
- 2) Require that an arsenic water sample be collected at each new well in the restriction area. This provides a mechanism for continued public awareness and data evaluation.

Underground Injection Control (UIC) Program. Public water utilities in Oak Creek and Green Bay are continuing to work with the Bureau of Drinking Water and Groundwater to evaluate the use of aquifer storage recovery (ASR)² techniques in Wisconsin:

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

The Bureau of Drinking Water and Groundwater continues to work with the United States Environmental Protection Agency (EPA) to revise the primacy agreement that gives the DNR primary enforcement for Wisconsin's Underground Injection Control (UIC) program. The Department is required to revise the existing regulatory agreement to reflect newly enacted federal regulations that address a variety of injection practices. Failure to establish a new agreement may result in the direct implementation of federal Underground Injection Control program requirements by EPA.

As part of the activities to revise the state/federal primacy agreement, the DNR had proposed to create Chapter NR 815, Wis. Adm. Code. This new chapter was to have served as a template that demonstrated how existing state administrative rules would have continued to impose state regulatory requirements that were as least as

² ASR systems involve the injection of treated drinking water via a well into a suitable bedrock aquifer. The injected water is stored underground until the time it is needed to meet the needs of a utility's customers. During a high demand event the stored drinking water is pumped back up the same injection well and recovered into the water distribution system with little need for additional treatment to remove potential drinking water contaminants.

stringent as the new federal regulations. During its review of the proposed chapter, the Wisconsin Legislature requested that modifications be made to the section regarding the visitorial powers of the DNR. The Department is working to resolve this issue and has indicated to EPA that a revised primacy application cannot be completed and submitted until after the new administrative rules are in place. EPA has not yet responded regarding a new deadline for submitting the UIC program primacy application.

High Capacity Wells. The Department of Natural Resources is authorized under statute to regulate wells on each property where the combined capacity of all wells on the property, pumped or flowing, is greater than 70 gallons per minute. Such wells are defined as high capacity wells. When the operation of a high capacity well is anticipated to have an adverse impact on the quality or quantity of water available to a public utility well, the Department is obligated to deny approval or to limit operation of the high capacity well so that their operation does not adversely impact a public utility well.

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

Drinking Water and Groundwater web site. The Bureau continues to expand its Drinking Water and Groundwater web site (<http://www.dnr.state.wi.us/org/water/dwg/index.htm>). The site provides information on arsenic, the Perrier issue, capacity development, the plan review process for community water systems, groundwater, the Groundwater Coordinating Council, operator certification information, private and public water systems, underground injection well information, well driller and pump installer information and DNR Drinking Water & Groundwater staff. Access to many of the program's paper forms is available through the web site. Four online databases are also accessible through the site links. In addition, several new site segments were added this last year and many of the existing links were greatly expanded with new or additional information and materials.

Bureau of Waste Management

The Bureau of Waste Management regulates and monitors groundwater at proposed, active, and inactive solid waste facilities and landfills. The Bureau also reviews investigations of groundwater contamination and implementation of remedial actions at active solid waste facilities and landfills.

Over the past few years increasing numbers of residential developments have been located close to old, closed landfills. To recommend ways to ensure integration and communication within the DNR when addressing the problem of private wells near old, closed landfills, an ad hoc team, the Landfill Encroachment Work Group, was formed with members from the Bureaus of Waste Management, Remediation and Redevelopment, and Drinking Water and Groundwater. The work group's goal was to work together to prevent people from drinking contaminated groundwater from private wells near landfills and locating homes where this may already be occurring. The work group made the following recommendations to help avoid old, closed landfills from impacting private wells:

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

The three bureaus involved in the workgroup have taken several steps to implement the recommendations listed

above. Information is being collected for a GIS layer of locations for all the sites listed on the Registry of Waste Disposal Sites using Global Positioning System (GPS) and digitizing from blueprint plan sheets. In 2000 and 2001 we digitized the location of 230 landfills with plan sheets and have begun GPS locating smaller landfills that do not have plan sheets. Landfill characteristics are also being collected for all the Registry Sites. In the future, we hope to link the two databases and provide this information to potential homeowners, planners, realtors, and others using a mapping interface.

The Bureau of Waste Management was also concerned staff was not aware of some old, closed landfills that are impacting groundwater. Program staff used several reports from the Groundwater and Environmental Monitoring System to do a rough screening of old, closed town, city and village landfills with monitoring wells. Every two years the program runs the screening reports, identifies landfills that need further attention and sends the list to each of the regions for follow-up evaluations.

Over the past two years the bureau has studied 31 landfills accepting municipal solid waste, to try to determine whether VOC contamination in groundwater at these landfills is increasing, decreasing or remaining stable. We chose sites with 10 years of data and summarized the trends over this period of time. One purpose of this study was to determine whether natural attenuation is occurring in groundwater near leaking landfills. The findings of this study will be available in September 2002.

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

Bureau for Remediation and Redevelopment

The Bureau for Remediation and Redevelopment is primarily responsible for implementing and aiding cleanups under the Spill Law, the Environmental Repair Law, federal programs (Superfund, Hazardous Waste Corrective Action, LUST, Brownfields), the Land Recycling Law and State Brownfield Initiatives and at closed landfills. All cleanups are conducted according to WI Administrative Rules NR 700-750, Investigation and Remediation of Environmental Contamination, and NR 140, Groundwater Quality. Persons responsible under the laws, or those persons or groups involved in the redevelopment of potentially contaminated properties, do the majority of cleanups. Program staff provide assistance on cleanups conducted by consultants at responsible parties direction, and contract with and direct consultants on state-funded cleanups.

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

Brownfields program. In FY 02, the RR program continued to implement the Brownfields Site Assessment Grant (SAG) program. This program provides grants to local governmental units to conduct environmental site assessments and other eligible activities at contaminated properties. Eligible activities include site assessment and investigation, demolition, asbestos abatement, removal of petroleum and hazardous substance storage tanks and removal of abandoned containers. The SAG program benefits groundwater by serving as a funding source for (1)

removal of potential sources of groundwater contamination, and (2) site investigations to determine whether groundwater is contaminated, including the determination of the extent and degree of contamination. The SAG program does not fund remediation activities but funds preliminary activities to determine whether remediation is necessary.

Eligible sites are abandoned, idle or underused industrial or commercial facilities or sites whose expansion or development is adversely affected by actual or perceived environmental contamination. Sites are eligible for funding only if the persons responsible for the contamination are unknown, cannot be located, or cannot pay for the activities for which grant funding is requested. In FY 02 the DNR received applications for 73 sites requesting a total of approximately \$3.12 million. Of this the Department awarded \$1.7 million in grants to 34 different local governmental units at 54 sites. These grants will fund the removal of 94 aboveground and underground storage tanks and 151 abandoned drums and other containers of hazardous substances. These grants will also be used to fund 30 environmental site investigations. In two years the program has existed, grants were awarded to a total of 103 properties around the state.

The RR program continues to provide redevelopment assistance at brownfield sites with groundwater contamination. RR staff assist local governments and private businesses with the cleanup and redevelopment of abandoned or under-used properties where redevelopment is hindered by contamination. In many cases these properties have groundwater contamination or contamination that poses a threat to groundwater. Also, the RR program continues to provide a number of different assurance letters related to properties with groundwater contamination. General Liability Clarification Letters provide assurances to parties involved with voluntary cleanup sites so that they can buy or redevelop brownfield properties without concern about liability. "Off site" letters are provided to owners of property who demonstrate that the contamination under their properties did not originate on the property. These letters facilitate development of the property while the Department provides oversight of the cleanup being conducted by the person responsible for the contamination. In addition, lease letters are provided to lessees who rent properties overlying contaminated groundwater. These letters clarify the activities that lessees may undertake in order to remain free of liability for the contamination. Other assurance letters are also provided to lenders and local governments.

The RR program also continues to assist parties with voluntary investigations and cleanups of Brownfield properties through the Voluntary Party Liability Exemption (VPLE) process. After a person has conducted an environmental investigation of the property, and cleaned up soil and groundwater contamination, the Department will issue a "Certificate of Completion" which provides a release from future liability for any contamination that occurred on the property prior to issuance of the certificate. In FY 02, there were 9 completed cleanups where the Department issued a Certificate of Completion.

In March of 2001, the RR program began allowing parties to obtain a Certificate of Completion for sites that have not met groundwater standards if they could demonstrate that natural attenuation is effective and they paid for environmental insurance coverage (see the section below for further discussion of natural attenuation closure). The state has entered into this insurance policy to cover the cost to cleanup contaminated groundwater if natural attenuation fails at VPLE sites. As of July 2002, two cleanup sites have paid for this insurance to protect groundwater in case natural attenuation fails and obtained a Certificate of Completion.

Dry Cleaner Environmental Response Fund (DERF) Program. The DERF program reimburses dry cleaner owners and operators for eligible costs associated with the cleanup of soil and groundwater at sites contaminated by dry cleaning solvents. Fees paid by the dry cleaning industry provide program funding. Environmental cleanup at dry cleaner sites will be conducted following the NR 700 rule series. To date, there are more than 65 sites in the program, at various stages of investigation and cleanup. The program is implemented through ch. NR 169, Wis. Adm. Code.

Site closure rules for Petroleum Contaminated Sites (under PECFA). NR 746 (and its counterpart, Comm 46) was promulgated in February 2001. The bulk of the rule establishes risk and closure criteria to determine whether petroleum contaminated sites can be closed using natural attenuation as a final remedy for groundwater

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

NR 726 provides closure requirements for all other sites.

GIS Registry. Revisions to NR 726, 716, 749, and 811/812 implement a GIS Registry of Closed Remediation Sites to replace the requirement to record groundwater use restrictions at the County Register of Deeds Office. These revisions went into effect in November 2001, along with a corresponding database on the Internet. The GIS Registry currently includes locational information on sites closed with residual groundwater contamination above the NR 140 enforcement standards, as well as site specific information pertaining to where the contamination is on the property in question and at what concentration it was found at the time the closure decision was made. This database is to be used with well construction requirements for private wells, and with a setback distance for new municipal wells. The Department is providing the information from the database to Diggers' Hotline. When well drillers contact Diggers' Hotline before drilling, Diggers' Hotline will then inform the Department that a well is proposed for a property listed on the Registry. The Department will then contact the driller and advise them that special well construction features may be necessary, and that they must contact the Bureau of Drinking Water and Groundwater prior to any well construction activities.

Starting in fall, 2002, the GIS Registry will be expanded to include sites closed with residual soil contamination, including those sites closed with soil deed restrictions. The same type of locational and site specific information will be included for these sites as is currently included on the GIS Registry for sites with residual groundwater contamination. Inclusion on the GIS Registry on the Internet will provide a means of notifying future owners or users of the property of the existence of soil contamination.

Another database, the Bureau of Remediation and Redevelopment Tracking System (BRRTS) has been available on the Internet for public access for the 2 past years. These two databases are linked for greater ease of information access. BRRTS is useful for locating potential contamination sites when evaluating new municipal well placement. These databases make site specific information on open and closed remediation sites much more available and accessible to the public and specific interested groups, particularly those wanting to install or replace a potable well on an affected property, as well as those buying properties. Sites regulated by the Departments of Commerce and Agriculture, Trade and Consumer Protection are also included in the GIS Registry of Closed Remediation Sites and BRRTS.

Bureau of Watershed Management

The Bureau of Watershed Management is responsible for statewide implementation of DNR's Groundwater Standards Program primarily through the issuance of discharge permits to facilities, operations and activities that discharge treated wastewater and residuals to groundwater. Field staff that work on integrated basin teams carry out compliance and enforcement activities using policies, codes and guidelines developed by the Bureau. Integrated basin planning carried out in the field under guidelines developed by the Bureau, assess and evaluate groundwater (and surface water) and provide general and specific recommendations for the protection and enhancement of the basin's groundwater.

Wastewater Discharges. The Bureau of Watershed Management continued to issue WPDES permits to all communities, industrial facilities, and large privately owned wastewater systems which discharge treated domestic or industrial wastewater to groundwater through land treatment/disposal systems. These systems are primarily

spray irrigation, seepage cell, subsurface absorption systems, and ridge & furrow treatment systems. WPDES permits, issued to these facilities, contain groundwater monitoring and data submittal requirements which are used to evaluate facility compliance with ch. NR 140, Wis. Adm. Code, groundwater quality standards. Groundwater monitoring systems at existing facilities are evaluated and upgraded, as necessary, at permit re-issuance.

The Bureau of Watershed Management continues to assist unsewered communities, served by failing or inadequate individual on-site treatment systems in their efforts to construct centralized wastewater treatment facilities.

The Department is continuing to refine procedures, guidance, and rules for the review and permitting of large private onsite wastewater treatment systems (POWTS). The DNR started issuing permits to large POWTS in early 2000, as a result of changes to Commerce Rules and a revised DNR/Commerce MOU. In general, large POWTS are defined as those with a capacity of greater than 12,000 gallons per day (gpd). The Department is proceeding with a revision to ch. NR 200, Wis. Adm. Code, to clarify how the 12,000-gpd criteria will be established in situations involving multiple systems that are commonly owned and located close together.

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

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

Agricultural Runoff - There are currently 105 Wisconsin Pollutant Discharge Elimination System (WPDES) permits issued under the NR 243 permitting program for livestock operations (78% dairy; 11% poultry; 11% swine & beef). The Department recently issued a single permit to a group of poultry operations, some of which were covered under an individual permit. While this has resulted in an overall decrease in the number of permits issued, the overall number of operations covered under a permit has increased significantly. In addition, there are 10 dairy operations seeking permits for the first time. Regional and central office staff have successfully maintained the permit backlog at less than 10%. The trend of growing numbers of permit applications for operations with 1,000 or more animal units is expected to continue.

Rules outlining statewide performance standards and prohibitions for agricultural operations (nutrient management, manure storage design, clean water diversion, erosion control) are expected to become effective in October of 2002. The performance standards and prohibitions have been a key component of the Department's Nonpoint Redesign Initiative and are intended to further address impacts from animal feeding operations with less than 1,000 animal units.

At the federal level, the US EPA is continuing efforts to revise regulations for Concentrated Animal Feeding Operations (CAFOs) to be completed by December of 2002. Department staff provided comments on an EPA request for additional input on a number of topics including the use of non-NPDES programs to address operations with fewer than 1,000 animal units and the use of Environmental Management Systems.

Storm Water - DNR is currently working on revising its storm water regulations under ch. NR 216, Wis. Adm. Code, in order to comply with federal storm water regulations to take affect by March 10, 2003. Storm Water Phase 2 regulations will require nearly 200 municipal separate storm sewer systems to obtain permit coverage

statewide and also require construction sites down to one acre of land disturbance to have permit coverage to control erosion during construction. Permit holders will also be required to install post-construction practices to limit pollutant discharge after construction is completed (storm water management). The Department has developed performance standards (i.e. 80% sediment control, infiltration, peak flow, buffer requirements, etc.) that have passed the legislature and are expected to become effective about October 2002. Many of these standards will be implemented through storm water permits, especially for new development. However, there are certain delays built into the performance standard rules including a 2-year delay for implementation of the storm water management performance standards.

Nutrient Management Plans – One of the performance standards included as part of the Redesign effort was a nutrient management standard, NRCS Standard 590. During 2000 and 2001, DATCP and DNR conducted public hearings and proposed changes to their non-point pollution control rules to include nutrient management standards and practices. These rules were adopted by the Natural Resources Board in spring of 2002 and subsequently passed legislative review. The rules will be promulgated in October 2002.

For more information, contact Susan Sylvester at 608-266-1099 (Susan.Sylvester@dnr.state.wi.us), or Mike Lemcke at 608-266-2104 (Michael.Lemcke@dnr.state.wi.us), DNR, PO Box 7921, Madison, WI 53707-7921.

DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION

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

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

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

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

Non-Point Source Activities

DATCP's primary effort related to nonpoint contamination (i.e., due to general use) of groundwater continues to involve the herbicide atrazine. In response to concerns about atrazine contamination, DATCP amended administrative rule ch. ATCP 30 in 1992 to manage the use of atrazine in an effort to reduce or eliminate the potential for further groundwater impacts. Rule revisions have been made annually in response to additional detections of atrazine in groundwater. Rule revisions for the 2002 growing season increased the total acreage of

atrazine use prohibition areas, based on groundwater sample results available as of September 2001. A set of 101 maps of new or existing prohibition areas is available from the Water Quality Section covering 1.2 million acres that have been incorporated into the rule. Information suggests that atrazine use has declined as a result of the atrazine management rule and concern about groundwater contamination.

DATCP, through its land and water resource management program, provides funding primarily to counties to assist in the protection of these resources. A portion of this funding is dedicated to the development and implementation of improved nutrient and pesticide management practices. In FY 02 approximately \$200,000 was provided to promote the adoption of nutrient management plans on farms to maximize profitability and to minimize excessive runoff of nutrients to surface and groundwater.

Point-Source Activities

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

In August 1993, section 94.73 of the Wis. Stats. was created and established the Agricultural Chemical Cleanup Program (ACCP) to address these point sources of contamination. The ACCP reimburses responsible parties for cleanup costs related to pesticide and fertilizer contamination at facilities and in nearby wells. The program may also handle point source contamination on farms. To date, more than 350 cases involving soil and/or groundwater remediation related to spills, misuse, and improper storage, mixing or loading have been initiated at pesticide and fertilizer handling facilities and on farms.

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

In addition, a pilot pollution prevention program was initiated in 2001. This program is an attempt to promote proper handling of agricultural chemicals to prevent future contamination at commercial facilities. A lead-arsenate program was also created. The goal of this program is to educate landowners of potential lead-arsenate contamination at former fruit orchard sites across the state. The program also provides assistance for remediation of contaminated sites.

Since 1990, the Agricultural Clean Sweep program has helped farmers dispose of unwanted pesticides, farm chemicals, and empty pesticide containers. Beginning in 1996, the program extended collection services to small agricultural businesses. In FY 02 DATCP provided \$365,411 to fund Clean Sweep projects in 37 counties for collection and disposal of waste pesticides and containers. Approximately 220,961 pounds of waste were reducing the potential for inadvertent environmental damage. Approximately \$350,000 will be available during FY 03 for these projects.

Groundwater Sampling Surveys

DATCP participates in a number of surveys on an annual basis to investigate the occurrence of pesticides in groundwater resulting from nonpoint sources. Results of these surveys are provided in the "Pesticides" section under *Condition of the Resource - Groundwater Quality*.

Exceedence Survey. From 1995-2001 DATCP has conducted an annual sampling program of private wells that have previously exceeded a pesticide enforcement standard. 150 wells have been re-sampled at least once in this

program for common pesticides and nitrate. Most of the wells are in atrazine prohibition areas. In 2001, 71 private wells that have historically exceeded groundwater standards were sampled.

Pesticide and Groundwater Impacts Study. In 1985, DATCP began a study to determine if normal field application and use of pesticides and fertilizer was causing groundwater contamination at highly susceptible sites (e.g. sandy soils, less than 25 ft. to groundwater). In 2001, this study entered its 16th program year. As many as 50 different field sites have been sampled. Currently 25 sites are being monitored across the state. DATCP's Water Quality Section maintains this network of monitoring wells primarily as an early warning system for pesticides new to the marketplace.

Monitoring Reuse of Atrazine in Prohibition Areas. In FY 98, DATCP began monitoring the limited reuse of the herbicide atrazine in selected areas where atrazine use has been prohibited. Ch. ATCP 31, Wis. Adm. Code, requires DATCP to collect scientific data to show if renewed use of atrazine in prohibition areas will cause further groundwater contamination. DATCP is monitoring groundwater quarterly at 17 fields, 10-40 acres in size, for 5 years. In 2001, 278 samples were collected in this program.

Atrazine Rule Evaluation Survey. In 1994 and 1996, DATCP completed groundwater sampling surveys designed to evaluate the effectiveness of the Atrazine Rule (ch. ATCP 30, Wis. Adm. Code). These surveys were designed to determine how levels of atrazine and its metabolites in groundwater were changing three and five years after the atrazine restrictions went into effect. In 2000 and 2001, Water Quality Section staff sampled 336 private wells across the state that included 122 of the same wells sampled in 1996. Results from this survey have been summarized in the May 2002 report "Groundwater Quality: Agricultural Chemicals in Wisconsin Groundwater", which may be downloaded at http://datcp.state.wi.us/arm/agriculture/land-water/water-quality/monit_proj.html.

Research Funding

DATCP funded three pesticide research projects during FY 02 with a total commitment of \$170,000 over two years. Two-year projects were funded to 1) evaluate pesticide and nitrate leaching on soils receiving manure, 2) evaluate agrichemical residues in two groundwater basins, and 3) to determine the occurrence of antibiotics in wastewater effluents and their mobility in soils. DATCP's research fund, which is based on fees paid by pesticide manufacturers, provides approximately \$135,000 annually to meet pesticide related research needs of the Department.

For further information, visit the following web site (<http://datcp.state.wi.us>) or contact Nicholas Neher, DATCP, 2811 Agriculture Drive, PO Box 8911, Madison, Wisconsin, 53708-8911; phone: 608-224-4567; e-mail: nicholas.neher@datcp.state.wi.us.

DEPARTMENT OF COMMERCE

Chapter Comm 10, Wis. Adm. Code, regulates flammable and combustible liquids and hazardous substance liquids on the CERCLA list. The regulatory authority for the storage tank program is within the Division of Environmental and Regulatory Services (ERS) in the Department of Commerce. The ERS Division has two bureaus: Bureau of Petroleum Products and Tanks, and the Bureau of PECFA.

Under 145.02, Wis. Stats., the Department of Commerce also has the responsibility of safeguarding public health and the waters of the state relative to the construction, installation and maintenance of plumbing. One mechanism of the Department to fulfill this responsibility is to promulgate a state plumbing code, chapters Comm 81-87. Chapter Comm 83 that addresses Private Onsite Wastewater Treatment Systems is part of the state plumbing code, and is administered by the Division of Buildings and Safety.

Private Onsite Wastewater Treatment Systems (POWTS)

A revised private onsite wastewater treatment systems (POWTS) code, Comm 83, was implemented on July 1, 2000. Audits of the county onsite sewage system programs indicate that even with the availability of additional onsite treatment options, based on plan review and permit activities, most property owners are choosing to install the same types of onsite systems that were available under the previous code. Nine manuals for standard system designs are referenced in the code. The majority of the designs are being selected from the conventional, mound, pressure distribution, at-grade, and holding tank component manuals. The quality of written management and contingency plans that are now required for each onsite system design continues to improve. These plans are intended to alert the owners of onsite systems to the need for regular inspection, servicing and/or maintenance. These plans provide for mandatory system maintenance schedules and reporting of maintenance events over the life of the system. To help insure that the maintenance is properly performed, training classes and workshops for "POWTS Maintainers" continue to be offered by private vendors and the University of Wisconsin - Extension. The number of registered POWTS Maintainers continues to increase. This will help insure that the maintenance requirements are met. The Department initiated a "fix-up" Comm 83 code package that is intended to correct errors and clarify certain provisions in the current code. A code council was formed and has met several times to discuss issues and offer recommendations to the Department.

Petroleum Product and Hazardous Substance Storage Tanks

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

Since 1991 the database inventory of petroleum product tanks regulated under Comm 10 has increased from 143,681 to 175,539 tanks as previously unregistered tanks have become registered. In 1991 the database included 68,056 tanks classified as federally regulated with 51,088 of those tanks in use. As of June 17, 2002 the database reflects 78,597 federally regulated tanks with only 12,753 tanks in use. In order to maintain a federally regulated tank in use, the tank must have a valid "permit-to-operate," which is complimented by an annual inspection. Annual inspections involve verification of leak detection, spill and overfill protection, and record keeping. Permit renewal administrative review includes compliance assessment of the owner's financial responsibility.

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

The closure of underground storage tanks is being supplanted by private fueling moving to retail fueling and some operators moving storage tanks to above ground. Residential heating fuel has not been significantly impacted, as the closures are generally associated with the conversion to natural gas or liquid propane gas (LPG). Existing aboveground bulk storage facilities were subject to release prevention upgrade requirements in 2001 providing an enhanced measure of environmental protection over the former levels of acceptance.

Proactive educational outreach efforts and annual inspections by the Department and its agents have resulted in a high level of regulatory compliance, and a reduction of system failures and environmental contamination. Wisconsin's progress continues to reflect very favorably with the US EPA.

Petroleum Environmental Cleanup Fund Act (PECFA)

The PECFA program from August 1989 through April 2002 has reimbursed petroleum storage tank system owners approximately \$1.15 billion to remediate petroleum contamination both in the soil and groundwater. The program, in addition to auditing owner invoices and authorizing payments, performs technical reviews of site investigations, remedial options, and grants closures for 65% of the State's LUST sites.

The budget bill passed in late August 2001 increased the bonding authority by \$72 million to a total of \$342 million. The proceeds from the sale of revenue bonds have been used to "pay down" the backlog of audited claims awaiting payment. The debt service that resulted from the original bond sales reduced the annual spending authority to \$75 million in FY 02 and \$68 million in FY 03. In FY 02, PECFA reimbursed close to 1,900 claimants a total of over \$115 million dollars. Currently PECFA is making reimbursement payments approximately 6 months after the claim is received. The petroleum inspection fee supports PECFA's spending authority.

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

For more information, visit the following web site (<http://www.commerce.state.wi.us>) or contact Cathy Cliff, ERS Division Administrator, P. O. Box 7839, Madison, Wisconsin 53707-7839, phone: 608-266-9403, fax: 608-267-1381; e-mail ccliff@commerce.state.wi.us.

DEPARTMENT OF HEALTH AND FAMILY SERVICES

Chapter 160, Wis. Stats., directs the DHFS to recommend health-based enforcement standards for substances found in groundwater and specifies the protocol for developing the recommended standards. Recommended standards are sent to the DNR and are submitted through the rule-making process as amendments to ch. NR 140, Wis. Adm. Code. In the fall of 2001, DHFS staff completed work on recommendations for two additional groundwater enforcement standards and revisions of three existing enforcement standards. The proposed standards were approved for public hearing by the Natural Resources Board in June of 2002. After the hearings, the public comments received will be reviewed and responses prepared before final recommendations are made to the Board.

DHFS staff are the primary resource for information about the health risks posed by drinking water contaminants, and are charged with investigating suspected cases of water-borne illness. Toxicologists, public health educators, and epidemiologists employed in the Department's Division of Public Health present this information to the public at meetings and conferences, and provide direct assistance to Wisconsin families via home visits, letters to well owners, and telephone consultations. DHFS staff review correspondence sent to well owners by DNR representatives. The agency provides additional advice to owners of wells that are highly contaminated with volatile substances such as benzene and vinyl chloride, especially in cases where the contaminants may pose concerns from inhalation of indoor air. Follow-up letters sent by DHFS explain the health effects of the specific contaminant(s) and suggest strategies for reducing exposure until a safe water supply can be established. DHFS also prepares and distributes a wide variety of informational materials on groundwater and drinking water issues related to human health.

DHFS staff have been active in research and outreach activities relating to naturally-occurring arsenic in groundwater in Winnebago, Outagamie and Brown Counties. Long-term exposure to arsenic in drinking water

has been shown to contribute to increased risk of skin, lung and bladder cancers, as well as a number of cardiovascular and dermatological problems. Other conditions that may be related to arsenic exposure include diabetes and adverse reproductive outcomes. DHFS staff received a grant from the GCC to conduct a follow-up investigation on the relationship between exposure to inorganic arsenic in water and health outcomes. As part of this research effort, local health departments, DNR and DHFS staff, town clerks and others have carried out township-based well sampling campaigns throughout Winnebago and Outagamie counties. More than 2200 families completed questionnaires aimed at assessing arsenic exposure and related health outcomes. Since the first round of sampling efforts, several townships have begun to conduct follow-up well testing campaigns on an annual basis, and some have expanded the scope of the sampling to include nitrate, bacteria and other contaminants of concern. Awareness of arsenic as a public health concern well water should continue to grow in northeastern Wisconsin as a result of these ongoing efforts.

In the summer of 2001, DHFS conducted a survey of households in selected areas of northeastern Wisconsin affected by arsenic in groundwater. The goal of this survey was to assess residents' understanding of their laboratory results, learn what actions people have taken in response to their results, and to identify barriers to increased participation in well sampling campaigns. The survey revealed that more than 80% of those who perceived their well water to be unsafe had taken action to reduce their exposure to arsenic, usually by installing a treatment system or by drinking bottled water. Among those who had not sampled their wells for arsenic, confidence in the safety of their well and lack of information about how to have their water tested were the most commonly cited reasons. Many of those who had not had their wells tested had reported that they had only recently moved into their homes or into the area.

Recent groundwater-related publications and presentations by DHFS staff:

Knobeloch, L.M., and M. Proctor. 2001. Eight blue babies. *Wisconsin Medical Journal* 100: 43-47.

Knobeloch, L.M., and H.A. Anderson. Arsenic-contaminated water and skin cancer in Wisconsin. Presentation given at the 5th International Conference on Arsenic Exposure and Health Effects, San Diego, CA, July 14-18, 2002.

For more information, visit the following web page (<http://www.dhfs.state.wi.us/eh/Water/index.htm>) or contact Henry Anderson (608-266-1253; anderha@dhfs.state.wi.us), Lynda Knobeloch (608-266-0923; knobelm@dhfs.state.wi.us) or Mark Werner (608-266-7480; wernema@dhfs.state.wi.us), 1 W. Wilson St., Rm. 150, Madison, Wisconsin, 53701.

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

The Wisconsin Geological and Natural History Survey (WGNHS) performs basic and applied groundwater research and provides technical assistance, maps, and other information and education to aid in the management of groundwater resources. The WGNHS groundwater program is complemented by geology and soils programs that provide maps and research-based information essential to the understanding of groundwater recharge, occurrence, quality, and movement. WGNHS researchers collect and describe geologic samples from 250 wells per year.

In FY 02, the WGNHS continued to respond to requests for information and assistance from other local, state, and federal agencies, consultants, students, and the public. These requests ranged from the simple, "What will I find underground if I dig or drill here?" to more complex questions about groundwater flow, contaminant transport, or wellhead protection. Public information, records, and research results that the WGNHS stores and disseminates save the considerable expense of gathering the same geologic or groundwater information several times for different purposes, or "re-discovering" the same information over time.

Well Records and Statewide Well Network

Well records. The WGNHS serves as the repository for Well Constructor's Reports, one- to two-page reports that are usually submitted to the DNR by a well driller within a few years of a well's completion. In cooperation with the DNR, the WGNHS continues to review, sort, and catalog approximately 18,000 Well Constructor's Reports per year. Approximately 400,000 of these reports are on file at the Survey. The 1999 initiative to carry out computer scanning and basic database entry for all Well Constructor's Reports in the WGNHS files to support DNR's source-water assessment program has been completed.

The database and scanned images are now available to state agencies, consulting firms, and private well owners on CD-ROM. The computerization of these records will allow WGNHS to streamline our record keeping and provide better, more usable information to the public. Locational information of the Well Constructor's Reports is continually scrutinized and updated during our county and regional studies. The development of a separate statewide database for approximately 36,000 geologic logs and drillholes that have complete lithologic information will be continued.

Statewide groundwater level network. The statewide groundwater level monitoring network has been operated jointly with the USGS since 1946. Currently, the network consists of approximately 140 wells, in 66 counties. Over the past few years six shallow wells in the network have been replaced with wells of similar construction at the same locations because the original well screens were becoming plugged. The groundwater level monitoring network provides a consistent, long-term record of fluctuations in water levels in deep and shallow aquifers. Such information is critical for accurate analyses of the effects of high capacity wells pumping, the response of groundwater levels to droughts, and the effects of land-use changes on groundwater systems. The long-term data are also used for calibration of regional groundwater models.

In FY 03 the WGNHS, in cooperation with the USGS, will continue to compile and interpret data from the statewide network and will make the data available on the USGS web site at <http://wi.water.usgs.gov/gw/>. In addition, the WGNHS will continue to evaluate individual wells in the network for optimum data value at minimum cost. The WGNHS will continue to supply the information to public and private clients and aid in data interpretation.

County and Regional Groundwater Studies

County studies. Geologic and groundwater studies at the county scale continue to be an important part of WGNHS programs. During FY 02 the Survey carried out the following county-based groundwater studies:

- Dane County:** Continued updates of the regional groundwater flow model; continued model simulations for local municipalities and industries; initiation of a two-year study on the effects of new rural subdivisions on groundwater; assistance with University-based research projects on springs and wetlands in the county.
- Fond du Lac County:** Development (with D. Cherkauer, UW-Milwaukee) of a preliminary groundwater flow model of the county for use in the DNR source water assessment (SWAP) programs.
- La Crosse County:** Preparation of a report on the hydrogeology of the county (scheduled for completion in FY 03); detailed studies of the hydrogeology beneath bedrock ridges in the county.
- Sauk County:** Completion of depth to bedrock and water-table maps at 1:100,000 scale; completion of documentation for delineation of zones of contribution for municipal wells and presentation of project results at a series of public meetings in Sauk County as part of the SWAP program.

Rock County: Development of groundwater flow models for the SWAP program; delineation of contributing areas for municipal wells in the county.

Geologic and hydrogeologic analyses in southeastern Wisconsin. In the past several years, much public attention has been focused on the problem of ensuring an adequate and inexpensive supply of potable water to southeastern Wisconsin for the next century. The southeastern Wisconsin communities of Waukesha, Brookfield, Germantown, Menominee Falls, and Pewaukee, among others, are prohibited by the Great Lakes Charter from diverting water out of the Great Lakes Basin, which precludes them from drawing surface water from Lake Michigan. Water utilities in these areas are concerned that rapidly falling groundwater levels indicate that water supply will not be able to keep pace with development. In response to these concerns, the Southeastern Wisconsin Regional Planning Commission (SEWRPC) joined with the WGNHS and USGS to carry out a quantitative study of the deep aquifer system. This deep system, known as the sandstone aquifer, provides most of the water to the high-capacity wells serving municipalities in southeastern Wisconsin. Funding for much of this work was obtained from SEWRPC and participating water utilities.

During FY 02, the WGNHS, SEWRPC, and the USGS developed and calibrated a regional groundwater flow model for southeast Wisconsin. During FY 03 the project team will use the model to simulate various water management scenarios proposed by SEWRPC and the participating water utilities. The model will also be used to delineate zones of contribution to all municipal wells in the SEWRPC region with additional support from the DNR's SWAP program. During FY 03 the project team will prepare written reports on model development and management scenarios for the SEWRPC project.

One notable offshoot of the SEWRPC project has been the acquisition of new borehole geophysical data. Over the past few years, with DNR support, the WGNHS has significantly upgraded its geophysical logging capabilities and experience. During FY 02 the WGNHS worked with water utilities and their engineering consultants to collect new geophysical logs (temperature, gamma radiation, electrical properties, borehole flow, fluid properties, and water samples) from several deep (approximately 2,000 ft) municipal wells in southeast Wisconsin. These datasets are invaluable for improving the understanding of deep bedrock units and groundwater flow in the area. During FY 03 the Survey will continue to collect new geophysical logs from deep wells as they become available due to pump maintenance or other work.

Since 1999 the WGNHS, with DNR support, has carried out significant research on the hydrogeologic properties of the Maquoketa shale, the regional bedrock confining unit in southeastern Wisconsin. This unit controls downward movement of groundwater from the shallow aquifer to the deep sandstone aquifer and helps protect the sandstone aquifer from contamination. In FY 03 the Survey intends to prepare a publication summarizing this work. In late 2001 the WGNHS received a grant from the American Water Works Association Research Foundation (AWWARF) for additional study of bedrock aquitards. This project will be carried out cooperatively during FY 03 with Dr. John Cherry at the University of Waterloo (Ontario) and will focus on aquitards in Dane County and southeastern Wisconsin.

Groundwater Research Activities

Arsenic in Groundwater. The WGNHS, with DNR support, is carrying out research on the source(s) and geochemical characteristics of arsenic contamination in water-supply wells in northeastern and southeastern Wisconsin. In FY 02 the WGNHS completed field experiments in the Fox River Valley that evaluated mechanisms of arsenic release to groundwater from domestic wells completed in the St. Peter sandstone aquifer, including studies of arsenic exposure to residents in the area and the effects of well chlorination on arsenic levels. Results of this study were presented to DNR Drinking Water and Groundwater Program staff and used by the DNR to develop well construction guidelines for the Towns of Algoma and Omro. Results were also presented at several public meetings held in Winnebago County regarding the water supply for a proposed ethanol plant. The results of this research, conducted cooperatively with the USGS and with J. Antonio Simo of the UW-Madison Department of Geology and Geophysics, will be published in FY 03.

In FY 03, the WGNHS will begin a two-year study of sources and mechanisms of arsenic in groundwater in southeastern Wisconsin, emphasizing impacts to sand and gravel and shallow bedrock aquifers in Walworth County. This work has developed from a preliminary study of water quality in the area conducted by the WGNHS with DNR support in FY 01.

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

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

Over the past few years, the WGNHS has developed a program of research and public education on groundwater movement in carbonate rocks and has provided assistance to various agencies facing carbonate-rock problems. Examples of recent work include verification of capture zones for municipal wells at Sturgeon Bay, investigation of groundwater under carbonate ridges in La Crosse County, and development of groundwater models for carbonate-rock areas in southeast Wisconsin. During FY 03 the WGNHS will continue these activities. WGNHS staff members are also involved in professional short courses on fractured-rock hydrogeology.

Karst features, including a variety of sinkholes, cavities, and solution openings, commonly are found in carbonate rock (limestone and dolomite). Environmental problems associated with karst features include rapid groundwater contamination, unpredictable groundwater flow, difficulty in groundwater monitoring, and unexpected failure or collapse of surface structures such as roads and foundations. In recent years there has been increased concern about the hazards and effects of karst features in many parts of Wisconsin, but little published information has been available. The WGNHS is serving as a clearinghouse for karst information, and has begun assembling a karst database for the state (<http://www.uwex.edu/wgnhs/karst.htm>).

During FY 03 the WGNHS will continue to provide data and consultation on karst issues as requested by various units of government and the public.

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

Research projects completed this year or in progress include:

1. Hydrogeology of Sauk County
2. Hydrogeology of Rock County
3. Hydrogeology of La Crosse County
4. Field verification of well capture zones for the City of Sturgeon Bay
5. Hydrogeologic properties of the Maquoketa shale
6. Hydrostratigraphy of southeast Wisconsin
7. Regional groundwater flow model of southeastern Wisconsin

8. Hydrogeology of Dane County
9. Investigation of arsenic contamination of groundwater in northeastern Wisconsin
10. Development of new methods for determining groundwater recharge rates
11. Review of material submitted regarding proposed mine near Crandon, Wisconsin
12. Investigation of the effects of rural subdivisions on groundwater quality.
13. Source-water protection for Fond du Lac County

Groundwater Education

WGNHS groundwater education programs for the general public are usually coordinated with the UW-Extension network of county-based faculty, the DNR, the Central Wisconsin Groundwater Center, or the UW-Extension Environmental Resources Center. The WGNHS also produces and serves as a distributor of many groundwater educational publications and visual aids. Some of these materials are primarily DNR products, but it has proven to be convenient and effective to use our map and publication sales and distribution system.

In October 2001 the WGNHS co-hosted the Midwest Groundwater Conference, a technical conference that drew participants from across the Midwest.

In FY 03 WGNHS staff members plan to participate in groundwater educational meetings in counties where county mapping and/or other hydrogeologic studies are in progress. Arsenic in groundwater and the potential groundwater implications of proposed quarries, gravel pits, and high-capacity wells have been popular topics recently and probably will continue to provide educational opportunities in FY 03. Staff members will also participate in about 20 other general groundwater educational programs throughout the state and teach hydrogeology at fairs and trade shows such as Farm Progress Days and the Water Well Association annual meeting. Several staff members will contribute to professional short courses that educate professionals (such as consultants, regulators, and officials) on technical aspects of well hydraulics, wellhead protection, waste disposal, etc. The WGNHS will also provide two staff members for eight days of instruction at the DNR-sponsored continuing education program for well drillers and pump installers. This is an annual event held at eight locations around the state.

Geologic and hydrogeologic field trips for DNR water staff and new DNR employees have been held in the past and will continue in FY 03. We also provide a collection of representative Wisconsin rocks for teachers to use, which include samples of our major aquifers.

For more information, contact Ken Bradbury, Wisconsin Geological and Natural History Survey, 3817 Mineral Point Road, Madison, Wisconsin, 53705-5100; phone: 608-263-7389; email: krbradbu@facstaff.wisc.edu; web site: <http://www.uwex.edu/wgnhs/>

Recent WGNHS Publications

Miscellaneous Map 41: Depth to bedrock map of Trempealeau County, Wisconsin, 2001. K.J. Cates. (Scale 1:100,000.)

Miscellaneous Map 46: Depth to bedrock map of Buffalo County, Wisconsin, 2001. K.J. Cates. (Scale 1:100,000.)

Miscellaneous Map 52: Glacial landforms of the southern Green Bay Lobe, southeastern Wisconsin, 2002. P.M. Colgan. (Scale 1:100,000.)

Miscellaneous Map 53: Groundwater quality investigation maps of Buffalo County, Wisconsin, 2001. Compiled by P.D. Roffers and K.J. Cates. Plate 1: Nitrate as Nitrogen. Plate 2: Chloride. Plate 3: Laboratory measurement of alkalinity. Plate 4: Total hardness. Plate 5: Laboratory measurement of electrical conductivity. Plate 6: Ferrous iron. (Scale 1:100,000.)

Miscellaneous Map 54: Depth to bedrock map of Sauk County, Wisconsin, 2002. M.B. Gotkowitz and K.K. Zeiler. (Scale 1:100,000.)

Open-File Report 2000-02: Report on the preliminary investigation of arsenic in groundwater near Lake Geneva, Wisconsin, 2002. M.B. Gotkowitz, 24 p.

Open-File Report 2001-01: Field verification of capture zones for municipal wells at Sturgeon Bay, Wisconsin: Final report to the Wisconsin Department of Natural Resources, 2002. K.R. Bradbury, T.W. Rayne, and M.A. Muldoon, 30 p.

Open-File Report 2001-04: Verification and characterization of a fracture network within the Maquoketa shale confining unit, southeastern Wisconsin, 2001. T.T. Eaton, K.R. Bradbury, and H.F. Wang, 35 p.

Open-File Report 2002-02: Delineation of zones of contribution for municipal wells in Rock County, Wisconsin: Final report, 2002. S. Gaffield, M.B. Gotkowitz, and K.R. Bradbury, 48 p.

DEPARTMENT OF TRANSPORTATION

The DOT regulates the storage of highway salt (ss. 85.17 and 85.18, Wis. Stats.) to protect the waters of the state from harm due to contamination by dissolved chloride. DOT is also responsible for potable well sampling at 29 rest areas and 102 waysides. Other DOT groundwater related activities include: road salt research; hazardous material and waste investigation or remediation; wetland compensation and research; and storm water management and research. Various divisions and sections in DOT are responsible for these activities:

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

Salt Storage and Road Application. Highway salt is stored statewide by suppliers, counties, cities, villages, and private companies. Annual inspections occur and reports are provided for salt storage sites to insure that storage practices are in accordance with ch. Trans 277, Wis. Adm. Code (Highway Salt Storage Requirements). The intent of the Code is to help prevent entry of highway salts into waters of the state from storage facilities. All salt must be covered and stored on an impermeable base. The base for stockpiles is required to function as a holding basin and to prevent runoff. The covers must consist of impermeable materials or structures to prevent contact with precipitation. State funded facilities are being added to the DOT salt storage program to provide more indoor storage. This will improve groundwater protection and it creates greater flexibility for scheduling salt purchase at optimal prices.

Current policy in the State Highway Maintenance Manual restricts the spreading of deicer salts to a maximum of 400 pounds per lane mile per initial application, and 300 pounds per lane mile for subsequent applications. Electronic controls for salt spreader trucks are continually tested to record and verify application rates and coverage effectiveness. New technology equipment (e.g., zero-velocity spreaders, ground speed controllers, and onboard liquid pre-wetting units) has been installed on county highway patrol trucks to help keep a greater percent of salt applied to the roadway on the pavement surface. Additional efforts to minimize and conserve salt applications are being pursued by use of an in situ weather monitoring system. This system consists of temperature sensors and remote processing units, which determine and record temperatures of road pavements at

56 separate locations along major highway routes. The pavement temperature information helps determine the sand and salt application rates. Annual training for proper snowplowing and salt spreading techniques is provided for county snowplow operators, and the counties provide weekly reports of salt usage.

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

During the 2001-02 winter season: salt use on the state trunk highway system was approximately 309,000 tons, the lowest use since 1994-95 (295,000 tons); 30 counties used liquid $MgCl_2$ products for pre-wetting or anti-icing applications; 8 counties used one of the agricultural based products either for pre-wetting or anti-icing applications; and 29 counties used salt brine for pre-wetting or anti-icing.

Salt Research - Since 1970, DOT has investigated potential road salt impacts on the environment adjacent to highways. Early investigations (1970s to early 80s) were focused on evaluating road salt impacts to surface water runoff, vegetation, and soils. In the last several years DOT has conducted limited investigations evaluating road salt impacts to groundwater (1 or 2 shallow monitoring wells per site). To date approximately 20 sites throughout the state have been studied. In general, each site is monitored quarterly for a period of 5 years. The monitoring consists of analyzing soil, water, or vegetation samples for calcium, sodium, chloride, and electrical conductivity. Approximately 5 sites are currently monitored, and future groundwater monitoring plans are being evaluated (i.e., longer monitoring periods and multiple well arrangements per site). Results from the studies are discussed in 5 separate DOT progress reports entitled: Investigation of Road Salt Content of Soil, Water and Vegetation Adjacent to Highways in Wisconsin (1972, 1975, 1979, 1989 and 1996). The next progress report is due in 2002.

Hazardous Materials (Petroleum) and Hazardous Waste - As part of the highway improvement program, DOT performs an estimated 25 to 75 environmental assessments annually along right-of-way where potential sources of petroleum or hazardous waste contamination may occur. Assessments consist of standard environmental audits of properties, environmental drilling, and sampling to identify or delineate the extent of soil or groundwater contamination. Numerous contaminated sites are identified as part of the environmental assessment process. This information is shared with DNR so appropriate enforcement and remedial action is taken to protect groundwater resources. In addition, DOT works with DNR and Commerce on 15 to 25 sites per year where underground storage tank removal or other remedial actions are necessary to accomplish highway improvement (e.g., managing the removal, treatment, and disposal of contaminated soils or groundwater). DOT manages about 7,500 to 15,000 tons of contaminated soil per year and about 5 million gallons of contaminated water per year.

Wetlands - Compensatory wetland mitigation is required under section 404 of the Clean Water Act for transportation projects. DOT completed a cooperative study with the US Geological Survey on groundwater of three wetland compensation projects. The final report on this study, *Hydrogeological, Geomorphological, and Vegetative Investigations of Select Wetland Creation and Restoration*, was completed February 1999, and is available. DOT has several ongoing wetland monitoring projects, which evaluate wetland hydrology, water quality and biotic response to constructed mitigation sites.

Since July 1993, DOT has an interagency approved wetland mitigation banking program. In March 2002 the second revision of *Wisconsin DOT Wetland Mitigation Banking Technical Guideline* was agreed upon by the regulatory agencies. This revision allows in addition to wetland restoration and creation the use of preservation for wetland protection, enhancement of existing wetlands and upland buffer to restored or created wetland. Currently wetland loss due to highway, bridge and airport may be compensated through the bank system. As of December 31, 2000, there have been 1,719 wetland acres lost to 958 DOT construction projects throughout the state since 1990. This loss was compensated by 2,434 acres of wetland restoration and creation. Thirty wetland bank sites have been planned and constructed. There are 15 constructed bank sites containing 1,386 available wetland acres. The percent acres compensated through the bank is approximately 60%, while remaining compensation is done on or near specific transportation projects. During calendar year 2001 there were 212

construction projects that caused 394.45 acres of wetland loss, which compensated at bank sites (300.83 ac.), on-site (75.7 ac.) or near-site (114.8 ac.).

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

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

Other Groundwater-Related Research and Projects - DOT is currently participating in a FHWA study investigating methods for treatment of highway runoff which flows directly into karst sinkholes for the purpose of protecting groundwater resources. Another effort to improve water quality from highway runoff includes a research project to evaluate the effectiveness of high efficiency street sweepers for pollutant reduction and participating in a study to verify the effectiveness of various storm water treatment devices.

For more information, visit the following web site (<http://www.dot.state.wi.us>) or contact Ms. Carol Cutshall, Director, Bureau of Environment, Room 451, P. O. Box 7965, Madison, Wisconsin 53707-7965; phone: 608-266-9626, or e-mail carol.cutshall@dot.state.wi.us.

UNIVERSITY OF WISCONSIN SYSTEM

The UWS has research, teaching and outreach responsibilities. These three missions are integrated through cooperation and joint appointments of teaching, research, and extension personnel who work on groundwater issues. In cooperation with other state and federal agencies, groups and individuals, innovative problem-solving approaches to groundwater resource issues are provided to the State's citizens through research, publications, meetings, teleconferences, satellite programs, water testing, and other forms of assistance. Activities of several specific programs follow.

The UW Water Resources Institute (WRI)

The UW Water Resources Institute (WRI) is one of 54 water resources institutes located at land grant universities across the nation. It promotes research, training, and information dissemination focused on the nation's water resources problems. The WRI research portfolio includes interdisciplinary projects in four broad areas: groundwater, surface water, groundwater-surface water interactions, and drinking water. Groundwater is a top priority and an area of particular strength at the Wisconsin WRI. Key areas of emphasis in 2002 included studies of the behavior of mercury in the aquatic environment and investigations into the presence of arsenic in drinking water supplies.

Research. During FY 02 the WRI directed a wide-ranging program of priority groundwater research consisting of 14 projects. The projects included short- and long-term studies, and may be of a fundamental or applied nature. They provide a balanced program of laboratory, field and computer-modeling studies and applications aimed at preserving or improving groundwater quality. The groundwater problems that were investigated include:

- Determination of the importance of groundwater in the production and transport of methyl mercury in Lake Superior tributaries;

- Investigation of denitrification as a basin-scale control of nitrate concentration and export in Wisconsin aquifers;
- Characterization of the hydrologic system in the Driftless Area of Wisconsin, by improving estimates of recharge, hydraulic conductivity, and aquifer storage;
- Examination of groundwater-lake interactions by estimating transient water-level response in lakes and the surrounding aquifer to potential climate change;
- Examination of the influence of groundwater on summer water temperatures in trout streams;
- Identification of ecologically important (adverse) effects of insecticide-polluted groundwater in a sensitive, efficient, cost-effective invertebrate whole animal assay.
- Testing the use of “rain gardens” for receiving runoff and recharging local aquifers;
- Examination of how subdivisions constructed without private sewers may contaminate groundwater;
- Development of thin-film microporous absorbents to remove arsenic from contaminated groundwater;
- Investigation into the use of alfalfa for bioremediation of nutrients in groundwater;
- Investigation into the feasibility of removing heavy metals from contaminated soils using cationic surfactant;
- Development of an efficient and economical method of removing arsenic from groundwater with minimal waste byproducts;
- Examination of methods of removing iron from groundwater and assessing the potential for using these methods to simultaneously remove arsenic;
- Determination of whether stream water can serve as an indicator of groundwater quantity.

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

The UWS selected six new groundwater research projects from this year’s Joint Solicitation for support during FY 03 (July 1, 2002 – June 30, 2003) (see Table 2). Seven projects, selected from the previous year Joint Solicitation, will receive continuation support during FY 03. New projects are based at UW-Madison, UW-Extension, UW-Stevens Point and UW-Whitewater.

Teaching. Institutions within the UWS continue to offer undergraduate- and graduate-level courses and programs focusing on diverse issues regarding groundwater resources. Additionally, several campuses offer for-credit, field-oriented water curriculum courses for middle and high school teachers during summer sessions. The WRI views education as an important component of its total program, and recognizes the importance of K-12 education as a fundamental component of its outreach and training effort. The WRI distributes two publications—*Local Watershed Problem Studies-Elementary Activities* and *Local Watershed Problem Studies-Middle and High School Curricula Guide*—upon request. These two guides assist educators in the development and dissemination of curricula concerning soil and water resources. In addition, the Water Resources Library has purchased a number of other guides with innovative approaches to teaching water-related science in K-12 classes.

Grants Administration. WRI staff members have developed a web page that enables online proposal submission and review of the FY 03 Joint Solicitation of Groundwater and Related Research and Monitoring Proposals. The

site allows investigators to submit proposals one section at a time, rather than waiting until the entire document is complete. Having proposals in electronic format also makes the proposal review process more convenient. Reviewers can simply log on to the site and review proposals at their convenience.

Information Transfer. Results of WRI-supported research are published in a variety of formats. Most WRI research ultimately appears in refereed professional journals, although results are also published in technical reports, conference proceedings and abstracts, book chapters, dissertations and theses, and conference presentations. In addition, WRI disseminates groundwater research results to a wider audience through its web site at <http://www.wri.wisc.edu/>. Staff members maintain a complete list of publications resulting from UWS-funded projects at <http://www.wri.wisc.edu/Publications/66-00pubs.html>. The Water Resources Library makes copies of the publications available to the public.

WRI also assists in disseminating information about DNR, DATCP and Commerce projects funded through the Joint Solicitation. WRI established and continues to maintain the Wisconsin Groundwater Research and Monitoring Project web page at <http://www.wri.wisc.edu/wgrmp/wgrmp.htm>. This site presents summaries of the results of more than 100 completed groundwater research/monitoring projects funded through the Joint Solicitation since 1989, and is updated as projects are completed. The Water Resources Library lends copies of the complete final project reports to the public.

WRI staff has begun redesigning the Groundwater Research and Monitoring Project web page to make it easier to use and more visually appealing. Plans for the redesign include an expanded search capability and the availability of complete final reports in pdf format. Use of the site grew almost 100% from FY 01 to FY 02. Site improvements should make it even more popular and effective in disseminating groundwater-related research results.

The Online Directory of Water Expertise and the Water Resources Library offer other avenues for the dissemination of groundwater-related research information. First put online in 2000, the database contains more than 800 water experts, including groundwater professionals, and can be searched by area of expertise, research interests or name. The database can be found at <http://www.wri.wisc.edu/wriexpertise/index.asp>. Users with an interest in water issues can contact the experts by phone, fax or email. Water professionals can sign up or update their entries online. In June 2002, WRI began a comprehensive update of the database.

Water Resources Library. The Water Resources Library maintains a specialized collection of more than 25,000 water-related publications, 30 journals and 100 newsletters. The collection covers all major topics in water resources, but is particularly strong in groundwater-related publications. A popular service is the K-12 water-related curricula collection. All materials are included in MadCat, the UW-Madison online library catalog, and can be searched at <http://madcat.library.wisc.edu>. The library will assist and lend materials to anyone with an interest in water.

Because the library is located on the UW-Madison campus, the library collection is supplemented by the university's major research collection, numerous online databases and full-text resources. The Water Resources Library also maintains a web site (<http://wri.wisc.edu/library>), which serves as a gateway to water-related information on the Web as well as a guide to the library. Web users can pose questions to AskWater, the library's online reference service. The library's monthly publication, "Recent Acquisitions and Web Sites of Interest," frequently emphasizes groundwater-related publications and web sites, and is distributed widely among university personnel, state agency staff, researchers, consultants, libraries, private organizations and interested citizens.

Media Relations. The institute has a media relations professional on staff, who regularly distributes news releases, media advisories and other information regarding groundwater-related research. A news release sent out in March 2002, regarding new groundwater projects, solicited the interest of several media outlets across the state, most notably WXPB in Rhinelander, which aired an interview with Institute Director for Research James Hurley. Most recently, the WRI issued a news release on new projects funded in July 2002.

Conferences, Meetings, and Presentations. The Wisconsin WRI co-sponsored the American Water Resources Association—Wisconsin Section annual meeting on March 7 and 8, 2002, in Wisconsin Dells, Wisconsin. The title of this year's event was "Sustainability of Wisconsin's Water Resources." Conference speakers explored the threats to water supply and quality resulting from increased urbanization, agricultural expansion, climate change, and population growth. More than 35 contributed papers or posters, covering a range of topics regarding Wisconsin's water resources, were presented. The meeting is unique, in that it especially encourages students to present papers or posters describing their original research. Students funded by the Joint Solicitation are asked to present results of their research at this forum.

The institute also was a co-sponsor of the 46th Annual Midwest Groundwater Conference, which was held in Madison in October 2001. The conference focused on the political and scientific implications of current groundwater issues in Wisconsin, and featured more than 60 contributed papers and posters addressing water resources issues in the Midwest.

For more information, visit the following web site (<http://www.wri.wisc.edu/>) or contact Dr. Anders W. Andren, Director, UW-Madison Water Resources Institute, 1975 Willow Drive, Madison, WI 53706; phone (608) 262-0905, Fax (608) 263-2063, or email awandren@seagrant.wisc.edu.

UW-Extension Water Programs

Central Wisconsin Groundwater Center. The Central Wisconsin Groundwater Center provides groundwater education and technical assistance to the citizens and governments of Wisconsin. Programs range in breadth from answering citizen questions to helping communities with wellhead protection planning, describing the extent and causes of groundwater nonpoint pollution in Wisconsin, and examining groundwater quantity issues. The Center is an office of UW-Extension located at UW-Stevens Point, and frequently works through county Extension faculty in program delivery. More information can be found at the Center's web site: <http://www.uwsp.edu/cnr/gndwater/>.

In 2001, the Center assisted nearly 2800 households in having their water tested in conjunction with county Extension offices and the UW - Stevens Point Environmental Task Force Program. Of these, 11% exceeded drinking water standards for nitrate-nitrogen. Eighteen percent were unsafe because of coliform bacteria. Twelve education programs helped nearly 800 well users in 8 counties understand potential remedies for these problems and the relationship of land use practices to groundwater quality.

Center staff are playing pivotal roles in a number of state groundwater issues. This includes working with stakeholders on groundwater extraction policy and law, and lending leadership to the Wisconsin Academy's Waters of Wisconsin effort. Center staff are also involved with agencies and private organizations, including the Wisconsin Potato and Vegetable Growers Association Nonpoint Pollution subgroup; DATCP Atrazine Technical Advisory Committee; Golden Sands Resource Conservation and Development Area Water Resources Committee; and Extension Nutrient Management Self-Directed Team. Involvement with local watershed based groups includes the Wolf River Basin Partnership and Pigeon River Partnership. The Center has also provided technical assistance to the Portage County Citizens Groundwater Advisory Committee and its subcommittees.

A new effort this year involves using the national Groundwater Guardian program to build the groundwater knowledge and leadership skills of Wisconsin citizens in order to develop a Wisconsin grass-roots groundwater constituency. In partnership with the DNR, the Center has hired a statewide Groundwater Guardian program coordinator. The program has developed outreach materials including a display, presentation, and brochure; made numerous presentations to interested groups; and assisted the seven existing Wisconsin Groundwater Guardian communities in carrying out their activities. More about the Wisconsin Groundwater Guardian program can be found on the web site: (<http://www.uwsp.edu/cnr/gwguardian>).

UWS Farm and Home Environmental Management Program. The UWS Farm and Home Environmental Management Program encompasses voluntary pollution risk assessment and prevention activities, including the

Farm Assessment System (Farm*A*Syst) and Home Assessment System (Home*A*Syst) programs. The “Farm and Home” program enables urban and rural landowners, managers and residents to assess environmental and health risks and to take voluntary actions to prevent pollution. Farm*A*Syst and Home*A*Syst provide fact sheets and worksheets that help farmers and other land managers assess water pollution risks related to their structures, management practices, and site characteristics. The programs are available statewide.

An impact assessment study estimated that concerned citizens nationwide completed at least 46,000 pollution risk assessment worksheets in 1999-2000, and invested at least \$17.5 million to fix problems and prevent pollution. A successful project in Grant County, Wisconsin, has led the County Land & Water Conservation Committee to continue a staff position after grant funds ran out. A follow up survey to participants in the original USDA Environmental Quality Incentives Program (EQIP) project in Grant County found more than one quarter of respondents had invested already in changes linked directly to their Farm*A*Syst experience, and nearly all others listed changes they still intended to make. Ninety percent said they found the program valuable and would recommend it to a neighbor.

The Wisconsin Dairy Environmental Management System builds on the Farm*A*Syst foundation and provides an opportunity for creative response to the forthcoming EPA regulations on Concentrated Animal Feeding Operations. Collaborators in shaping the Wisconsin program include the Wisconsin Dairy Business Association, the Wisconsin Milk Marketing Board, and the Professional Dairy Producers of Wisconsin, as well as DATCP, DNR, and the UWS Nutrient and Pest Management program. A \$2,500,000 grant from USDA, led and administered by the “Farm and Home” program, is supporting similar pilot projects with dairy, beef and poultry producers in 8 states besides Wisconsin. The Healthy Homes Partnership, an offshoot of Home*A*Syst, has just published its new edition of Help Yourself to a Healthy Home – for use in Wisconsin and nationwide. The booklet is a self-help informational workbook that focuses on children’s environmental health, with some attention to actions that protect water quality.

2001 and 2002 Publications:

Reducing Food Safety Risks in Apples. (20-page booklet with background information and risk assessment worksheets.) Co-authored by Richard Castelnovo of the National Farm*A*Syst/Home*A*Syst Office, and Steven Ingham, University of Wisconsin Madison, Food Science Department.

Pesticide and Nutrient Management for Orchards (12-page factsheet/worksheet) and *Seasonal Integrated Pest Management Checklist for Orchards* (8-page worksheet). In conjunction with the National Farm*A*Syst office, co-authored by Charles Edson, Allen Krizek, Roberta Dow, David Epstein, Larry Gut, Amy Irish-Brown, Gary Thornton and Don Lehman of Michigan State University, with private crop consultants Doug Murray and John Bakker.

*Farm*A*Syst/Home*A*Syst Program Impacts Update, Focus: 1999-2000* (40-page booklet). Co-authored by David Eagan with Farm*A*Syst/Home*A*Syst staff.

Environmental Management Systems for Agriculture: Improving Your Environmental and Economic Bottom Line. 12 minute Video. UW Extension.

Help Yourself to a Healthy Home. Protect Your Children’s Health. 2nd Edition. Healthy Homes Partnership.

UW Environmental Resources Center (ERC). The UW Environmental Resources Center (ERC) develops and coordinates a number of national youth water education initiatives related to groundwater. It provides a database of more than 140 youth water-related curricula that may be searched by grade level or water topic. The ERC continues to provide national coordination for a service-learning curriculum, *Give Water a Hand*. The goals of this curriculum are to protect and improve local water quality by encouraging youth to investigate local issues, and plan and complete a service project to address a problem they identify with the assistance of a local natural resource expert. Program materials consist of an Action Guide for youth, with step-by-step instructions for

addressing local watershed concerns, and a Leader Guidebook to assist teachers and youth leaders in facilitating projects. Both guides may be downloaded from the *Give Water a Hand* web site, <http://www.uwex.edu/erc/gwah>. Other ERC youth water education initiatives include: *Agua Pura*, a leader institute planning manual and guide for Latino water education; an evaluation of USGS water education materials to assist with USGS education program development decisions; and gap analyses of youth water curriculum for source water education and riparian education resources. New water education projects include the development of a national riparian curriculum and a collaboration with USDA/CSREES and other federal agency clean and safe water partners to develop and promote best education practices for water education and to improve access to education resources and strategies. Many of these items are posted on the ERC web site at <http://www.uwex.edu/erc>.

UW Nutrient and Pest Management (NPM) program. The UW Nutrient and Pest Management (NPM) program mainly serves Wisconsin farmers and the other agricultural professionals who assist them in making management decisions. A prime focus of NPM programs is to improve nutrient management practices to save money and reduce the potential for nonpoint source pollution. The program's regional staff works one-on-one with farmers in priority watersheds or other critical areas. For instance, NPM is working on a farmer centered environmental assessment and assistance system for St. Croix county dairy producers. The purpose is to encourage the adoption of agricultural practices that protect the farm's water resources. NPM is also part of a team helping create and environmental management system for Wisconsin dairying.

The NPM program revised and distributed the Nutrient Management Farmer Education Program Curriculum that was taught in 16 counties in winter and/or spring of 2000/2001. It continues to lead educational and organizational efforts with Wisconsin's custom manure haulers. These businesses handle manure for hire (almost one third of the dairy manure generated in state) and are crucial for implementing nutrient management plans on many acres. NPM provided leadership and support to start their new professional organization started this year.

A parallel NPM focus is increasing educational programs on integrated pest management to assist farmers moving beyond pesticide-dependent cropping systems. Activities include hands-on IPM training for farmers, publications, and field research and demonstration projects. More information on these efforts and many publications are available at the NPM web site (<http://ipcm.wisc.edu>).

Basin Education Program. The UWS cooperates with other state agencies involved with water resources and natural resource issues. In 1998, UW-Extension entered into a new partnership with the DNR and USDA-NRCS in Wisconsin. This new partnership provides land and water resources education in the state's 22 major river basins. Fifteen Basin Educators work collaboratively with three publication/editorial specialists, two evaluation experts, and one coordinator who works on volunteer-based issues. Collectively this river basin focus works to support other local conservation professionals such as county Extension agents, Land Conservation Department staff, and NRCS staff. This focus on river basins includes drinking water fact sheets, newsletter articles about groundwater, and in some instances, specific watershed studies that address unique water quality problems. More information can be found at <http://clean-water.uwex.edu/index.html>.

Multi-Agency Land and Water Education Grant Program (MALWEG). UW-Extension also coordinates the Multi-Agency Land and Water Education Grant Program (MALWEG) which has funded ten groundwater-focused projects since its inception in 1997. These projects, which totaled over \$170,000 in educational assistance funds, examined the effects of intensive rotational grazing on groundwater quality, provided well testing for rural landowners, and conducted Farm*A*Syst assessments to help farmers identify and address groundwater contamination on their property. Altogether, between January 1, 1997, and December 31, 2001, 106 projects totaling over \$1.4 million have been funded to improve Wisconsin's land and water resources. The source of this money has primarily been the USDA's Environmental Quality Incentives Program. More information can be found at <http://clean-water.uwex.edu/malweg/index.htm>.

For more information on UW Extension groundwater programs, contact Jim Peterson, UW Environmental Resources Center, 1450 Linden Drive, Madison, WI 53706-1562, phone (608) 262-3799, fax (608) 262-2031, or email jopeters@facstaff.wisc.edu, or Chris Mechenich, Central Wisconsin Groundwater Center, College of

Natural Resources, UW-Stevens Point, Stevens Point, WI 54481; phone (715) 346-4270; email gndwater@uwsp.edu.

Wisconsin State Laboratory of Hygiene

At the Wisconsin State Laboratory of Hygiene (WSLH), a great deal of effort is focused on identifying and monitoring chemical and microbial contaminants in groundwater, both through routine testing, specialized research, emergency response, and education and outreach. The testing and research related to groundwater spans several departments at WSLH and, collectively, their efforts make up the WSLH Drinking Water Quality Program. The mission of the WSLH Drinking Water Quality Program is to protect the health of drinking water consumers by providing analytical expertise, research and educational services to the scientific and regulatory communities.

The chemical and microbial groundwater contaminants tested include all contaminants regulated by the federal Safe Drinking Water Act as well as many emerging contaminants that appear on the USEPA Contaminant Candidate List. Examples include: fecal indicators (Total coliform, *E. coli*, Coliphage), *Helicobacter pylori*, *E. coli* O157:H7, *Salmonella*, waterborne viruses, parasites (*Cryptosporidium*, *Giardia*, and microsporidia), radioactivity, inorganic compounds (mercury, nitrate, arsenic) and organic compounds (atrazine, PCBs, PBDEs).

The state and nationally funded research projects conducted by the Drinking Water Quality program at WSLH focus on a variety of topics related to analysis and monitoring of microbiological and chemical contaminants in groundwater. Examples of research projects started or ongoing in FY02 include:

- Development of a culture methods for detection of *Helicobacter pylori* in ground water (WDNR);
- Preservation and survival of *E. coli* in well water samples submitted for routine analyses (WDNR and US EPA);
- Assessment of source waters and drinking waters for estrogenic endocrine disrupters (AWWARF);
- Well chlorination in arsenic-sensitive areas (WDNR);
- Assessment of the ability of mound sand (ASTM C33) to remove microorganisms in column experiments (WDNR and Commerce);
- Virus groundwater surveillance studies (USGS);
- Analysis of secondary metabolites of atrazine using ELISA (WDNR).

Another important focus of the WSLH Drinking Water Quality Program is emergency response to incidences involving groundwater. For example, WSLH works with DHFS and DNR in outbreak investigations of unknown (possibly food or water) origin and provides consultation services during outbreaks, both for local public health officials, local media, and the general public. WSLH also responds to spills and incidents and supports state agencies in remediation and emergency clean-up activities. Most recently, WSLH has focused its efforts on enhancing and expanding terrorism response programs.

WSLH also provides educational and outreach activities related to groundwater and drinking water. Examples include: providing instructional consultations for well owners and well drillers; on-site training of municipal water supply operators; tours for a variety of international, educational, regulatory, and other governmental groups; development of an interactive study guide dealing with safety, sampling, and chemistry for drinking water operators; and attendance, presentations, and paper submissions for a variety of conferences and symposia, and publications related to drinking water.

For more information, contact William Sonzogni, Wisconsin State Laboratory of Hygiene, 2601 Agriculture Drive, Madison, WI 53703, phone (608) 224-6200, or email sonzogni@facstaff.wisc.edu.

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FEDERAL AGENCY PARTNERS

U.S. Geological Survey: Water Resources Division - Wisconsin District

The mission of the U.S. Geological Survey-Water Resources Division is to provide the hydrologic information and understanding needed for the optimum utilization and management of the Nation's water resources for the

overall benefit of the people of the United States. This mission is accomplished, in large part, through cooperation with other Federal, State and local agencies, by:

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

The Wisconsin District is currently conducting cooperative projects that have a significant groundwater component with the DNR, WGNHS, Southeast Wisconsin Regional Planning Commission (SEWRPC), LaCrosse, Dane and Sauk Counties and the Menominee and Stockbridge-Munsee Tribes of Wisconsin. In addition, several projects are funded by Federal agencies: EPA-Region V and USGS. On going projects that have a significant ground-water component are listed below.

Ongoing projects with state and local agencies

1. Ground-water observation well network
2. Wisconsin water-use data file
3. Southeast Wisconsin Hydrologic Study
4. LaCrosse, Dane and Sauk County Groundwater Studies
5. Susceptibility of La Crosse municipal wells to enteric virus contamination from surface water.
6. Hydrologic review of proposed zinc-copper mine near Crandon
7. Delineation of zones of contribution for several Menominee towns
8. Monitoring contaminant flux from a storm water infiltration facility to groundwater

Ongoing projects with Federal agencies

1. Area-wide brownfield assessment – Menomonee Valley, Milwaukee (EPA)
2. Hydrologic and biogeochemical budgets in temperate lakes and their watersheds, Northern Wisconsin (USGS)
3. Western Lake Michigan Drainages National Water-Quality Assessment (USGS)
4. Groundwater/surface water Interaction – Mississippi River, Pool 8 (USGS-Biological Resources Division)

A summary of the Wisconsin District projects and listing of publications is published annually in "Water-Resources Investigations in Wisconsin." Copies of the summary are available at the Wisconsin District Office or by calling 608/821-3801.

For more information please contact Jim Krohelski, USGS, 8505 Research Way, Middleton, Wisconsin, 53562-3581 (608/821-3850), jtkrohel@usgs.gov or visit the Wisconsin District web page (<http://wi.water.usgs.gov>).

USDA Natural Resources Conservation Service

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

- Nutrient management: management of the amount, form, placement and timing of nutrients applied to the soil so that the amount applied is only what is needed to produce optimum crop yield. This reduces the potential for applied nutrients to pollute surface and groundwater.
- Pest management: utilization of environmentally sensitive prevention, avoidance, monitoring and suppression strategies to manage weeds, insects, diseases, animals and other organisms that directly or indirectly cause damage or annoyance. This enhances quantity and quality of commodities. It also minimizes negative impacts of pest control on soil resources, water resources, air resources, plant resources, animal resources and/or humans.
- Animal waste storage: proper waste storage siting and design is imperative to protect groundwater from contamination by nutrients in animal waste.
- Comprehensive Nutrient Management Plan (CNMP): a conservation system unique to livestock farms. It is a grouping of conservation practices and management activities to insure both production and resource protection goals. It addresses soil erosion, manure, and organic by-product impact on surface and groundwater quality. CNMP components include nutrient management based on phosphorus or nitrogen, manure and wastewater handling and storage, adequate erosion control of cropland, and proper record keeping. It may also include feed management to reduce phosphorus in manure and other manure use alternatives such as biofuel production and composting.
- Farm*A*Syst Program: a site assessment program to determine areas of possible groundwater contamination on a farm or rural home - enables individuals to apply management practices to their own property. <http://www.wisc.edu/farmasyst>
- Wetland Reserve Program: restores wetlands through permanent or 30-year easements or 10-year contracts.
- Environmental Quality Incentives Program: provides cost sharing for conservation practices on agricultural land. Statewide priorities include groundwater protection practices such as well decommissioning and nutrient and pesticide management and prescribed grazing.
- Well decommissioning: proper decommissioning is essential to prevent contaminants from entering groundwater through abandoned wells, which are direct conduits to the groundwater.
- Conservation Reserve Program/Conservation Reserve Enhancement Program: participants establish permanent vegetative cover on agricultural lands in return for guaranteed rental payments.
- Dam rehabilitation pilot project: From the 1950s to 1980s, NRCS built 87 small flood control dams in Wisconsin that reduced flooding and improved groundwater infiltration. Since 2000, NRCS has planned or completed the rehabilitation of 9 deteriorating dams in seven western counties as part of a four state pilot project. Planning will begin on 9 more dams soon.

The agency also provides leadership in the following:

- Interagency committee to find improved joint sealers for concrete animal waste storage structures. These sealers are critical to the groundwater protection provided by these structures.
- Interagency Committee to revise NRCS Conservation Practice Standards. Practice Standards benefit the public by helping to protect groundwater. For example NRCS Practice Standard Code 590 – Nutrient Management was recently completed. This revision enhances groundwater protection by minimizing agricultural nonpoint source pollution of surface and groundwater resources.

To find out more information about NRCS, go to the home page at <http://www.wi.nrcs.usda.gov>, contact Renae Anderson at 608-276-8732 ext. 227, or Jim Kaap at 608-276-8732 ext. 266.

GROUNDWATER MONITORING AND RESEARCH

CONDITION OF THE RESOURCE - GROUNDWATER QUALITY

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

Volatile Organic Compounds

VOCs volatilize under normal temperatures and pressures. Examples of VOCs include gasoline and industrial solvents, paints, paint thinners, drain cleaners, air fresheners, and household products (such as spot and stain removers). Short-term exposure to high concentrations of many VOCs can cause nausea, dizziness, tremors or other health problems. Some VOCs are suspected of causing cancer upon long-term exposure.

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

Wisconsin has 80 active, licensed solid waste landfills, all of which are required to monitor groundwater. In addition, the DNR currently tracks more than 9,400 LUST sites, 4,000 waste disposal facilities, and about 1,400 high priority Environmental Repair sites. Many of these sites have been identified as sources of VOCs. Facilities include gas stations, bulk petroleum and pipeline facilities, plating, dry cleaning, industrial facilities, and abandoned non-approved unlicensed landfills.

Landfills. Two studies conducted over a four-year period revealed that out of 45 unlined municipal and industrial landfills, 27 (60%) had VOC contamination in groundwater. All of these landfills are currently closed. Six landfills with liner and leachate collection systems were also sampled and no confirmed VOCs were detected. VOCs contaminated groundwater at 21 (81%) of the 26 unlined municipal solid waste landfills included in the two studies. While 20 different VOCs were detected overall, 1,1 - Dichloroethane was the most commonly occurring VOC at all solid waste landfills. The two DNR publications - "Volatile Organic Compounds in Groundwater and Leachate at Wisconsin Landfills", dated February 1988, and "VOC Contamination at Selected Landfills - Sampling Results and Policy Implications", dated June 1989 - further describe the research results. In a follow-up VOC study conducted from July 1992 through July 1994, the DNR reviewed historical data and sampled groundwater at 11 closed, unlined landfills and at six older, lined landfills. VOC levels have decreased after closure at all but two of the unlined landfills, though at many sites VOC levels do not show continued decline. Also, the level of contamination remains high at many closed sites. No VOC contamination was attributable to leachate migration at any of the six older, lined landfills.

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

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

Underground storage tanks. Wisconsin requires underground storage tanks with a capacity of 60 gallons or greater to be registered with Commerce. This registration program has identified a total of 175,539 tanks as of June 17, 2002 of which 78,597 tanks are regulated by the federal underground storage tank program. Only 12,753 regulated tanks are currently in use. A federally regulated tank is any tank, excluding exempt tanks, that is over 110 gallons in size, has at least 10 percent of its volume underground, and is used to store a regulated substance. Exempt tanks include: farm or residential tanks of 1,100 gallons or less; tanks storing heating oil for consumptive use on the premises where stored; septic tanks; and storage tanks situated on or above the floor of underground areas, such as basements and cellars.

Underground storage tanks over 110 gallons have been federally regulated since 1988. As of August 1, 2002, DNR records indicate there are 3,600 active underground storage tank contamination cleanups and approximately 4,600 open sites. The contaminants most commonly associated with leaks from petroleum underground storage tanks are benzene, toluene, ethyl benzene, and xylene (BTEX compounds). More than 5,000 LUST sites have BTEX groundwater standards exceedances. Drinking water at more than 600 households has been contaminated by leaks from underground storage tanks.

Hazardous waste. Hazardous waste treatment storage and disposal facilities are another VOC source. The DNR Bureau for Remediation and Redevelopment is investigating or remediating contamination at 27 sites. Approximately 140 sites statewide are subject to corrective action authorities. However, only a small percentage will follow the corrective action process because of minimal contamination at the site or jurisdiction under other regulatory authorities.

Generators improperly managing hazardous waste are another source of VOC contamination. All new generator remediation cases statewide and many existing actions are to be addressed in accordance with the NR 700 Wis. Adm. Code series.

Hazardous Substance Spills. The Hazardous Substance Spill Law, ch. NR 292.11 Wis. Stats, requires immediate notification when hazardous substances are discharged, as well as taking actions necessary to restore the environment to the extent practicable. Approximately 800 discharges are reported annually to the DNR, and of those, approximately 65% are petroleum related, with another 15% being agrichemicals. The NR 700 Wis. Adm. Code series, specifically ch. NR 706, contains the requirements for notification when a discharge or spill occurs. Chapter NR 708 contains requirements for taking immediate and/or interim actions when releases occur. Groundwater monitoring is performed when necessary to delineate the extent of contamination. The spills program develops outreach materials to help reduce the number and magnitude of spills and provide guidance for responding to spills. Topics addressed include spills from home fuel oil tanks, responses to illegal methamphetamine labs, and mercury spills, all of which can lead to significant environmental impacts, if not properly addressed.

Pesticides

Pesticide contamination in groundwater results from field applications, pesticide spills, misuse, or improper storage and disposal. Serious concerns about pesticide contamination in Wisconsin were first raised in 1980 when aldicarb, a pesticide used on potatoes, was detected in groundwater near Stevens Point. The DNR, DATCP, and other agencies responded to these concerns by implementing monitoring programs and conducting groundwater surveys.

The DNR and DATCP expanded their sampling programs in 1983 to include analysis of pesticides commonly used in Wisconsin. The most commonly detected pesticides in Wisconsin groundwater are:

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

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

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

Beginning in October 2000 and ending in May 2001, DATCP collected 336 samples from private drinking water supplies to determine the statewide impact of pesticides on groundwater resources. DATCP analyzed the samples for commonly used herbicides including the chloroacetanilide herbicides and their metabolites. This study also was compared to previous surveys to attempt to understand trends in groundwater quality over time. Results from this survey have been summarized in the May 2002 report "Groundwater Quality: Agricultural Chemicals in Wisconsin Groundwater" available at http://datcp.state.wi.us/arm/agriculture/land-water/water-quality/monit_proj.html. A total of seven common herbicides, ten metabolites and nitrate were included in the latest survey. Highlights from this overall study show:

- The estimate of the proportion of wells that contain a detectable level of a herbicide or herbicide metabolite is 37.7%.
- Alachlor ESA and metolachlor ESA are the most commonly detected herbicide compounds with proportion estimates of 27.8 and 25.2%, respectively.
- A significant decline in parent atrazine concentrations between 1994 and 2001.

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

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

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

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

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

Exceedence Survey. In 1995, DATCP completed a re-sampling of 122 Wisconsin wells that previously exceeded a pesticide enforcement standard. Most of the wells in the survey had exceeded standards for atrazine. Most were also within an atrazine prohibition area. Of wells exceeding standards for atrazine, 84% had declined in concentration and 16% had increased. About 50% of well owners continued to use their contaminated well and about 25% had installed new wells at an average cost of \$6,300. This survey has been repeated annually through 2001, with samples collected from 150 different wells at least once during this time period. In 2001, 71 private wells that have historically exceeded groundwater standards were sampled. Thirty-two percent of the wells tested above the atrazine enforcement standard and 68% tested below the standard.

Pesticide and Groundwater Impacts Study. In 1985, DATCP began a 2-year study funded by the Wisconsin Department of Natural Resources (DNR) to evaluate the potential impact of agriculture on groundwater quality. The study focused on areas of the state with high groundwater contamination potential. In 2001, this study entered its 16th program year. In 2001, 29 samples from monitoring wells near 25 agricultural fields were sampled. A total of ten compounds were detected in groundwater. Three of these (nitrate, alachlor ESA and atrazine + metabolites) were found at levels above an existing enforcement standard. Other compounds detected include alachlor, acetochlor ESA, metribuzin, metolachlor and its metabolites ESA and OS, and cyanazine amide.

Monitoring Reuse of Atrazine in Prohibition Areas - In FY 98, DATCP began monitoring the limited reuse of the herbicide atrazine in selected areas where atrazine use has been prohibited. DATCP is gathering data to see if renewed atrazine use at current restricted use rates will cause groundwater contamination. DATCP is monitoring groundwater quarterly at 17 fields, 10-40 acres in size, for 5 years. Although it is too early in the project to make recommendations, 1998 through 2001 summary data showed that atrazine concentrations increased at all but one site. One or more wells at 14 of 17 of sites exceeded the enforcement standard for atrazine (3.0 parts per billion) at some time during the first 3 years of the project. The nitrate enforcement standard was exceeded at 100% of these sites over the same sampling period.

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

In 2000 and 2001, Water Quality Section staff sampled 336 private wells across the state that included 122 of the same wells sampled in 1996. Results of this survey show that the proportion of wells that contained a detectable level of parent atrazine showed a statistically significant decline between 1994 and 2001. However, a decline in total chlorinated residues of atrazine was not apparent.

Nitrate

Nitrate-nitrogen is the most common contaminant found in Wisconsin's groundwater. Detections of nitrate in private water supplies frequently exceed the state drinking water standard of 10 milligrams/liter (mg/L). A 1994 study by WGNHS and DHFS estimated that 9 to 14% of private water wells in Wisconsin exceed the nitrate standard. As part of an analysis to provide baseline groundwater data for the State of the Basin Reports, the most recent nitrate sample from each well in the GRN data base was extracted. Of 10,105 well samples, 2016 (20%) equaled or exceeded the enforcement standard of 10 mg/L. In the same data set, 5113 (50%) were equal to or exceeded the PAL (2 mg/L). A statewide groundwater sampling program completed by DATCP in 2001 estimated that the proportion of private drinking water wells in the state that exceed the 10 mg/L health standard was 14.1%.

Consumption of water that contains high concentrations of nitrate by infants under 6 months of age can induce a condition called methemoglobinemia or "blue baby syndrome." This condition occurs when red cell hemoglobin is oxidized to a form that is unable to carry oxygen to the body's tissues. All infants are at risk of nitrate poisoning, but those suffering from gastrointestinal illnesses appear to be more sensitive than are healthy infants. DHFS staff completed a summary of two cases from southern Wisconsin in which infants developed methemoglobinemia after being fed formula that was prepared with well water (Knobeloch et al. 2000). One of these infants required emergency air transport and life-saving therapy. The nitrate levels involved in these cases ranged from 22.9 to 28 mg/L (as N).

The chronic health effects of nitrate exposure are not well understood; however, many experts believe that long-term exposure may increase the risk of cancer. This theory is supported by some scientific studies. For example, in 1996 researchers in the Netherlands found that residents who consumed water that was high in nitrate had higher levels of cancer-causing nitroso compounds in their urine (Van Maanen et al., 1996). These researchers also found that genes in the blood cells of these individuals had higher numbers of mutations. Two years earlier, these same researchers had reported a link between consumption of high-nitrate water and the incidence of thyroid disorders (Van Maanen et al., 1994). In 1996, a study conducted jointly by the National Cancer Institute, the University of Nebraska, and Johns Hopkins University found an association between nitrate-contaminated water and Non-Hodgkin's lymphoma (Ward et al., 1996). A large cohort study conducted jointly by the University of Iowa, Mayo Clinic and the University of Minnesota found a positive association between nitrate levels in municipal water supplies and the incidence of bladder and ovarian cancer among adult women (Weyer et al. 2001).

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

Nitrate can enter groundwater and surface water from a variety of sources including farm fields, septic tanks, animal feedlots, decaying vegetation, and urban storm water. Contamination is difficult to prevent. Although the Department of Commerce continues to evaluate state-of-the-art septic system designs for nitrate removal, septic tanks continue to be a significant source of nitrate in heavily populated, unsewered areas. DATCP proposed regulatory authority for fertilizer use in the FY 96-97 budget but the proposal was not approved. In 1997, Wisconsin Act 27 required the development of performance standards for a number of agricultural and non-agricultural practices to reduce non-point sources of pollution of surface and groundwater. These performance standards include nutrients applied to cropland and DATCP was directed to develop a nutrient management program. During 2000 and 2001, DATCP and DNR conducted public hearings and proposed changes to their non-point pollution control rules to include nutrient management standards and practices. These rules were adopted by the Natural Resources Board in spring of 2002 and subsequently passed legislative review. The rules will be promulgated in October 2002. Adoption and implementation of nutrient management standards, based on UW recommendations, will reduce the over-application of nitrogen that occurs on some farms. This will dramatically reduce the amount of nitrate that would be available to leach to groundwater.

Owners of nitrate-contaminated water supplies have few options. They do not qualify for well-compensation funding unless the nitrate level in their well exceeds 40 mg/L (as N) and a dairy herd uses the well. In order to establish a safe water supply, they may opt to replace an existing well with a deeper, better cased well or to connect to a nearby public water supply. Alternatively, they may choose to install a water treatment system or to use bottled water. A study published by DHFS in 1999 examined this issue (Schubert et al. 1999). Their survey of 1500 families found that few took any action to reduce nitrate exposure. Of those who did, most purchased bottled water for use by an infant or pregnant woman.

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Biological Hazards

Biological contamination often occurs in areas where there is little natural attenuation potential. This is common in areas where the depth to groundwater or the depth of soil cover is shallow, or in areas of fractured bedrock. Biological agents include bacteria, viruses, and parasites. These agents can cause acute illness and result in life-threatening conditions for some population groups. Approximately 23% of well water samples statewide test positive for total coliform bacteria, an indicator species of other biological agents (Warzecha et al 1995). Approximately 3% of well water samples test positive for *E. coli*, an indicator of water borne disease that originates in the mammalian intestinal tract. The DNR recommends that well owners test for biological quality annually or when there is a change in taste, color, or odor of the water.

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

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

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Naturally-occurring Radioactivity

Naturally-occurring radioactivity in groundwater, including uranium, radium, radon, and gross alpha is becoming an increasing concern. Sampling has identified radionuclides in groundwater in north-central Wisconsin, high levels of radium in water supplies in eastern Wisconsin, and gross alpha problems in northeastern and southeastern parts of the state. Nearly 70 public water systems either exceed or are nearing the drinking water standard of 15 pCi/L for gross alpha activity. The DNR is enforcing the revised radionuclide standard adopted into NR 809 in October 2001. All systems that do not meet the current standards for gross alpha or radium will be asked to submit treatment plans and specifications, and to return to compliance by December 2003.

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

A second study "Factors Effecting the Determination of Radon in Groundwater" will help determine the impact of expected new EPA standards for radon in drinking water. Staff from the DNR will sample about 340 noncommunity, nontransient and other than municipal water systems per year. To date, approximately 250 samples have been collected from nontransient, noncommunity wells. Preliminary results tend to support findings from earlier community water system monitoring which indicated that approximately 50% of the public water systems monitored in Wisconsin exceed the proposed radon standard of 300 pCi/L. As of July 2002, EPA has not finalized the drinking water standard for radon.

Summaries of the gross alpha and radon studies are available on the WSLH web site at <http://www.slh.wisc.edu/radiochem/research.html>.

Arsenic

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

Arsenic bearing geologic units exist across the state. It is found in the igneous rocks of the Precambrian shield, the Paleozoic sedimentary rock, and within glacial deposits. The highest concentrations are present in the sedimentary bedrock. Results from several DNR studies indicate the geochemical phenomena causing the elevated levels of arsenic in groundwater are associated with oxidation of sulfide-mineralized zones within the bedrock aquifers. The main zone of mineralization extends some ten feet below the base of the Platteville Dolomite, which is part of the main upper bedrock formation of this region. If the St. Peter Sandstone is present within the geologic sequence, it lies directly below the Platteville Dolomite and the arsenic-rich mineralized zone then extends about ten feet into this sandstone. Although it is certain that this is the main mineralized zone, experts believe that there are other lateral and vertical occurrences of arsenic-rich strata.

Arsenic Advisory Area - Studies conducted by DNR led to the delineation of the extent of the arsenic contaminated area. This delineation led to the establishment of an "Arsenic Advisory Area" in the early 1990s. This area includes the strip of land five miles either side of the bedrock subcrop of the St. Peter Sandstone, extending in a northeasterly trend, from a location just southwest of Oshkosh, to a location just west of Green Bay. For this area, DNR developed special well construction specifications, more stringent than the minimum Private Well Code requirements. DNR guidance recommends the installation of 80 feet of casing through the sandstone contact for drinking water wells in the AAA. These specifications were recommended, but not required, for new wells constructed within the "Arsenic Advisory Area". The specifications, when followed, will increase the likelihood of installing a well free of arsenic. A special casing and construction area has been established for the Town of Algoma in Winnebago County. In this area, all wells must be drilled with mud/wash rotary methods with a 10-inch upper enlarged drillhole, Bradenhead grout methods and cased to the Cambrian sandstone aquifer.

Ongoing research indicates that casing off the upper parts of the St. Peter Sandstone is usually effective in eliminating or reducing the presence of arsenic in drinking water. However, over the last several years some wells that were constructed according to guidance have exhibited increasing arsenic concentrations and have required replacement or reconstruction. In addition, follow-up testing on 50 replacement wells found that arsenic levels are exceeding standards in at least 5 cases where initially they had been below the ES. Additional sampling of replacement wells will occur in FY 02 to test whether current guidelines are adequate at lowering arsenic concentrations.

Recent information has raised questions about the St. Peter Sandstone – Sinnipee Dolomite contact being the only location where high arsenic concentrations are found. A renewed effort is currently underway to reexamine this problem. In addition, there is evidence to suggest that increased levels of arsenic in this region may be related to increased groundwater consumption³. In many areas, increasing concentrations of arsenic may be a result of the

³ Since the 1950s, groundwater consumption in northeastern Wisconsin has risen significantly due to an increase in population and per capita water use. Thousands of new private wells have been constructed in this region. Municipal and industrial groundwater use has increased. As a result, regional groundwater levels in the sedimentary bedrock aquifers of northeastern Wisconsin have shown a steady long-term decline. The decline has averaged as much as three to four feet per year in the Green Bay area and as much as two to three feet per year in the Fox Cities area surrounding the City of Appleton.

water table dropping to levels at or just below the sulfide rich mineralized zone and then fluctuating up and down across this layer. This fluctuation can allow oxygen in the air to come in contact with and oxidize the sulfide minerals in this layer. This initial oxidation can then trigger a complex set of geochemical reactions that can eventually release arsenic into the groundwater. Once this reaction has been initiated it is likely to continue.

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

On October 31, 2001 EPA announced that the Federal Drinking Water Standard for arsenic would be lowered from 50 parts per billion ($\mu\text{g/L}$) for public water systems to 10 $\mu\text{g/L}$. EPA had previously delayed the rule in order to look at new studies regarding the health effects and to analyze economic issues associated with arsenic especially costs to small systems. The new standard became effective in February 2002 and compliance must be reached by 2006. The arsenic rule affects municipally owned water systems and those that serve an average of at least 25 people daily for six months of the year, among them schools, mobile home parks, apartment buildings, day care centers, and factories.

Raw water samples submitted as part of a DNR and State Laboratory of Hygiene study indicated that approximately 80 public water systems contain arsenic levels exceeding 10 $\mu\text{g/L}$. However, some of those systems are already reducing arsenic to the federal health standard when they treat their raw water for other contaminants, such as iron. The 80 systems are equally divided among the Municipal, Other Than Municipal, and Non Transient Non Community water system categories.

The new standard also raises questions for private water supplies, particularly in regards to health risks associated with drinking water with moderate levels of arsenic (between the old and new standards). Historical data indicates that 37% of the wells in the 4-county area affected by arsenic exceed 5 $\mu\text{g/L}$, while 20 percent are over the new standard of 10 $\mu\text{g/L}$. In FY 01, the DHFS received funding to conduct a follow-up investigation on the relationship between exposure to inorganic arsenic in water and health outcomes. As part of this research effort, local health departments, DNR staff, town clerks and others have conducted well sampling campaigns in 21 townships in the affected counties. Several other towns have offered similar well testing programs. 2233 households have submitted samples and returned health surveys, providing health and exposure information for 6669 individuals. In two of the townships, almost 50% of the samples tested in the current campaign exceed 5 $\mu\text{g/L}$ while 34% exceed 10 $\mu\text{g/L}$.

CONDITION OF THE RESOURCE - GROUNDWATER QUANTITY

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

In 1997, the Wisconsin Groundwater Coordinating Council (GCC) addressed groundwater quantity issues in a report entitled "Status of Groundwater Quantity in Wisconsin." The Groundwater Section of the DNR's Bureau of Drinking Water and Groundwater prepared this report with the assistance of a Technical Advisory Committee (TAC). The full report is available from the DNR and may be downloaded at <http://www.dnr.state.wi.us/org/water/dwg/gw/Pubdwld.htm>. Some of the findings of the report are:

- Despite a general abundance of groundwater in Wisconsin, there is a growing concern about the overall

availability of good quality groundwater for municipal, industrial, agricultural, and domestic use and for adequate baseflow to our lakes, streams, and wetlands. Groundwater quantity problems have occurred naturally and from human activities.

- The effects of groundwater withdrawals are well documented on a regional scale in the Lower Fox River Valley, southeastern Wisconsin, and Dane County. There are substantial declines in groundwater levels in these three areas. Localized effects from groundwater withdrawals are not as well documented as the regional effects. Cases exist around the state where wells, springs, and wetlands have gone dry; lake levels have dropped; streamflow has been reduced; and contamination has prevented installation of new wells.
- The availability of groundwater may also be affected by groundwater quality, both due to naturally-occurring substances in groundwater and human-caused contamination.
- Groundwater use grew from 570 to 754 million gallons per day (Mgal/d) from 1985 to 1995.
- Groundwater withdrawals can affect both groundwater and surface water.
- There is an ongoing effort by state and federal agencies and university staff to gather data and information on groundwater quantity issues. However, additional information is needed to increase our understanding of groundwater-surface water interactions, identify areas with groundwater quantity problems, and determine the impacts of groundwater withdrawals.
- The DNR is the "central unit of government to protect, maintain, and improve the quality and management of the waters of the state, ground and surface, public and private." Other agencies involved in groundwater quantity issues include the WGNHS, Central Wisconsin Groundwater Center, GCC, Public Service Commission, the USGS, local units of government and water utilities.
- Groundwater quantity will continue to be an issue of concern in Wisconsin. A coordinated effort is needed to determine appropriate management options for addressing groundwater withdrawals, to prioritize information needs, and to implement information and education programs. Funding is needed for additional data collection and research to address groundwater quantity management issues.

Since publication of that report, other developments have further highlighted the importance of groundwater quantity. Two communities, Green Bay and Oak Creek, have proposed aquifer storage and recovery as a method for addressing water shortages. Aquifer storage and recovery (ASR) involves injecting treated water into the aquifer during times of less groundwater use and pumping that water out when water demand is high, typically during the summer. Both communities are working with the WDNR on pilot studies to determine if this is feasible in Wisconsin. In addition, the communities around Green Bay are considering whether to construct a pipeline as Green Bay has done to withdraw water from Lake Michigan.

One of the impacts of groundwater over-pumping in the Lower Fox River Valley has been increased detections of arsenic in private well water in recent years. Some of the arsenic concentrations found in groundwater have been quite high, with 20% of wells sampled over the new standard of 10 ppb. Investigations in the affected area indicate that most of the arsenic is coming from a highly mineralized zone at the top of the St. Peter Sandstone. It appears that over-pumping in the Lower Fox River Valley has drawn down the bedrock aquifer to such an extent that the mineralized zone is exposed to the atmosphere and becomes oxidized, releasing arsenic.

In 2000, Perrier proposed installing one or more wells in the Big Springs area in southeastern Adams County to pump out groundwater to be bottled and sold as spring water. Many local residents opposed the Perrier proposal because of concern about potential impacts to the spring. The WDNR issued an approval with conditions to protect the aquifer. The proposal highlighted the issue that, for high capacity wells, the WDNR only had authority to approve a high capacity well application if it is determined that the new well will interfere with a municipal water supply well.

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

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

The report is entitled "Modernizing Wisconsin Groundwater Management: Reforming the High Capacity Well Laws" and is available from the Department of Urban and Regional Planning, UW-Madison/Cooperative Extension, 112-A Old Music Hall, 925 Bascom Mall, Madison, WI 53706 for \$7.00 per copy. (Also available at <http://www.wisc.edu/urpl/people/born/index.html> under "Projects.")

Groundwater quantity was an important topic at the Groundwater Summit held October 30, 2001. Common themes in the afternoon breakout sessions included the need for a statewide management plan for water quantity, water conservation, high capacity well reform, reevaluation of water pricing structures and regional approaches to water quantity issues. At the conclusion of the Summit, 87.5% of those who filled out an evaluation form agreed that there is a need for a statewide groundwater quantity strategy in Wisconsin. 100 per cent of evaluation form respondents agreed that we are not doing enough to protect groundwater quantity in the state.

COORDINATION OF GROUNDWATER MONITORING AND RESEARCH

The GCC provides consistency and coordination among state agencies in funding groundwater monitoring and research to meet state agency needs. Four state agencies have made up to \$750,000 available each year for groundwater-related monitoring or research. Approximately \$11.4 million has been spent through FY 02 on 291 different projects dealing with groundwater or related topics (see Table 3 in Appendix). The sources of money and purposes of monitoring or research include:

1. **DNR Management Practice Monitoring** - The DNR has had approximately \$300,000 available each year since FY 86 to support groundwater monitoring studies evaluating existing design and/or management practices associated with potential sources of groundwater contamination. The intent of these studies is to reduce the impacts of potential sources of contamination by changing the way land activities that may impact groundwater are conducted. The money comes from the Groundwater Account of the Environmental Fund (which is funded by various fees). Through FY 02, the DNR has spent approximately \$5.4 million on 160 monitoring projects. Several of these projects have been co-funded with DATCP, Commerce and/or UWS.
2. **UWS Groundwater Research** - The UWS, through its UW-Madison Water Resources Institute (WRI), has received funding since FY 90 for groundwater research. Through FY 02, the UWS has spent \$3.8 million on 107 groundwater research projects. Several projects have been co-funded with DNR, Commerce and/or DATCP and seven were co-funded with WRI through the US Geological Survey.
3. **DATCP Pesticide Research** - Since 1989, DATCP has had approximately \$125,000 available annually as a result of the pesticide law to fund research on pesticide issues of regulatory importance. The money comes from fees paid by pesticide manufacturers to sell their products in Wisconsin. Through FY 02, DATCP has spent about \$1.7 million on 42 pesticide projects. Several of these projects have been co-funded with DNR and/or UWS.
4. **DILHR/Commerce Private Sewage System Research** - The Division of Safety & Buildings (formerly in the Department of Industry, Labor, and Human Relations) received a special GPR appropriation of \$50,000 from 1990 to 1993 to fund research on alternatives to current private sewage system technology.

In 1994, when the appropriation expired, \$75,000 generated through plan review and licensing fees became available each year for research on private sewage systems. Through FY 02, DILHR/Commerce has spent approximately \$600,000 on eight projects. Two projects were co-funded with DNR and UWS.

The Joint Solicitation

In 1988, the GCC requested that the UWS create a Groundwater Research Advisory Council (GRAC) to establish a long-range groundwater research plan and develop a groundwater research decision item narrative (DIN) for inclusion in the University's biennial budget. The GRAC consists of university, state agency, and public representatives. During the summer of 1990, the GRAC and GCC developed and endorsed a plan to coordinate the solicitation of projects for funding in FY 92 and subsequent years. The joint solicitation provides for only one submittal of project proposals, rather than four as had been the case. The intent of the joint solicitation is to determine the most appropriate funding source for a particular project.

Statutory language requires that there be agreement between the UWS and the GCC on the use of the UWS research funds before the funds can be released by the Department of Administration. To expedite this agreement, a MOU was signed in 1989 and 1991 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. This MOU will be reviewed and updated in FY 03 to reflect current practices and clarify the intent of the monitoring and research funds in light of potential limited budgets in the future.

FY 02 Joint Solicitation. The joint solicitation for FY 02 was distributed in September 2000. A total of 30 project proposals were submitted in response to the joint solicitation. To assist in the review process, a joint meeting of the Monitoring & Data Management and Research Subcommittees of the GCC was held in December 2000 to review and rank the projects that were submitted for funding. As a result of the subcommittee meeting, the GRAC meeting in February, and review of the proposals by agency staff, 21 new projects were selected for funding in FY 02. Eleven on-going projects were carried over into FY 02. A total of 33 projects were funded through the joint solicitation at a cost of approximately \$877,500 (see Table 1).

FY 03 Joint Solicitation. A joint solicitation for project proposals by the UW System, DNR, and DATCP was distributed in September 2001 for funding in FY 03. The joint solicitation package contained a listing of the monitoring and research priorities for each of the agencies, as determined by agency staff, the GRAC, and members of the GCC Monitoring & Data Management and Research Subcommittees (see Appendix). The deadline for proposals was November 19, 2001.

This year, WRI staff members developed a web site that allowed investigators to submit proposals online and reviewers to simply log on to the site to review proposals at their convenience. 38 proposals were submitted, representing 11 institutions or campuses and requesting over \$1 million in funding. A minimum of 3 external peer reviews was solicited for each proposal from experts within the field. GCC Subcommittee members and agency staff also reviewed the proposals and met in January to rank the 38 proposals submitted. In addition, the GRAC met in February to select projects to recommend to the GCC for UWS funding.

Seven of the 38 proposals received will be funded in full or in part through the joint solicitation process. State budget shortfalls severely limited the number of new projects that were selected for funding during FY03. However, with the assistance of Federal (USGS) dollars leveraged through the Water Resources Institute, all of the continuing projects that began in FY 02 will be funded through FY 03. The GCC directed that a letter be sent to the secretary of each of the agencies represented on the GCC asking that funding for groundwater monitoring and research activities be restored in future years (see Appendix). The projects to be funded in FY 03 are listed in Table 2 and online at <http://www.wri.wisc.edu/index.html>.

Distributing Project Results

Final reports are required for each project funded through the Joint Solicitation. Reports from UWS funded projects are kept in the Water Resources Institute Library. DATCP, Commerce, and DNR funded reports are kept on file with the respective agencies, but many are provided to the WRI Library for public distribution as well. All project investigators must submit a 2-page Project Summary upon completion of the final report. These summaries are made available on the WRI web site (<http://www.wri.wisc.edu/wgrmp/wgrmp.htm>). Over 100 summaries are currently provided. Summaries from older reports are printed in *Wisconsin Groundwater Research and Monitoring Project Summaries* (DNR PUBL-WR-423-95 and DNR PUBL-WR-205-90) both of which are available from the WRI Library or the DNR.

Projects funded through the Joint Solicitation have provided valuable information regarding the Wisconsin's groundwater resources, helped evaluate existing regulatory programs, increased the knowledge of the movement of contaminants in the subsurface, and developed new methods for groundwater evaluation and protection. The next section, *Benefits from Monitoring and Research Projects*, highlights some of these projects and illustrates how agencies have used the project results to improve the management of the state's groundwater resources.

Other Coordination Activities

The GCC attempts to compile information about other groundwater research programs within Wisconsin. To this end, groundwater-related research projects funded through the Fertilizer Research Council in FY 01 and 02 are listed in the Appendix. Staff from the GCC, the WFRC, and DATCP met in February of 2002 to discuss ways to identify common research needs, share information about submitted proposals, and communicate research findings. Some preliminary efforts to bring these two processes closer together will be made during the FY 04 Joint Solicitation.

The GCC continues to contact other states with groundwater research programs to prevent research duplication and to make efficient use of limited research funds. The strategy for interstate coordination of groundwater research consists of identifying groundwater research program contacts in each neighboring state and sending each contact information on the GCC, the joint solicitation process, the state groundwater monitoring and research programs, and the project summaries.

Table 1: Groundwater Projects Funded through the Joint Solicitation for FY 02

<i>Agency Title</i>	<i>Author(s)</i>	<i>Affiliation</i>	<i>FY 02 Budget</i>
<i>DATCP</i>			
*Pesticide and nitrate leaching in soils receiving manure	B. Lowery, F. Arriaga, and D. Stoltenberg	UW-Madison	\$18,380
*Effectiveness of phytoremediation and hydrogeologic response at an agricultural chemical facility in Bancroft, WI	W. DeVita and M. Dawson	UW-Stevens Point	\$16,400
Chloroacetanilide and Atrazine Residue Penetration and Accumulation in Two Wisconsin Groundwater Basins	W. DeVita, P. McGinley, and G. Kraft	UW-Stevens Point	\$32,349
Agrochemical Leaching from Sub-optimal, Optimal, and Excessive Manure-N Fertilization of Corn	J. Norman and K. Brye	UW-Madison	\$43,187
<i>The total cost for all projects funded by DATCP in FY 02, including the co-funded projects below is \$135,000.</i>			
<i>DNR</i>			
*Geologic and geochemical controls on arsenic in groundwater in northeastern Wisconsin	M. Gotkowitz, T. Simo, D. Krabbenhoft, M. Schreiber, & R. Hunt	WGNHS, UW-Madison & USGS	\$35,478
*Development of analytical methods for comprehensive chemical and physical speciation of arsenicals in groundwater	J. Aldstadt	UW-Milwaukee	\$31,450
*New approaches to the assessment of microbes in groundwater: application to monitoring bioremediation and detection of pathogens.	M. Collins	UW-Milwaukee	\$37,910
*An analysis of arsenic replacement wells to determine validity of current DNR well construction guidance	K. O'Connor and K. Lauridsen	DNR	\$21,276
*Public health impacts of arsenic contaminated drinking water	L. Knobeloch, L. Hanrahan, H. Anderson, and M. Weisskopf	DFHS	\$28,912
Nitrate Loading History, Fate, and Origin for Two Wisconsin Groundwater Basins	G. Kraft	UW-Stevens Point	\$32,754
Susceptibility of La Crosse Municipal Wells to Enteric Virus Contamination from Surface Water Contributions	R. Hunt and M. Borchardt	USGS & UW-LaCrosse	\$49,704x
Monitoring Contaminant Flux from a Stormwater Infiltration Facility to Groundwater	C. Dunning and R. Bannerman	USGS & DNR	\$22,600x
Preservation and Survival of <i>E. coli</i> in Well Water Samples Submitted for Routine Analyses	W. Sonzogni, J. Standridge, and M. Bussen	WSLH	\$24,990x
Development of a Culture Method for Detection of <i>Helicobacter pylori</i> in Groundwater	W. Sonzogni, J. Standridge, and M. Hamacher	WSLH	\$24,851x
Time Domain Electromagnetic Induction Survey of the Sandstone Aquifer in the Lake Winnebago Area	R. Taylor and J. Jansen	UW-Milwaukee	\$33,530
Delineation of High Salinity Conditions in the Cambro-Ordovician Aquifer of Eastern Wisconsin	T. Grundl and R. Taylor	UW-Milwaukee	\$28,779
Importance of Disinfection on Arsenic Release from Wells	W. Sonzogni, G. Bowman, J. Standridge, and A. Clary	WSLH	\$34,846
<i>DNR/DATCP</i>			
Occurrence of Antibiotics in Wastewater Effluents and their Mobility in Soils: A Case Study from Wisconsin	K. G. Karthikeyan and W. Bleam	UW-Madison	DNR \$29,205 DATCP \$16,654

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