

Chapter 3 -- SUMMARY OF AGENCY GROUNDWATER ACTIVITIES

DEPARTMENT OF NATURAL RESOURCES

The Department of Natural Resources (DNR) has statutory authority as the central unit of state government to protect, maintain and improve the quality and management of the waters of the state, ground and surface, public and private (s. 281.11 Wis. Stats.). The DNR establishes the groundwater quality standards for the state under authority of ch. 160, Wis. Stats. DNR regulatory activities to protect groundwater are the responsibility of four programs:

Drinking Water and Groundwater (DG) – Regulates public water systems, private drinking water supply wells, well abandonment and high capacity wells. DG is responsible for adoption and implementation of groundwater standards contained in ch. NR 140, Wis. Adm. Code, and works closely with other programs and agencies to implement Chapter 160, Wis. Stats., including groundwater monitoring, database management, and staffing the Groundwater Coordinating Council. The new provisions under 2003 Wisconsin Act 310 and much of the Great Lakes Compact are also being implemented by DG. The program also coordinates the state's Wellhead Protection and Source Water Protection programs.

<http://dnr.wi.gov/org/water/dwg/index.htm>

Waste and Materials Management (WMM) – Regulates and monitors groundwater at proposed, active, and inactive solid waste facilities and landfills. WMM reviews investigations of groundwater contamination and implementation of remedial actions at active solid waste facilities and landfills. WMM 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://dnr.wi.gov/org/aw/wm/index.htm>

Remediation and Redevelopment (RR) – Oversees response actions at spills, hazardous substance release sites, abandoned containers, drycleaners, 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's work relates to groundwater contamination. <http://dnr.wi.gov/org/aw/rr/index.htm>

Watershed Management (WT) – Regulates the discharge of municipal and industrial wastewater, by-product solids and sludge disposal from wastewater treatment systems and wastewater land treatment/disposal systems. WT also issues permits for discharges associated with clean-up sites regulated by WT for the RR program. WT also has primary responsibility for regulating stormwater and agricultural runoff as well as managing waste from large animal feeding operations. <http://dnr.wi.gov/org/water/wm/index.htm>

More information about the groundwater programs and activities of the DNR is detailed in the following pages.

Drinking Water and Groundwater Program

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 123 substances of public health concern, 8 substances of public welfare concern and 15 indicator parameter substances in NR 140.

Revisions to NR 140 groundwater quality standards were last approved by the Natural Resources Board in 2007. These revisions established new state NR 140 groundwater standards for alachlor-ESA, a degradation product of the corn herbicide alachlor. The Legislature adopted these proposed revisions to NR 140 and they are now in effect. The Wisconsin Dept. of Health Services (DHS) is currently evaluating a list of substances, submitted to it by the DNR, for possible new groundwater quality standards development. If adequate toxicological information is available DHS will develop recommendations for possible new (or revised) groundwater quality standards for the substances on the list.

The Drinking Water and Groundwater Program (DG) maintains a table, at <http://dnr.wi.gov/org/water/dwg/health/haltable.htm>, listing NR 140 health and welfare based enforcement standards, NR 809 state drinking water standards, and established health advisory levels (HALs) for substances in water. This table of regulatory standards and advisory levels provides a useful source of information to members of the public concerned about the safety of their drinking water and it is also a valuable resource for DNR staff involved with groundwater contamination and remediation cases. Links to resource web sites listed in the table allow users to obtain additional toxicological and health related information on many of the table substances.

DG staff work with Remediation and Redevelopment program (RR) staff to identify policy issues, develop guidance, and provide training related to the implementation of chs. NR 720, NR 722, NR 724 and NR 726, Wis. Adm. Code. DG staff provide advice and assistance on site investigations, soil and groundwater remediation, and case closure decisions. This coordination is critical in obtaining statewide consistency on how the DNR evaluates, addresses and closes soil and groundwater contamination sites.

DG staff also work with Runoff Management Program staff to ensure that the performance standards for stormwater infiltration established in ch. NR 151, Wis. Adm. Code, comply with groundwater quality standards in NR 140. DG staff provide input on stormwater management guidance for developers, land use planners and government agencies to help assure that stormwater practices meet performance standards while preserving groundwater quality.

Groundwater Protection Act Implementation. The DNR 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 (100,000 gallons per day over a 30-day period). Such wells are defined as high capacity wells. Prior to 2004, when the operation of a high capacity well was anticipated to have an adverse impact on the quality or quantity of water available to a public utility well, the DNR was 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. In May of 2004, the statutes regarding high capacity wells were expanded through 2003 Wisconsin Act 310 to give the DNR the authority to consider environmental impacts of wells in order to protect critical surface water resources (see Chapter 1 for more information on the Act). DNR may allow, deny or limit an approval to assure that these wells do not cause significant environmental impact.

In FY 07, five groundwater quantity staff began implementing the new programs created by the law. Since then these staff have handled work associated with updating the high-capacity well inventory, collecting annual pumping information, application review, data management, inspections, providing staff support for the Groundwater Advisory Committee (GAC), and development of a new administrative rule authorized by Act 310 to implement the statutory

requirements.

The new rule – Chapter NR820 – went into effect on September 1, 2007. The rule creates a mechanism for evaluating proposed high capacity wells to determine whether the well will have a significant environmental impact on springs, trout streams, outstanding and exceptional resource waters. Since late 2007, when Ch. NR 820 went into effect, the DNR has approved fewer than 10 wells in groundwater protection areas. In most cases, the application involved a proposed well with a pumping capacity that was very small relative to the size of the potentially affected water body. For each well that was approved within a groundwater protection area the DNR determined that the well would not result in significant adverse environmental impact and in some cases imposed conditions on the operation of the well to ensure that significant impacts did not occur.

Chapter NR 820 also imposes a requirement that all owners of high capacity wells submit annual reports documenting the volume of water pumped from their wells on a monthly basis. To facilitate this reporting, DG staff has been updating the inventory of high capacity wells in the state. Starting in late 2006 and continuing through 2008, substantial progress was made in verifying ownership and collecting basic well information for the roughly 10,000 existing high capacity wells in the state. Using this updated and verified information pumpage report forms were mailed to owners of high capacity wells to report their 2007 and 2008 pumping. Pumpage data was collected for 2008 and was substantially more complete. The level of compliance, in terms of percentage of wells for which pumping was reported, increased in the second year of reporting to approximately 67%, and is expected to continue to increase in subsequent years. High capacity well pumpage data is available on the DNR's website. Information received from well owners using these pumpage reports, in combination with pumpage data already collected for municipal and certain public water supplies, will help to establish baseline information regarding groundwater use in the state.

Great Lakes Compact and Implementation of 2007 Act 227 - Congress' unexpectedly swift consent to the Great Lakes Compact in 2008 greatly accelerated the timetable for implementing the Compact in Wisconsin.

In FY 09 the DNR has issued interim approvals to persons who were withdrawing water in the Great Lakes Basin above the threshold permitting level of 100,000 gallons per day as of December 8, 2008. The DNR is also planning to promulgate administrative rules related to the following Compact-related topics: Registration & Reporting; Water Use Permitting; Consumptive Use/Water Loss; Public Participation; Water Conservation & Efficiency; and Water Supply Service Area Planning; and Water Withdrawal Fees.

The DNR's post rule development workload will include implementing the following programs: Registration & Reporting; Permitting in the Great Lakes Basin (DNR's Northern, Northeast, and Southeast Regions); Water Supply Service Area Planning; Statewide Water Conservation & Efficiency; and Public Participation.

The Governor's proposed 2009-11 biennial budget includes position authority and funding for 2 FTE in FY 2010; and an additional 2 FTE in FY 2011, along with funding for water quantity monitoring and database and GIS development. To fund the program in FY 2011 and beyond, the Governor's budget also includes a statewide water withdrawal base fee of \$125 on all water supply systems with the capacity to withdraw 100,000 gallons per day, and an additional fee to be imposed in the Great Lakes Basin only on persons who withdraw more than 50 million gallons per year. The DNR is directed to promulgate a rule to implement the latter fee.

Well construction and abandonment. DG sets and enforces minimum standards for well construction, pump installation and well abandonment through ch. NR 812, Wis. Adm. Code. The standards are intended not only to provide health protection but also to protect groundwater. DG also licenses and educates well drillers under ch. NR 146, Wis. Adm. Code, so that they are qualified to construct wells in a way that won't contaminate groundwater. Drillers submit reports to the DNR describing the construction of each well drilled. Field staff in the program conduct surveillance and inspections to enforce the minimum well construction standards.

Representatives of the Private Water Supply Program worked with the Wisconsin Water Well Association and members of the Wisconsin legislature to develop revisions to Ch. 280, Wis. Stats. that will result in increased protection of groundwater (as well as increased public health protection.) The changes went into effect in June, 2008. The significant changes include:

- Well abandonment must be performed by a licensed well driller or pump installer, or someone employed by a licensed well driller or pump installer—homeowners may not abandon their own wells. There is an exemption for wells under the authority of municipal abandonment ordinances.
- Well and pressure system inspections conducted as part of real estate transactions must be done by an individually-licensed well driller or pump installer (not an employee of a licensed person.) Inspection details will be specified in department rules and will require a diligent search for any wells that need to be abandoned.
- Drill rig operators must register with the department and will be required to complete additional training and/or testing requirements prior to becoming eligible to receive a well driller license. Each rig must have a licensed well driller or registered rig operator present onsite to supervise during all drilling activities.
- The department has authority to issue citations for some violations that don't rise to the level of referral to the Department of Justice, e.g., work done without a license; work on substantially noncomplying existing pump installations (pits, short-cased wells); improper well abandonment; or repeated failure to collect water samples and/or submit well construction reports.

The Private Water Supply Program is currently working with the Well Driller and Pump Installer Advisory Council to draft administrative rules to implement the revisions to Ch. 280, Wis Stats.

The Private Water Supply program continued its surveillance, investigation, and referral of well drilling and pump installation violators to the Department of Justice for prosecution. During the past year violations have included falsification of water samples, failing to notify well owners of repeated unsafe water test results, failing to grout, short casing wells, and unlicensed contractors. Falsification of water samples involves collecting a water sample from a known safe source and claiming it was collected from the newly constructed well. Failure to notify involves well water owners who were not told about the unsafe results for the water they were consuming. Failure to grout or failure to properly grout is a threat to groundwater because the empty space around the well casing pipe provides an easy conduit for contamination to enter the groundwater and contaminate lower aquifers. Short casing well involves installing less than the code minimum amount of casing, and then reporting and billing for casing that was not installed.

Another activity involved the designation and enforcement of special well construction requirements in areas where arsenic is known to exist. These requirements, if not followed, could trigger the release of naturally occurring arsenic into groundwater at higher levels. The DNR has

designated a special casing area that covers all of Outagamie and Winnebago Counties. In these areas wells must be constructed to avoid the arsenic rich St. Peter and Prairie du Chien formations. Wells can be constructed to draw water from the overlying Galena/Platteville dolomite or they must be cased and grouted into the Cambrian sandstone. The Department is working with the WGNHS to update and refine the geologic mapping and improve the accuracy of the special casing requirement depths.

The Private Water Section also responds to numerous complaints regarding the contamination of private wells. Contamination by manure has been an increasing problem in recent years. Using the results of newly developed analytical tools for tracking the source of microbial contamination, staff are able to determine whether fecal contamination is from grazing animal manure or human sources (see the “Microbial Agents” section in Chapter 4, and the “Detection and Monitoring of Microbiological Contaminants” section of Chapter 5 of this report for more information on the development and use of microbial source tracking methods). These new tools have proven useful in granting Well Compensation awards to private well owners with well contamination from manure. Since 2006 when the Well Compensation statute was revised to allow use of funds for replacement of water supplies due to manure contamination, about 40 well compensation grants totaling over \$500,000 have been awarded for that purpose. Additional costs have been incurred by well owners to cover related expenses not covered by the grants.

Private water staff developed a web page titled “What’s Wrong with My Water?” The website answers some commonly asked questions about private well water quantity, helps well owners diagnose their aesthetic water quality problems and captures and preserves DNR water supply institutional knowledge.

DG continues to promote electronic management of well construction, well abandonment and other information through its website at <http://dnr.wi.gov/org/water/dwg/gw/software.htm> and through semiannual releases of a Water Well Data CD with well construction reports and many other related files.

Groundwater monitoring well requirements, as specified under NR 141, are administered by DG staff. Activities include consultation on well construction with Remediation and Redevelopment, Waste Management & Materials, Watershed Management and Department of Commerce staff, consultants and drillers. Random inspections of environmental drilling operations provide an opportunity for DNR hydrogeologists to update drillers and consultants about NR 141 requirements and enhance compliance with the code. Review of new technologies and their application also continue to be a priority.

Aquifer Storage and Recovery (ASR). Aquifer storage and recovery (ASR) is a technique that involves the direct injection of water into an aquifer for storage and later recovery. The technique is promoted as a solution to problems that water utilities may face in managing peak seasonal water demands. ASR may prove to be a lower cost alternative to more traditional water supply management approaches involving the construction of water storage facilities, expansion of water treatment facilities or the drilling of additional wells if the injected water does not need to be conditioned (deoxygenated, pH adjusted, dechlorinated, etc.) to prevent the mobilization of minerals from the rock matrix of the receiving aquifer.

State administrative rules (Chapter NR 811, Wis. Admin. Code) regulate the use of ASR in Wisconsin. Only municipal water systems are allowed to operate an ASR system and only treated drinking water may be injected. Demonstration testing is required before routine operation of an ASR system may be approved by the DNR. These restrictions help to ensure that

this type of underground injection practice complies with both federal regulatory requirements and Wisconsin's Groundwater Law.

To date, only the municipalities of Oak Creek and Green Bay have sought approval to develop ASR wells. Work at the Green Bay ASR well was terminated after significant concentrations of arsenic and other contaminants were mobilized during the injection and storage phases of the ASR demonstration test.

Oak Creek completed the required ASR demonstration test and received a conditional approval to operate its ASR well; however, after performing two additional ASR cycles, the concentrations of manganese and iron in groundwater were observed to have increased to levels that are above their respective enforcement standards. As a result of the exceedances, the utility is required to make changes to its ASR operations plan. If ASR operations cannot be modified in a manner that will return the ASR facility to compliance with Wisconsin's groundwater protection regulations, the DNR is required to rescind its approval for Oak Creek Water and Sewer Utility to operate an ASR system. ASR activities have been temporarily suspended while the water utility considers its options. A final decision on future ASR operations will be made in 2010.

Public water systems. DG oversees monitoring and operation of public water systems through ch. NR 809 (Safe Drinking Water), Wis. Adm. Code, to ensure all public water systems are safe to drink and use. Working in cooperation with owners and operators of water systems DG ensures that samples are collected and analyses completed to determine if the water meets federal Safe Drinking Water Act (SDWA) standards. Also, through ch. NR 811 (Requirements for the Operation and Design of Community Water Systems), DG regulates the general operation, design and construction of community water systems. DG also works to educate water system owners and operators concerning proper operation and maintenance of water systems to ensure safe drinking water for Wisconsin consumers.

DG developed and continues to maintain data about Wisconsin's drinking water and groundwater quality through the Drinking Water System database. The Drinking Water System is an important tool used to efficiently enforce SDWA regulations for public water systems. It contains the monitoring and reporting requirements for each public water system and their drinking water sampling results. It also includes violations for any missing requirements and exceedances of the maximum contaminant levels (MCLs).

This fiscal year, DG has been working updating existing rules dealing with lead and copper, groundwater disinfection, water system design and operation, and disinfection byproducts.

Wellhead protection. The goal of Wisconsin's Wellhead Protection (WHP) program is to reduce the risk of groundwater contamination in areas contributing groundwater recharge to public water supply wells, consistent with the state's overall goal of groundwater protection. A WHP plan is required for new municipal wells and must be approved by the DNR before the new well can be used. 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 these older wells.

The DNR coordinates a statewide public information effort aimed at encouraging water utilities to protect their water supplies from potential sources of contamination through WHP planning. A video and several publications are available to assist communities in their WHP efforts. The DNR also maintains a web page (dnr.wi.gov/org/water/dwg/gw/wellhead.htm) with a variety of relevant information.

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In addition, the DNR has developed a tracking system for wellhead protection activities in the DNR's Drinking Water System database. The DNR uses this information to report annually to U.S. EPA on WHP progress.

In FY 09, 18 communities submitted wellhead protection plans to the DNR. There are now 342 communities who have a WHP plan for at least one of their wells. The list is online at <http://dnr.wi.gov/org/water/dwg/gw/whp/communities.pdf>

For the ninth year in a row, DNR staff worked with the Groundwater Center at the Center for Watershed Science and Education (CWSE) and the Wisconsin Geological and Natural History Survey (WGNHS) to sponsor three groundwater workshops for teachers in January and February. Educators from 24 schools centers took part in the workshops held at Mount Horeb, Eau Claire, and West Bend and were able to take a free groundwater model back to their school. Besides learning how to use the groundwater model, the educators received groundwater resources to incorporate groundwater concepts into their classroom. The intent of the workshops is to provide information for teachers to educate students – and their parents – on the importance of protecting groundwater in their own communities. With funding from an EPA grant, groundwater models have been given to over 200 schools or nature centers since 2001.

The DNR continues to work with the Wisconsin Rural Water Association (WRWA) staff in providing assistance to local communities in their protection efforts. WRWA staff work on both plans for individual communities and area wide plans for multiple water supply systems. The DNR and WRWA staff share information and meet as needed to discuss progress and priorities. WRWA staff also helped with the teacher workshops noted above.

The DNR provided WHP information to Wisconsin communities, other states and EPA. Staff answered questions, sent publications, made presentations, and reviewed draft plans and ordinances. The DNR updated the WHP website to keep current information available to communities interested in wellhead protection and made copies of the WHP video available.

The DNR continued to work with the federal Farm Service Agency to identify cropland in WHP areas. Farmers that own cropland in WHP areas could be eligible for cost-sharing and annual rental payments as part of the federal Conservation Reserve Program (CRP). The CRP program is designed to protect the environment by taking agricultural cropland out of production and installing conservation practices. The Groundwater Section worked with U.S. EPA Region V and the other Region V states to increase the acreage eligible for CRP in WHP areas. The new CRP Rule (7 CFR part 1410) defines WHP areas as including land located within a 10-year time of travel surrounding a public well. The proposed rule published on April 7, 2009 and is currently undergoing interagency review.

Groundwater Information and Education. As noted in the WHP discussion above, staff from the DNR and other agencies led three groundwater workshops for educators to provide training in the use of the groundwater sand tank model and provide the model and additional resources to the educators.

The DNR continued to have significant demand for the *Groundwater: Wisconsin's Buried Treasure* publication and the *Groundwater Study Guide* folder. Both publications were updated within the past three years.

Groundwater Monitoring and Research. Chapter 160 of the Wisconsin Statutes requires the DNR to work with other agencies and the Groundwater Coordinating Council (GCC), to develop and operate a program for monitoring and sampling groundwater to determine whether harmful

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substances are present (s. 160.27, Wis. Stats.). The DNR has also supported 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. See Chapter Two for more information on the DNR's monitoring studies.

During FY 09, six projects were supported at a total cost of \$233,200. Due to the State budget shortfall, no new projects were selected for funding in FY 10. More details on the DNR's groundwater monitoring and research activities can be found at <http://dnr.wi.gov/org/water/dwg/gw/research.htm>.

Final reports and 2-page research summaries are available for many projects from the Water Resources Institute website: <http://www.wri.wisc.edu>

In FY 09, DG staff continued to work with representatives from the DATCP, USGS, WGNHS, and UW Stevens Point on implementing the statewide groundwater monitoring strategy. The objective of the strategy is to coordinate groundwater monitoring between all agencies that assess groundwater quality and quantity in the state. Key components of the strategy include:

- A fixed network of groundwater level monitoring locations
- A statewide assessment of groundwater quality
- A fixed network of groundwater quality monitoring sites
- Surface water monitoring stations, and
- Water use reporting

These components of the strategy have been integrated into DNR's overall water monitoring plan. Other agencies will also continue to make improvements in their monitoring efforts based on the comprehensive strategy. The components of the strategy may change over time according to needs of the different agencies. The requirements of Chapter 160, Wis. Stats., will continue to be met under the strategy.

Groundwater Data Management. Groundwater data from the DNR's consolidated Groundwater Retrieval Network (GRN) system is available on the following website: <http://dnr.wi.gov/org/water/dwg/data.htm> GRN accesses groundwater data from database systems in the Waste & Materials Management, Drinking Water & Groundwater and Watershed Management programs including information on approximately 300,000 wells. These wells represent public and private water supply wells, piezometers, monitoring wells, non-potable wells, and groundwater extraction wells. In FY 09, DG staff continued to improve the locational data associated with GRN's wells and the ease with which the data can be accessed.

The DNR continued to make progress on several other groundwater-related data initiatives in FY 09. DG continued to improve its public water supply well data and coordinated efforts with the RR, WMM, and WT programs to improve the DNR's data on significant potential sources of contamination that may threaten these wells. Additionally the WGNHS and DNR continue to improve their searchable index of scanned images of more than 350,000 well construction reports (see WGNHS section) for numerous program uses. Work continued to refine and update DG's Mapping Application which is a geographic information system that maps locations of high-capacity wells, trout streams, springs, outstanding water resources, and exceptional water resources, public wells, source water areas, and potential contaminant sources within source water areas in a format consistent with high-capacity well approval, vulnerability assessment program, WHP, and other DNR needs. Another application, the Assessment Form, uses the mapped potential contaminant sources along with well construction, monitoring, and geologic

information to help DNR staff determine susceptibility of public wells to contamination. These applications are at the leading edge of DNR's efforts in integrating spatial and tabular data toward the goal of public health and resource protection.

DG staff assisted in making the DATCP well construction report search tool available to agency staff outside of DATCP. This new geographic information system-based tool offers expanded features over previously available applications.

Waste and Materials Management Program

The Bureau of Waste and Materials Management (WMM) implements the DNR's Groundwater Standards Program in several ways during the life of a landfill. When staff review an applicant's "Feasibility Report," which proposes to site a landfill in a particular location, they review baseline data submitted by the applicant to determine whether exemptions and alternative concentration limits are needed for the public health and welfare parameters listed under NR 140. In addition, reviewers establish preventive action limits for indicator parameters based on calculations submitted by the applicant. During the active life of a landfill and after closure, staff evaluate groundwater conditions at the landfill site to determine compliance with NR 140 standards. Should conditions warrant, staff require groundwater investigation reports that include proposals for further evaluations and recommendations for remediation at landfills that exceed groundwater standards. Staff review results of site investigations triggered by the exceedances of groundwater standards and evaluate the effectiveness of remedial actions at active solid waste facilities and closed landfills, by comparing results to groundwater standards over time.

WMM only accepts electronic submittal (via diskette or CD) of environmental monitoring data from landfill owners, labs and consultants. As of January 2006, WMM provides facilities and the public access to the environmental monitoring data contained in its Groundwater and Environmental Monitoring System (GEMS) database. In the future, a web interface, possibly using the Department's Data Portal and/or Web Access Management System, will allow facilities to upload environmental monitoring data into GEMS. Currently, funding is not available to do the necessary programming.

WMM has been concerned that staff might not be aware of some old, closed landfills that may be 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. In July 2003 we sent the screening reports, identifying landfills that need further attention to each of the regions for follow-up evaluations. Program staff have since reviewed most of the identified sites. A more in-depth screening of all closed landfills occurred in November 2006. Review of all the sites identified in the screening as possibly impacting the environment was completed by February 2009.

In FY 01, WMM studied 31 landfills that accept municipal solid waste, to try to determine whether VOC contamination in groundwater at these landfills is increasing, decreasing or remaining stable. One purpose of this study was to determine whether natural attenuation is occurring in groundwater near leaking landfills. The study showed a large number of stable or decreasing concentration trends. However, the concentrations took longer to stabilize and stabilized at higher levels than at other types of VOC contamination sites described in the literature.

Another study in FY 00-01 was done to evaluate the effectiveness of chemical oxygen demand (COD) as an indicator parameter at landfills. Mercury waste is generated when COD is analyzed in the laboratory so the overall goal was to reduce that amount of mercury. Findings from the first year of the study indicated that there was potential to eliminate COD monitoring at some

types of landfills. The second year of the study evaluated possible alternatives to sampling for COD. Dissolved organic carbon (DOC) appears to be an acceptable alternative in certain circumstances. WMM staff incorporated the recommendations of this study into code changes that went into effect in February 2006.

A study was done in FY 03 to review groundwater quality at solid waste landfills to determine whether they are a source of pesticide contamination. Eleven sites were sampled and analyzed for 14 common Wisconsin pesticides. Findings indicated that leaking landfills may be contributing alachlor, aldicarb, atrazine and 2,4-D to groundwater. The study researchers believed a follow-up study was needed to provide more evidence to help make concrete recommendations about which pesticides to sample for. However, staff and funding have not been available for this.

Remediation and Redevelopment Program

The Bureau for Remediation and Redevelopment (RR) has primary responsibility for implementing and aiding cleanups under the Spill Law, the Environmental Repair Law, federal programs (Superfund, Hazardous Waste Corrective Action, Leaking Underground Storage Tanks (LUST), and Brownfields), the Land Recycling Law and State Brownfield Initiatives, the Drycleaner Environmental Response Fund and at closed landfills. The RR program provides technical assistance, helps to clarify legal liability, provides financial assistance primarily to local governmental units and provides technical project oversight of cleanup projects.

All cleanups are conducted according to the NR 700 rule series, Wis. Adm. Code, Investigation and Remediation of Environmental Contamination, and NR 140, Groundwater Quality. The majority of cleanups are done by persons responsible under the laws, or persons or groups involved in the redevelopment of potentially contaminated properties. Program staff provide technical assistance on cleanups conducted by consultants at the direction of responsible parties. In addition, RR staff contract and direct consultants on state-funded cleanups.

Cleanup Of Groundwater Contamination. In FY 2009, the program spent \$1.76 million in Environmental Fund dollars to initiate or continue environmental cleanup actions at over 73 locations where groundwater contamination is known or suspected. The Environmental Fund is used when contamination is significant but no identifiable private party 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 DNR staff. Whenever feasible, the RR program and legal staff attempt to recover costs from responsible persons after the cleanups are undertaken.

Investigation, Cleanup and Redevelopment of Brownfields. Brownfields are abandoned, idle or underused industrial or commercial facilities or sites whose expansion or development is adversely affected by actual or perceived environmental contamination. The RR program coordinates several efforts to encourage local governments and private businesses to cleanup and redevelop brownfield properties. At many brownfields sites, the release of hazardous substances threatens groundwater quality.

One of the financial assistance programs implemented by the DNR is the Brownfields Site Assessment Grant (SAG) program. The SAG program benefits groundwater by serving as a funding source for (1) the removal of potential sources of groundwater contamination, and (2) site investigations to determine whether groundwater and soil are contaminated, including the determination of the extent and degree of contamination.

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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. Although the SAG program does not fund remediation activities, it funds preliminary activities to determine whether remediation is necessary. 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 09, DNR awarded 42 Site Assessment Grants totaling approximately \$1.7 million to 29 communities across the state. Small grants up to \$30,000 make up 30 of the awards, while 12 are large grants between \$30,000 and \$100,000. Local governments have also pledged more than \$607,000 in additional funds for the projects, well beyond the 20 percent match required through the application process.

The grants will provide funds for environmental activities on 162 acres of land. Activities include 61 site assessments and investigations, the demolition of 61 buildings or structures and the removal of 17 tanks, drums and other abandoned containers. Since site assessment grants began 10 years ago, the state has awarded more than \$15 million to 199 communities to begin investigation and cleanup on more than 1,500 acres.

In addition to the Site Assessment Grants, the RR Program granted funds to local governments through the Brownfields Green Space and Public Facilities Grant program to pay for the remediation of contaminated soil and groundwater at properties that will be reused as parks and public facilities. In FY 09, the RR program awarded \$118,950 in grants for two brownfields projects; a \$19,000 grant for one, and a \$99,950 for another. The RR Program was unable to award additional funds this fiscal year due to a forced lapse of funds as a result of the Wisconsin state budget shortfall.

The RR Program also provides redevelopment assistance at brownfield sites with groundwater contamination. Program staff assist local governments and private businesses with the cleanup and redevelopment of brownfields by providing technical assistance. In many cases, these properties have groundwater contamination, or soil contamination that poses a threat to groundwater. An example of this type of assistance is the DNR's Wisconsin Urban Reinvestment Initiative partnership with the city of Milwaukee and the 30th Street Industrial Corridor Corporation. Through this partnership, the RR Program initiated work on redevelopment of this economically and environmentally distressed area of the state. Through a \$400,000 U.S. EPA Brownfields Site Assessment Grant, the partners have begun site investigation activities on more than 30 sites in the Corridor since 2004.

In FY 09 the partnership continued with significant progress by:

- completing Phase I environmental site assessments at 23 properties;
- completing or continuing Phase II work at 16 properties; and
- identifying additional sites for Phase I or II assessment work.

Completion of the first grant occurred in the fall of 2008. However, the partners were awarded a complete grant of an additional \$400,000 EPA site assessment grant in May 2007. The DNR Urban Reinvestment Initiative and 30th Street web page is located at:

<http://dnr.wi.gov/org/aw/rr/rbrownfields/uri-30th-street.htm> .

The RR program also provides a number of different assurance, comfort or general liability clarification letters related to properties with groundwater contamination. Collectively, these

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letters facilitate the reuse and development of properties. The RR program provided 70 redevelopment assistant reviews – which can include liability clarification letters, off-site exemption letters, cleanup agreements for tax delinquent properties, etc. – at brownfield properties throughout the state in FY 09.

The RR program also continues to provide technical assistance and assist parties with voluntary investigations and cleanups of Brownfield properties through the Voluntary Party Liability Exemption (VPLE) process. Many sites that follow the VPLE process have contaminated groundwater.

After a person has conducted an environmental investigation of the property, and cleaned up soil and groundwater contamination, the DNR 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 09, DNR issued a Certificate of Completion at 6 properties for completed cleanups and 10 new sites began the voluntary cleanup process.

Drycleaner Environmental Response Fund (DERF) Program. The DERF program reimburses drycleaner 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 cleanups at dry cleaner sites are conducted following the NR 700 rule series. As of June, 2009, there are 230 sites in the program, with 182 at various stages of investigation and cleanup and 48 sites closed. The program is implemented through ch. NR 169, Wis. Adm. Code. The DERF program closed to new applicants in August of 2008.

Site closure rules for petroleum contaminated sites. Under the Petroleum Environmental Cleanup Fund Award (PECFA) Program, NR 746 – and its Department of Commerce counterpart, Comm 46 – was promulgated in February 2001. The bulk of NR 746 establishes risk and closure criteria to determine whether petroleum contaminated sites can be closed using natural attenuation as a final remedy for groundwater contamination. The rule 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. Sites requesting closure with groundwater contamination above NR 140 enforcement standards are placed on the GIS Registry.

NR 726 provides closure requirements for all other sites.

Tracking System and GIS Applications. The program's main database on the status of sites undergoing investigation and/or cleanup is the Bureau of Remediation and Redevelopment Tracking System (BRRTS). In 2000, the program created BRRTS on the Web, making the DNR's main database for contaminated properties accessible via the Internet at <http://botw.dnr.state.wi.us/botw/Welcome.do> .

In 2001, revisions to NR 726, 716, 749, and 811/812 implemented a Geographic Information System (GIS) Registry of Closed Remediation Sites to replace the requirement to record

groundwater use restrictions at the County Register of Deeds Office. In 2002, additional rule revisions required the inclusion of sites with residual soil contamination on the GIS Registry. The GIS Registry currently includes locational information on sites closed with residual groundwater contamination above the NR 140 enforcement standards and sites closed with soil contamination above NR 720 soil 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. In 2006, new legislation in WI Act 418 replaced the use of deed restrictions for certain sites with residual contamination with conditions of closure and placement on the GIS Registry.

Inclusion on the GIS Registry on the Internet provides a means of notifying future owners or users of the property of the existence of soil and/or groundwater contamination, as well as any responsibilities of the property owner (or occupant in some cases) to comply with any conditions of closure. The site specific information is attached to each site by a link to a .pdf. The GIS Registry can be accessed on the Internet at <http://dnr.wi.gov/org/aw/rr/gis/index.htm> .

The GIS Registry is to be used with well construction requirements for private wells, and with a setback distance for new municipal wells. Beginning in July 2004, the DNR made the GIS Registry information available to well drillers through a Well Construction CD that is updated twice a year. Before drilling, well drillers are asked to consult the CD to determine if a well is proposed for a property listed on the Registry. If the proposed well is located on a closed remediation site, then the driller must contact regional Drinking Water and Groundwater staff prior to any well construction activities to determine if additional casing or other construction techniques may be required.

In 2005, an expanded GIS application was made available, called the RR Sites Map. This application shows the locations of the majority of sites available on BRRTS (open and closed), or provides an address for those sites for which geolocational coordinates have not yet been obtained. The RR Sites Map can also be accessed on the Internet at <http://dnr.wi.gov/org/aw/rr/gis/index.htm> . In 2008, additional layers regarding financial tools and liability clarification actions were added, so RR Sites Map now provides even more information on redevelopment and cleanup activities.

The GIS applications are linked to BRRTS on the Web and are all useful for locating potential contamination sites when evaluating new municipal well placement or for property transactions. 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 BRRTS on the Web, the GIS Registry and RR Sites Map.

The RR Program continues to make improvements to both BRRTS and the GIS applications. In addition to the ongoing programming efforts, work continues on quality assurance and quality control (QA/QC) of existing data.

Watershed Management Program

The Bureau of Watershed Management (WT) is responsible for statewide implementation of DNR's groundwater standards 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 WT program. Integrated basin planning carried out in the field under guidelines developed by WT 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. WT issues Wisconsin Pollutant Discharge Elimination System (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 that 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. DNR has issued specific permits for 360 municipal and industrial facilities that discharge directly to land disposal (groundwater) systems.

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

WT occasionally assists or participates in local planning efforts for existing developed areas (served by onsite wastewater treatment systems) that are investigating the possibility of providing a public sewerage system.

In 2000, the Department of Commerce and DNR completed revision of an interagency memorandum of understanding after Commerce issued rules for private onsite wastewater treatment systems under ch. Comm 83, Wis. Adm. Code. The DNR completed refined procedures, guidance, and rules for the review and permitting of large private onsite wastewater treatment systems (POWTS). In general, large POWTS are defined as those with a capacity of greater than 12,000 gallons per day (gpd). The DNR started issuing permits to large POWTS in early 2000. On February 1, 2005 WT issued a general permit to regulate the operation of these types of systems in a more streamlined manner.

Septage And Sludge Management. WT 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. WT 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.

WT continues to 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 U.S. EPA to implement municipal sludge regulations, through its delegated NPDES (WPDES) permit program, in July of 2000.

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Wisconsin Act 347 became effective April 29, 2006 and provides incentives for more wastewater treatment plants to accept and treat septage. This is accomplished through the offer of a zero percent Clean Water Fund loan for the planning, construction of receiving facilities, and additional capacity provided for septage. Facilities which are upgrading capacity by more than 20% must evaluate septage generation and available disposal options in their planning area during facility planning. Although they are not mandated to provide such capacity, they are offered the zero percent loan if they do so. Structures are provided by which Publicly Owned Treatment Works establish costs for receipt of septage and a process is laid out for dispute resolution when such costs are questioned. Land application also remains a viable option when appropriate and the Act provides explicit pre-emptive authority to the state by disallowing restrictive local ordinances if they are not identical to state regulations.

Agricultural runoff. Chapter NR 243 Wis. Adm. Code covers the permitting requirements for livestock operations and contains provisions to protect surface water, groundwater and wetlands in Wisconsin. DNR has revised ch. NR 243, Wis. Adm. Code to address revisions to federal rules that govern the operation and permitting of large concentrated animal feeding operations (CAFO) that were promulgated in April 2003. The revisions to NR 243 improve groundwater protection from CAFOs by increasing setback requirements from community and non-community wells and karst features and further restricting winter applications of manure. The DNR continues to implement revisions to NR 243 that became effective on July 1, 2007.

There are currently 185 WPDES permits issued for livestock operations (87% dairy; 5% poultry; 4% swine; 4% beef). Regional and central office staff have successfully maintained the permit backlog at less than 15%. The trend of growing numbers of permit applications for larger-scale livestock operations is expected to continue.

Storm Water. Final revisions to Chapter NR 216, Wis. Adm. Code were promulgated on August 1, 2004. The revisions were completed primarily to comply with federal storm water regulations that took effect on March 10, 2003. The revisions to NR 216 require nearly 200 municipal separate storm sewer systems to obtain permit coverage and require construction sites down to one acre of land disturbance to have permit coverage to control erosion during construction. Permit holders are also required to install post-construction practices to limit pollutant discharge after construction is completed (storm water management). The DNR has developed performance standards (i.e. 80% sediment control, infiltration, peak flow, buffer requirements, etc.) that became effective in 2002. Provisions to implement NR 216 changes were included in two revised general permits. The general permit for municipal stormwater discharges was reissued on January 19, 2006 (expires on December 31, 2010) and the general permit to regulate stormwater discharges from construction sites was reissued on September 29, 2006 (expires on September 30, 2011).

Nutrient Management Plans: Sections NR 151.07 and ATCP 50.04(3) require all crop and livestock producers to develop and implement nutrient management plans. Technical Standard NRCS 590 contains planning and implementation requirements that must be met. The performance standard itself became effective January 1, 2005 for high priority areas in the State (source water areas, impaired waters and outstanding/exceptional resource waters) and became effective for the remainder of the state on January 1, 2008. On an ongoing basis, federal, state and local agencies are working to build the necessary technical resources and expertise to implement NRCS Standard 590, including development and dissemination in cooperation with the University of Wisconsin of the field-based Soil Nutrient Application (computer) Program. Implementation of this performance standard can not be required without cost sharing in certain situations. A multi-partner conservation consortium was effective in securing cost share resources from the legislature to help farmers meet the requirements. The DATCP administers these funds

through its Soil and Water Resource Management Program. In addition, the NRCS provides cost sharing for development and implementation of comprehensive nutrient management plans including 590 compliant planning and implementation. In other situations, cost sharing does not have to be provided to require compliance. This includes compliance for farms operating under a WPDES Animal Feeding Operation Permit, farms receiving state Farmland Preservation tax credits, livestock operations obtaining local permits under the state Livestock Siting Law and livestock operations that voluntarily apply for new or altered manure storage facilities when the local regulation requires development and implementation of a nutrient management plan.

For more information, visit the following website (<http://dnr.wi.gov/>) or contact Todd Ambs at 608-264-6278 (Todd.Ambs@wisconsin.gov) or Mike Lemcke at 608-266-2104 (Michael.Lemcke@wisconsin.gov), DNR, P O Box 7921, Madison, WI 53707-7921.

DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION

Protecting Wisconsin's groundwater is a priority for the Department of Agriculture, Trade and Consumer Protection (DATCP). DATCP's major activities in this area include management of pesticides and nutrients, research, and funding of local soil and water resource management projects.

In compliance with the Wisconsin Groundwater Law (1983 Wisconsin Act 410), 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. DATCP regulates storage, handling, use, and disposal of pesticides, and the storage and handling of bulk quantities of fertilizer. DATCP has authority to develop a statewide nutrient management program through section 92.05 Wis. Stats. The program includes compliance, outreach, and incentive components.

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.

Nonpoint Source Activities

Pesticides. DATCP's primary effort related to nonpoint contamination of groundwater from pesticides 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 with the latest revision being effective on April 1, 2009. A set of maps for 101 prohibition areas is available from the Environmental Quality Section covering 1.2 million acres that have been incorporated into the rule. Information suggests that atrazine use has declined from peak levels in the late 1980's and is now holding roughly constant. The decline in use may have been a result of the atrazine management rule and concern about groundwater contamination. In 2008 DATCP prohibited the use of a simazine, a related triazine herbicide, in a small area of the Lower Wisconsin River Valley near Spring Green. DATCP is conducting additional sampling of private wells to determine if additional actions are needed to protect groundwater from simazine.

Nutrients. Through its Land and Water Resource Management program, DATCP assists in the protection of water resources through nutrient management. The DNR rules on runoff management to protect both groundwater and surface water, NR 151, Wisconsin Administrative

Code, lay out the procedures for implementing and enforcing compliance with agricultural performance standards including nutrient management. The nutrient management rules apply to all crop and livestock producers that apply manure or other nutrients directly or through contract to agricultural fields. DATCP has adopted the USDA NRCS 590 nutrient management standard via administrative rule, ATCP50, to meet DNR's performance standards. Under Wisconsin Statutes, cost-share funds must be made available to producers to compel compliance. However, as many as half of Wisconsin farms may be compelled to comply with nutrient management standards and other performance standards without cost-sharing because they are either: Concentrated Animal Feeding Operations (operations with 1,000 animal units or greater); or, farms regulated by local manure storage or Livestock Siting ordinances; or, participants in the Farmland Preservation Program or Working Lands Initiative Program;

DATCP's nutrient management standard includes a number of practices to protect groundwater from the impacts of nutrient applications including:

- nutrient and manure application setbacks from karst features and other conduits to groundwater.
- combinations of reduced nutrient application rate, timing, and nutrient sources to mitigate movement of nutrients and manure when applying to highly permeable or thin soils.
- nitrogen applications must meet University of Wisconsin recommendations for crop production.

Like other agricultural performance standards, the nutrient management standard is "designed to achieve water quality standards by limiting nonpoint source water pollution" (Chapter 281.16 (3) 'Nonpoint sources that are agricultural'). Requiring applications of nitrogen to meet University of Wisconsin recommendations for crop production, in conjunction with the other practices listed above, is meant to "limit" non-point pollution of groundwater. Recent statewide estimates by DATCP indicate that in 2007, over 200 million pounds of nitrogen (from all sources) were applied *in excess* of UW recommendations. Clearly, if Wisconsin's agricultural lands were to meet University recommendations for crop production, and comply with the other required nutrient management practices, significant reductions in nitrogen loading to groundwater would be realized.

Research conducted by John Norman on silt loam soils at Arlington indicates that applications of nitrogen to UW recommendations on continuous corn would, on average, roughly comply with the nitrate water quality standard of 10 parts per million. Other research cited later in this report, on other soils and cropping systems, indicate that UW recommendations for nitrogen would result in leaching of nitrogen to groundwater that would exceed the nitrate standard. Additional research, and importantly, monitoring of actual in-field practices are needed to illuminate the effectiveness of the nutrient management standard to protect groundwater under various conditions. DATCP has advocated that approach through its priority recommendations to the GCC.

Currently, less than 20% of agricultural land in Wisconsin follows an approved nutrient management plan. DATCP contends that the current nutrient management standard, while not 100% protective under all conditions, would dramatically improve water quality if it were implemented widely throughout the state.

Increasing attention on the role of land use practices in achieving water quality goals was recognized in the 2008-2009 state budget. Funding for the land and water resource management program's cost-share allocation increased from \$520,000 to \$6.5 million in the second year of the 2008-2009 biennium. A portion of those funds have been directed to provide support for nutrient management implementation, including farmer outreach and education, Snap-Plus Nutrient

Management Planning Software, farmer training and program evaluation activities. DATCP elected to phase in nutrient management cost-sharing over two years, allocating about \$3.0 million in 2008. Due to budget shortfalls, cost-share funding was reduced to about \$740,000 for 2009. Despite budget cuts, DATCP continued to maintain funding for implementation support, ensuring access to farmer training and other support activities.

DATCP nutrient management program staff has worked to train farmers, consultants, and local agencies on the principles of sound nutrient management, how to comply with performance standards, and how to use available tools to create and evaluate an ATCP 50 compliant NMP. The 2008-2009 state budget also allocated funds to DATCP for the creation of a Manure Management Advisory System. This system is currently focused on helping farmers develop a good understanding of field-specific soils and their ability to accept nutrients and manure for optimal crop production while protecting water quality. In order to accomplish this goal, two new tools in development include web-accessible WI "590" Nutrient and Manure Application Restriction Maps and a model based website for predicting the likelihood for runoff events to take place on a given day. The 590 Restriction maps will be available on a statewide basis at the section level to assist farmers in making sound decisions about manure and nutrient applications to their cropland.

Through these combined efforts, DATCP increased the number of acres covered by NM plans statewide in 2008 to over 1.6 million acres, an increase of about 600,000 acres from 2007.

Point Source Activities

Previous work by DATCP identified pesticide and fertilizer operations as possible point sources of groundwater contamination. Past problems included improper disposal of unwanted agricultural chemicals, lack of containment for spills, out-dated product handling methods, and poor understanding by workers in the industry of how small actions, when continued over time, lead to large problems. DATCP has worked to address these problems through point source prevention. In cases where environmental degradation has already occurred, DATCP oversees environmental cleanup of contaminated soil and groundwater.

Since 1990, the Agricultural Clean Sweep program has helped farmers dispose of unwanted pesticides, farm chemicals, and empty pesticide containers. Beginning in 1996, the program extended collection services to small agricultural businesses. In 2004, DATCP began operating and managing the state's household hazardous waste program. In the fall of 2007, prescription drug collection authority was given to the Department and the annual program budget expanded to \$1 million. In 2007, nearly 2.3 million pounds of chemical wastes were collected by municipalities and counties with grants from the Department.

DATCP's rules for minimizing environmental damage from agrichemical storage and handling were put in place in 1988. Thirteen local DATCP specialists work with facilities across the state to keep them in compliance with the ATCP rules designed to protect the environment. DATCP staff also educate facility managers and employees about how routine practices may affect the environment.

In August 1993, section 94.73 of the Wis. Stats. was created and established the Agricultural Chemical Cleanup Program (ACCP) to address point sources of contamination and reimburse responsible parties for cleanup costs related to pesticide and fertilizer contamination. To date, about 500 cases involving soil and/or groundwater remediation related to improper storage and handling of pesticides and fertilizers have been initiated at storage facilities. Over this same time period DATCP has also cleaned up over 900 acute spills of agrichemicals. The ACCP staff have

received 997 reimbursement applications and provided over \$ 33.3 million in reimbursement payments.

The Pollution Prevention for Agrichemical Dealerships program began in 2000 and has evolved and been renamed the Environmental Partners program. Its purpose is to reduce the amount of agrichemicals that escape into the environment during routine transfer and handling of agricultural chemicals and fertilizers at agrichemical storage and dealership sites. The program helps protect soil and groundwater by encouraging better management practices. Participation in the program is voluntary, with the agrichemical industry and the Department working together to identify problems and brainstorm ideas to reduce pollution. The ideas used to solve problems at each facility can be shared so that everyone can learn and benefit from the program. To date, about 45 agrichemical dealerships have volunteered for assessments at their dealership sites. More information about this program can be obtained at <http://www.datcp.state.wi.us> (keyword search "Environmental Partners").

In 2007, DATCP received authority to manage a pollution prevention grant program. DATCP began preparing rules to govern how this grant program would be implemented, but with budget reductions and hiring limitations, has had to place a hold on further rule development.

Groundwater Sampling Surveys

DATCP conducts a number of annual surveys 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*.

Research Funding

Due to budget constraints, DATCP did not have funding for new pesticide research projects in FY08. Nutrient Research - DATCP funds fertilizer research at approximately \$130,000 per year.

Groundwater Data Management

DATCP maintains two groundwater sample databases: the Drinking Water Well System and the Monitoring Well System. The Drinking Water Well System contains contact and location information, well characteristics, and pesticide and nitrate sample results for private and public drinking water wells. The Monitoring Well System contains similar information for monitoring wells. These data represent samples analyzed by DATCP, Wisconsin State Lab of Hygiene (WSLH), and other public and private laboratories. DATCP's Drinking Water Well System currently contains information for over 56,000 wells and nearly 361,000 pesticide and nitrate-N sample analytical results.

DATCP uses geographic information system (GIS) tools to analyze groundwater data and prepare maps for public hearings, DATCP board meetings, presentations, and other uses. DATCP prepares and maintains GIS layers of well locations, atrazine concentrations, atrazine prohibition areas, and other pesticide and nitrate-N data. These GIS layers and associated database information are used to generate maps of statewide pesticide and nitrate-N detections in wells, as well as maps for chapter ATCP 30, Wis. Adm. Code (Pesticide Product Restrictions). For example, see the map of "Private Wells Tested for Atrazine in Wisconsin" in Chapter 4, *Condition of the Groundwater Resource*. Other GIS analyses involve identifying groundwater wells that may be impacted by point sources of pesticide and nitrate-N contamination. DATCP also uses global positioning system (GPS) receivers to locate and map wells and other features, such as agrichemical facilities and spill sites that may affect groundwater quality.

For further information, visit the following web site (<http://www.datcp.state.wi.us>) or contact Kathy Pielsticker or Stan Senger, DATCP, 2811 Agriculture Drive, PO Box 8911, Madison,

Wisconsin, 53708-8911; phone: 608-224-4500; e-mail:kathy.pielsticker@wisconsin.gov or stan.senger@wisconsin.gov.

DEPARTMENT OF COMMERCE

Three of the seven Divisions of the Department of Commerce regulate activities, protect or remediate Wisconsin's groundwater resources.

Within the Division of Safety and Buildings, two plumbing programs have the responsibility of safeguarding public health and the waters of the State. Graywater reuse and stormwater is regulated by the General Plumbing Program (Chapter Comm 82, Wis. Admin. Code) and private onsite wastewater treatment systems by the Private Onsite Wastewater Treatment Systems Program (Chapter Comm 83, Wis. Admin. Code).

Also within the Safety and Buildings Division the Soil Erosion and Sediment Control Program has statutory jurisdiction over stormwater runoff on building sites that are regulated under Chapter 101 of the statutes.

Within the Division of Environmental and Regulatory Services (ERS), two Bureaus regulate petroleum tanks and petroleum cleanups. The Bureau of Petroleum Products and Tanks regulates flammable and combustible liquids and hazardous substance liquids (Chapter Comm 10, Wis. Admin. Code). The Bureau of PECFA reimburses owners and operators of leaking petroleum storage tanks (Chapter Comm 47, Wis. Admin. Code) and has regulatory jurisdiction of petroleum sites determined to be a low or medium risk to the environment (Chapter Comm 46, Wis. Admin. Code).

Within the Division of Housing and Community Development, one program provides financial assistance for the cleanup and redevelopment of contaminated properties (Chapter Comm 110, Wis. Admin. Code). The Blight Elimination and Brownfield Redevelopment (BEBR) Program provides grants of up to \$1.25 million to assist local governments, businesses and individuals with the assessment and remediation of the environmental contamination at abandoned, idle or underused industrial or commercial facilities or sites.

Plumbing – Reuse, Stormwater and Private Onsite Wastewater Treatment Systems (POWTS)

In addition to public health and safety, the water supply and quality issues facing Wisconsin are a focus of the General Plumbing and POWTS programs in the Department of Commerce.

General Plumbing – Reuse and Stormwater Use. The Department plumbing code includes standards for reuse of wastewater and stormwater. Currently, the Chapter 82 stormwater rules create the ability for plumbing to be integrally involved with the design and installation of storm systems complying with Chapter NR 151, Wis. Admin. Code. Currently in Wisconsin there are over 50 approved stormwater use or wastewater reuse plumbing systems.

Private Onsite Wastewater Treatment Systems (POWTS). The Department communicates with the Department of Natural Resources regarding mutual issues of interest such as large onsite sewage systems, mixed wastewater treatment systems, Underground Injection Control (UIC) regulations and water well regulations. The Department also communicates with the USEPA Region 5 office regarding POWTS related matters. Department staff continues to participate in efforts to develop a regional and national model code related to onsite sewage systems.

Soil Erosion and Sediment Control

The Department works with the Department of Natural Resources in regulating the erosion and sediment control issues on building sites under the authority of s. 101, Stats.

Petroleum Product and Hazardous Substance Storage Tanks

The ERS Division continues to maintain regulatory oversight of aboveground and underground petroleum and CERCLA hazardous substance storage tanks in the Chapter Comm 10, Wis. Admin. Code. Underground storage tank regulations include the U.S. EPA Underground Storage Tank (UST) requirements, as well as heating fuels, tanks supplying stationary combustion engines such as emergency generators, and other tanks storing regulated liquid products. Chapter Comm 10, Wis. Admin. Code, was recently revised with an effective date of February 1, 2009. Another revision covering the Federal Energy Policy Act of 2005 operator training requirements is in the final stages of rule revision with anticipated implementation in the last quarter of 2009.

Since 1991 the database inventory of petroleum product and CERCLA hazardous substance underground storage tanks regulated under Chapter Comm 10, Wis. Admin. Code has increased from 143,681 to 181,353, along with 33,311 registered aboveground 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 May 20 23, 2009, the database reflects 81,444 federally regulated tanks with only 12,345 tanks in use and 313 in temporary-out-of-service status. In order to maintain a federally regulated tank in use, the tank must have a valid “permit-to-operate.” Permit renewal administrative review includes compliance assessment of the owner’s financial responsibility. Federally regulated and large fuel oil USTs are subject to periodic inspections involve verification of leak detection, spill and overfill protection, and record keeping.

Program tank permit initiatives have resulted in approximately 90% of the tanks required to have financial responsibility being in compliance with the rule. The remaining tanks will not be permitted and will be shut-down if financial responsibility coverage is not verified. 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 as realtors and lenders recognize the potential problems and liability.

Addressing “abandoned” tanks continues to be a challenge due to the difficulty in locating the site or the tank to determine if the tank exists and take the respective regulatory action. There currently are 6,746 abandon USTs on the tank database.

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. Mandates required in the Federal Energy Bill of 2005 will have a significant positive impact on release reduction as the requirement for secondary containment and owner/operator training is implemented with revisions to the administrative code. The ongoing regulatory challenges are owner operational compliance with leak detection. This past year the department partnered with trade associations working with the regulated community to provide training related to the revised Comm 10 and the pending operator training.

Petroleum Environmental Cleanup Fund Act (PECFA)

Since 1989, the PECFA program has reimbursed approximately \$1.49 billion to petroleum storage tank system owners for costs associated with the investigation and remediation of petroleum contaminated sites. The program, in addition to auditing owner invoices and authorizing payments, performs technical reviews of site investigations, evaluates the feasibility of remedial options, conducts a competitive public bid process for scopes of work, and makes

decisions regarding closures for the majority of the State's leaking underground storage tank (LUST) sites.

The Petroleum Inspection Fee supports PECFA's spending authority. The spending authority was \$20 million for FY09 and in 2010 is \$10 million. In FY08, the PECFA program reimbursed \$14.9 million to 796 claimants. The Program currently reimburses claimants within two months of receiving a claim.

The Program's current bond obligation is \$272 million.

In addition to administering the PECFA fund, the Department of Commerce PECFA Bureau has the administrative authority for low and medium risk petroleum contaminated sites (which includes both soil and groundwater sites). The Bureau closes approximately 100 sites per year.

Blight Elimination and Brownfield Redevelopment (BEBR) Grants

The BEBR program typically receives \$7 million/year that will be utilized for redevelopment awards of up to \$1.25 million. Funds may be used for the environmental activities including investigation, remediation or groundwater monitoring. Expenditures for site acquisition, demolition, building rehabilitation or infrastructure improvements may also be eligible for reimbursement.

The BEBR program has awarded \$66,415,000 in grants since the inception of the initiative in 1998. Funds have been used to remediate 171 properties with soil or groundwater contamination. Program staff has reviewed 323 applications requesting a total of over \$165 million.

Data Management

Commerce is continuing its data integration information technology (IT) initiative. With regard to groundwater protection, Commerce maintains databases of underground petroleum storage tank systems and properties with petroleum contamination either in the past or currently. The database also stores information on activities associated with on-site sewage system design, installation and maintenance. The Department is working with county code administrators and POWTS industry members to upgrade the reporting and recording of inspection, maintenance and servicing events for onsite sewage systems. The department promulgated a rule revision in late 2008 that implements POWTS program related provisions contained in 2005 Wisconsin Act 347. The revised rule requires that counties conduct an inventory to identify all POWTS within their jurisdictional areas. Counties must also initiate new or enhance existing reporting programs related to inspection, maintenance and servicing events. This is expected to be a multi-year effort with code specified deadlines

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

DEPARTMENT OF TRANSPORTATION

The Department of Transportation (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 30 rest areas and 60 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
- Salt Research - Bureau of Highway Construction (Geotechnical Section)
- Hazardous Materials (petroleum) - Environmental Services Section
- Hazardous Waste - Environmental Services Section
- Wetlands - Environmental Services Section
- Erosion Control and Storm Water Management - Environmental Services Section
- Rest Area Potable Well Sampling - Bureau of Highway Operations

Salt Storage

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 greater capacity of indoor storage. This will improve groundwater protection and create greater flexibility for scheduling salt purchase at optimal prices.

The DOT annually updates salt storage facility records into a database and assists the DNR Source Water Protection program in locating salt storage facilities for GIS mapping applications. There are currently 1,271 salt storage sites listed in the database and 2,459 sub-sites. Each county keeps detailed inventories of salt which are updated monthly. Facility inventories, inspections, repairs and improvements are included in the database.

Salt Use

The DOT Bureau of Highway Operations produces the Annual Winter Maintenance Report describing statewide salt use based on weekly reports from each county. 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. Other technology is used on county highway patrol trucks to keep salt on pavement surfaces (e.g., zero-velocity spreaders, ground speed controllers, and onboard liquid pre-wetting units). Additional efforts to minimize and conserve salt applications include the use of in-situ weather monitoring system. Pavement temperature sensors recorded at 59 locations along major highway routes are used to determine application methods. Annual training for snowplowing and salt spreading techniques is provided for county snowplow operators.

Salt Monitoring and 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. Approximately 20 sites throughout the state have been studied. In general, 1 or 2 shallow monitoring wells at each site were 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 new sites are added periodically. 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).

Well Access

For the past several decades, DOT has provided access to wells used in the Wisconsin Groundwater Observation Network maintained by USGS and WGNHS. Currently there are 24 wells in the network that are on DOT property.

For more information, visit the following web site (<http://www.dot.state.wi.us>) or contact Bob Pearson, Environmental Services Section, Room 451, 4802 Sheboygan Ave., P. O. Box 7965, Madison, Wisconsin 53707-7965; phone: 608-266-7980, or e-mail robert.pearson@wisconsin.gov.

**DEPARTMENT OF HEALTH SERVICES
(formerly Department of Health and Family Services)**

Chapter 160, Wis. Stats., directs the Department of Health Services (DHS) 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. When requested, DHS staff provides interim drinking water advisories for substances that do not have a current enforcement standard. DHS staff serves as a 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. DHS staff review correspondence sent to well owners by DNR representatives. The agency frequently provides supplemental 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 DHS explain the health effects of specific contaminants and suggest strategies for reducing exposure until a safe water supply can be established. DHS staff are called upon to review the toxicity of constituents of well construction and rehabilitation products to ensure that products approved for use in Wisconsin can be used safely without risk of chemical overexposure. DHS prepares and distributes a wide variety of informational materials on groundwater and drinking water issues related to human health.

Summary of Agency Activities in FY 09

In June of 2008, twenty-nine counties in southern Wisconsin were affected by severe flooding. In many of these areas, a larger portion of the population relies on private wells as the main source of drinking water. DHS partnered with the Wisconsin State Lab of hygiene and local health departments to provide no cost well sampling to homeowners affected by the floods. DHS encouraged homeowners with impacted wells to test their drinking water for coliform and E. coli. Between June 8th and June 30th, 885 samples were tested at the SLH. Of these, 250 (28.2%) were found to be unsafe. E. coli was found in 54 (6.1%) of the June samples. Well testing and well disinfection continued for many months after the event. Between June 8th and December 31st a total of 3016 well water samples were sent to the SLH. Of these, 912 (30.2%) were unsafe. E. coli was found in 126 (4.2%) of all samples. DHS will continue to work with flooded communities and provide sampling into the next fiscal year.

FY 2009 Groundwater Coordinating Council Report to the Legislature

In response to the demand for environmental specialists to assist impacted homeowners with testing and well disinfection, DHS requested two Applied Public Health Teams from the United States Public Health Service. The teams arrived August 22nd and assisted homeowners in the hardest hit counties until September 18th. During that time, the teams visited 1,047 homes, took 196 samples, and conducted 118 well disinfections.

Revisions to NR 140 groundwater quality standards were last approved by the Natural Resources Board in 2007. These revisions established new state NR 140 groundwater standards for alachlor-ESA, a degradation product of the corn herbicide alachlor. The Legislature adopted these proposed revisions to NR 140 and they are now in effect. DHS is currently evaluating a list of substances, submitted to it by the DNR, for possible new groundwater quality standards development. DHS will develop recommendations for possible new (or revised) groundwater quality standards for the substances on the list if adequate toxicologic information is available.

DHS has developed environmental public health tracking (EPHT) modules to create data systems that link health outcome information with relevant information on hazards and exposures. As part of this cooperative agreement, DHS has identified and developed environmental public health indicators of priority drinking water contaminants such as total trihalomethanes (TTHMs) and arsenic in community water supplies, and county-level indicators of nitrate contamination of private wells. Additional county-level indicators describing the proportion of the total population served by private or public wells, and surface or groundwater drinking water sources have also been developed. All indicators serve as tools to assist in developing future targeted environmental health analyses. Other partners in this initiative include DATCP, the Wisconsin State Laboratory of Hygiene, and the UW's Division of Information Technology (DoIT) and School of Medicine and Public Health.

DHS has also been integral in national CDC-supported initiatives to explore the utility and feasibility of incorporating consistent and comparable drinking water contaminant measures onto a national environmental public health tracking (EPHT) network. DHS staff co-chair the drinking water workgroup of the State Environmental Health Indicators Collaborative (SEHIC), in which state Safe Drinking Water Information Systems (SDWIS) data have been evaluated for development of state-level public health indicators. Through SEHIC, DHS established partnerships with the U.S. Geological Survey (USGS) to map and explore geological predictors of groundwater contamination in the state. DHS has also been an active participant in a national Drinking Water Exposure Methods Workgroup, which has sought to improve methods of estimating community-level contaminant exposures based on monitoring data and water distribution system parameters. The workgroup developed an online tool to survey water utilities and wrote guidance to identify relevant drinking water data and critical data gaps for estimating exposures and using existing data resources in public health assessments. Based on these efforts, DHS now co-chairs the national content workgroup of the environmental public health tracking program that will be making final recommendations for specific drinking water data and measures to be incorporated into the national EPHT network.

For over fifteen years, DHS and DNR have provided local health departments with fee exempt well water testing. Local health departments may provide these tests to new and expectant mothers who are served by a private well and otherwise could not afford to test their wells. The tests include bacteria, nitrates, fluoride, and arsenic.

For more information, visit <http://DHS.wisconsin.gov/eh/Water/>, or contact Henry Anderson (608-266-1253; Henry.Anderson@wi.gov), Lynda Knobloch (608-266-0923; Lynda.Knobloch@wi.gov) or Mark Werner (608-266-7480; Mark.Werner@wi.gov), 1 W. Wilson St., Rm. 150, Madison, Wisconsin, 53701.

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

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

Figure 1 shows the locations of WGNHS projects that were active in FY 2009. Highlights of the WGNHS groundwater activities for FY 09 include the following:

Groundwater-Level Monitoring Network

Wisconsin's statewide groundwater-level monitoring network has been operated jointly with the U.S. Geological Survey (USGS) since 1946. Currently, the network consists of approximately 140 wells in 66 counties. 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 well pumping, the response of groundwater levels to droughts, the effects of land-use changes on groundwater systems, and the impacts of climate change. The long-term data are also used for calibration of regional groundwater models. The WGNHS will continue to supply the information to public and private clients and aid in data interpretation. For available data see <http://wi.water.usgs.gov/public/gw/>.

County Groundwater Studies.

Geologic and groundwater studies at the county scale continue to be an important part of WGNHS programs. During FY 09, the Survey initiated or carried out geologic and/or groundwater studies in the following counties: Brown, Dane, Calumet, Columbia, Fond du Lac, Iowa, Marquette, Outagamie, Sheboygan, Walworth, Waukesha, and Winnebago. Many of these studies will generate or have generated water-table maps. For a current list of available county-scale water-table maps see <http://www.uwex.edu/wgnhs/watertable1.htm>.

Regional Groundwater Studies

Regional geologic and groundwater studies usually span multiple counties. During FY 09 the WGNHS was involved in several regional projects, including the following:

- a. Geologic and hydrogeologic analyses in southeastern Wisconsin. The WGNHS conducted regional groundwater modeling and analyses in the SEWRPC (Southeastern Wisconsin Regional Planning Commission) region, spanning seven counties in SE Wisconsin. During FY 09 this work included development of groundwater recharge maps for the entire Region and an analysis of the sustainability of shallow groundwater using a series of demonstration models. The WGNHS also participated in the development of new groundwater flow models for the Troy Valley area in southern Waukesha and northern Walworth Counties.
- b. Geologic mapping and groundwater investigations. With funding from the federal STATEMAP program and additional funding from the UW Groundwater Research Advisory Council, WGNHS scientists are preparing new geologic maps and acquiring new groundwater data for Brown, Iowa, Pierce, Polk, St Croix, and Waupaca Counties. Many of these new maps are now available digitally and have been released as open-file reports (see <http://www.uwex.edu/wgnhs/wofrs.htm>).

Groundwater Research Activities

The WGNHS carries out specific groundwater research projects focused on understanding topics important to groundwater use and management in Wisconsin and elsewhere. Active research areas during FY09 included the following:

- a. *Aquitard investigation and mapping.* Aquitards, low-permeability geologic materials such as clay or shale, are critical resources for protecting water-supply wells from contamination, yet are often difficult to characterize. During 2009 the WGNHS completed a research study of groundwater movement through clayey sediment of the glacial Lake Oshkosh basin. This study, funded in part through the Wisconsin Joint Solicitation Program, is evaluating the aquitard characteristics of the lake clays and implications for recharge and groundwater management.
- b. *Viruses in groundwater.* During 2005 WGNHS hydrogeologists, working with researchers at the Marshfield Clinic, detected human enteric viruses in water from three deep municipal wells in Madison, WI (see Borchardt and others, 2007). Detection of infective viruses in such deep bedrock wells was unexpected and has important implications for protection of groundwater quality and human health. The virus presence suggests that the deep wells may be more vulnerable to contamination than previously believed. In FY09 the WGNHS completed the first of two follow-up studies to sample additional wells in the Madison area and to evaluate the pathways and mechanisms of virus transport to the deep wells; this work shows that viruses are present in many wells and that transport times from the surface to the wells can be rapid (see <http://www.uwex.edu/wgnhs/news.htm>). Municipal sewers are a likely virus source. This work will continue in FY 10.
- c. *Flooding.* Severe flooding occurred across a large portion of southern Wisconsin following intense rainfalls in June, 2008. In several areas, long-lasting flooding occurred far from streams and rivers. At these locations, the water table rose above the land surface. The WGNHS provided technical assistance and education programs to several communities affected by high water table elevations, including Spring Green (Sauk County), Brooklyn (Dane County), and Clear Lake (Rock County). (see <http://www.uwex.edu/wgnhs/news.htm>) . In 2010 the WGNHS will begin a new the examine links between flooding and climate change.
- d. *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. The WGNHS has developed a computerized technique for rapidly delineating recharge areas for use in regional groundwater models. Currently, the WGNHS is incorporating the recharge delineation methodology into new projects and is cooperating with the USGS in using it in other areas of Wisconsin. In 2009 this method was applied to the SEWRPC area in SE Wisconsin and to Dane County for use in regional water supply planning.
- e. *Fluid flow in fractured rocks.* Fractured rocks (limestone, dolomite and crystalline rocks) 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. 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. During FY 09 the WGNHS participated in a study of

recharge in shallow-bedrock areas of Calumet, Kewaunee, Brown, and Manitowoc Counties.

Karst features, including a variety of sinkholes, cavities, and solution openings, commonly are found in carbonate rock (limestone and dolomite). 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..

- f. *Investigation of unsewered rural subdivisions.* Population growth and urban expansion in many areas has resulted in residential development on formerly agricultural land, but there have been few studies of the impacts of such developments on groundwater quality. To document the effects of this land-use conversion on groundwater quality, the WGNHS initiated a monitoring program to collect water-quality data before, during, and after construction of a new, unsewered subdivision located on agricultural land several miles outside of Madison, Wisconsin.
- g. *Water-level recovery in the Lower Fox Valley.* In late 2007, suburban communities in the Lower Fox Valley reduced consumption of groundwater by switching to surface water supplied by pipeline from Lake Michigan. As a result, water levels in the deep sandstone aquifer near Green Bay have begun to recover. In mid-2007 the Survey began an effort to monitor the water level recovery in the deep sandstone aquifer near Green Bay with the objective of documenting the recovery and improving our understanding of the deep hydrogeologic system in this region of the state. Also, in 2008, the Survey initiated new county-wide bedrock mapping and stratigraphic interpretation of Brown County with support from the USGS STATEMAP program, and this bedrock mapping should be completed in 2010. In early 2009 the Survey conducted borehole geophysics and packer testing in several boreholes. These boreholes have improved the understanding of hydrostratigraphy in the region. Survey staff also provided oversight to a graduate student who compiled pumpage and water level data for the region. These efforts will continue in FY2010.

Groundwater Data Management

During FY 09 the WGNHS continued to collect geologic and groundwater data and provide this data to a variety of users. Significant efforts include the following:

- a. *WiscLith database.* The Survey has developed and distributed a digital database, called *wiscLITH*, which contains lithologic and stratigraphic descriptions of geologic samples collected from across the state. Current work efforts aim to improve the quantity of data for areas of the state where there are active geologic and hydrogeologic projects, and to improve quality control and consistency of information in the state-wide database. See <http://www.uwex.edu/wgnhs/wisclith.htm>
- b. *Well construction reports.* The WGNHS serves as the repository for Well Constructor's Reports from wells installed between 1936 and 1995. These reports were usually submitted to the DNR by a well driller within a few months of a well's completion. The database and scanned images are now available to state agencies, consulting firms, and private well owners on CD-ROM. See <http://www.uwex.edu/wgnhs/wcrs.htm>
- c. *Tillpro Database.* TILLPRO is primarily a database of grain-size analyses performed on unlithified sediment samples collected from Wisconsin and analyzed in the Quaternary

Laboratory at the Department of Geology and Geophysics, University of Wisconsin-Madison. During 2008 the WGNHS updated this database to include hydrogeologic properties of materials. The data are available for public distribution on CD-ROM. See <http://www.uwex.edu/wgnhs/wisclith.htm>

- d. *WGNHS Research Collections and Education Center (RCEC)*. The WGNHS archives geologic records, rock samples, core samples, and other materials in Mt Horeb, Wisconsin. Currently the RCEC contains over 2.5 million feet worth of drillhole cuttings, more than 600,000 feet of drill core, and more than 51,000 individual hand samples of rock from across the State. Examination tables and basic laboratory facilities at the RCEC allow convenient analysis and study of these materials. See <http://www.uwex.edu/wgnhs/core.pdf>

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 early 2009 the Survey hired a new Outreach Manager, who has the responsibility to manage and direct the Survey's education and outreach programs.

In FY 10 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, flooding, karst and shallow bedrock, the potential groundwater implications of proposed quarries, gravel pits, and high-capacity wells, and groundwater issues relevant to comprehensive planning have been popular topics recently and probably will continue to provide educational opportunities in FY 10. 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, aquitards, and other hydrogeologic topics.

WGNHS maintains a long commitment to continuing education of water well drillers, pump installers, and plumbing contractors through participation in the programs of the DNR and the Wisconsin Water Well Association. Geologic and hydrogeologic field trips for DNR water staff and new DNR employees have been held in the past and will continue as requested in FY 10. We also provide a collection of representative Wisconsin rocks for teachers to use, which include samples of our major aquifers.

Recent WGNHS Publications Relevant to Wisconsin's Groundwater Resources

Bradbury, K.R., and Cobb, M.K., 2008, Delineation of areas contributing groundwater to springs and wetlands supporting the Hine's Emerald Dragonfly, Door County, Wisconsin: Wisconsin Geological and Natural History Survey Open-File Report 2008-04, 17 p.

Bradbury, K.R., and Rayne, T.W., 2008, Sustainability of shallow groundwater in southeastern Wisconsin, USA [abstract, poster]: Geological Society of America Abstracts with Programs, annual meeting, Houston.

Bradbury, K.R., and Rayne, T.W., 2008, Sustainability of shallow groundwater in the SEWRPC region [abstract, poster]: Brookfield, Wisconsin, American Water Resources Association (Wisconsin Section), annual meeting.

FY 2009 Groundwater Coordinating Council Report to the Legislature

- Bradbury, K.R., Borchardt, M.A., Gotkowitz, M.B., and Hunt, R.J., 2008, Assessment of virus presence and potential virus pathways in deep municipal wells: Wisconsin Geological and Natural History Survey Open-File Report 2008-08, 48 p.
- Brown, B.A., Hunt, T.C., Johnson, D.M., and Reid, D.D., 2009, The Upper Mississippi Valley lead-zinc district revisited: Mining history, geology, reclamation, and environmental issues 30 years after the last mine closed: Geological Society of America (North-Central Section), 42nd annual meeting, Illinois State Geological Survey Guidebook 38, 19 p.
- Brown, B.A., Madison, F.W., Czechanski, M.L., and Schoephoester, P.R., 2009, Identification of areas suitable for surface application of waste in carbonate bedrock settings [abstract]: Proceedings of Wisconsin Land Information Association 2009 Annual Conference, p. 19.
- Cooley, E.T., Lowery, B., Kelling, K.A., Speth, P.E., Madison, F.W., Bland, W.L., and Tapsieva, A., 2009, Surfactant use to improve soil water distribution and reduce nitrate leaching in potatoes: Soil Science, vol. 174, no. 6, 11 p.
- Duffey, D.M., and Peters, R.M., 2008, Wisconsin rocks and minerals—Student collection: Wisconsin Geological and Natural History Survey Educational Series 47, 3 p., 5 rock and mineral specimens.
- Gotkowitz, M., Ellickson, K., Clary, A., Bowman, G., Standridge, J., and Sonzogni, W., 2008, Effect of well disinfection on arsenic in groundwater: Ground Water Monitoring & Remediation, vol. 28(2), p. 60–67.
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- Gotkowitz, M.B., and Attig, J.W., 2009, Floodwaters beyond floodplains: Water table rise and groundwater-induced flooding at Spring Green, Wisconsin: Geological Society of America Abstracts with Programs, vol. 41, no. 4, p. 68.
- Gotkowitz, M.B., and Attig, J.W., 2009, Groundwater-induced flooding at Spring Green, Wisconsin: Program and Abstracts for the 33rd Annual Meeting of the American Water Resources Association—Wisconsin Section, p. 14.
- Gotkowitz, M.B., and Carter, J.T., 2009, Groundwater flow model of the Geneva Lake Area, Walworth County, Wisconsin: Wisconsin Geological and Natural History Survey Open-File Report 2009-02, 36 p, 1 plate.
- Gotkowitz, M.B., Hart, D.J., and Dunning, C.P., 2008, Groundwater sustainability in a humid climate: Groundwater pumping, groundwater consumption, and land-use change: Wisconsin Geological and Natural History Survey Open-File Report 2008-02, 53 p.
- Hart, D.J., and Schoephoester, P.R., 2008, GIS-based recharge estimation for southeastern Wisconsin, in Abstracts from the Wisconsin Land Information Association 2009 Annual Conference.
- Hart, D.J., Bradbury, K.R., and Gotkowitz, M.B., 2008, Is one an upper limit for natural hydraulic gradients?: Ground Water, vol. 46, no. 4, July–August 2008, p. 518–520.
- Hart, D.J., Bradbury, K.R., Feinstein, D., and Tikoff, B., 2008, Mechanisms of groundwater flow across the Maquoketa Formation: Wisconsin Geological and Natural History Survey Open-File Report 2008-03, 51 p.
- Hart, D.J., Schoephoester, P.R., and Bradbury, K.R., 2008, Groundwater recharge in southeastern Wisconsin estimated by a GIS-based water-balance model: Southeastern Wisconsin Regional Planning Commission Technical Report 47, 23 p.

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- Hart, D.J., Schoephoester, P.R., and Bradbury, K.R., 2009, Groundwater recharge in Dane County, Wisconsin, estimated by a GIS-based water-balance model: Wisconsin Geological and Natural History Survey Open-File Report 2009-01, 16 p.
- Hooyer, T.S., and Mode, W.N., 2008, Quaternary geology of Winnebago County, Wisconsin: Wisconsin Geological and Natural History Survey Bulletin 105, 41 p., 2 pls.
- Hooyer, T.S., Hart, D.J., Bradbury, K.R., and Batten, W.G., 2008, Investigating groundwater recharge to the Cambrian-Ordovician aquifer through fine-grained glacial deposits in the Fox River Valley: Wisconsin Geological and Natural History Survey Open-File Report 2008-07, 48 p.
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- Ostrom, M.E., and Peters, R.M., 2008, Important Wisconsin rocks and minerals: Wisconsin Geological and Natural History Survey Educational Series 46, 19 p., cover letter, minerals brochure, 15 rock and mineral specimens.
- Rawling, J.E., Hanson, P.R., Young, Aaron, and Attig, J.W., 2008, Late Pleistocene dune construction in the Central Sand Plain of Wisconsin, USA: *Geomorphology*, vol. 100, p. 494–505.
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- Wilcox, J.D., Bahr, J.M., Hedman, C.J., Hemming, J.D.C., Barman, M.A.E., and Bradbury, K.R., 2009, Removal of organic wastewater contaminants in septic systems using advanced treatment technologies: *Journal of Environmental Quality*, vol. 38(1), p. 149–156.

Wisconsin Geological and Natural History Survey Current projects—2009

Water resources

County

1. Occurrence and pathways of human viruses in deep municipal wells: Dane County
2. Hydrogeology of Dane County
3. Effects of unsewered subdivisions on groundwater: Dane County
4. Groundwater budget for Dunes Lake: Door County
5. Investigation of groundwater movement through thick clayey lake sediment: Outagamie County
6. Monitoring water-level recovery of deep wells following construction of a water-supply pipeline to Lake Michigan: Brown and Outagamie Counties
7. Geophysical methods for detection of septic effluent: Portage and Dane Counties
8. Fox River Valley arsenic project: Winnebago and Outagamie Counties
9. Response to groundwater flooding and evaluation of climate change on water table elevation in Spring Green: Iowa County
10. Development of a groundwater flow model in the vicinity of Geneva Lake: Walworth County

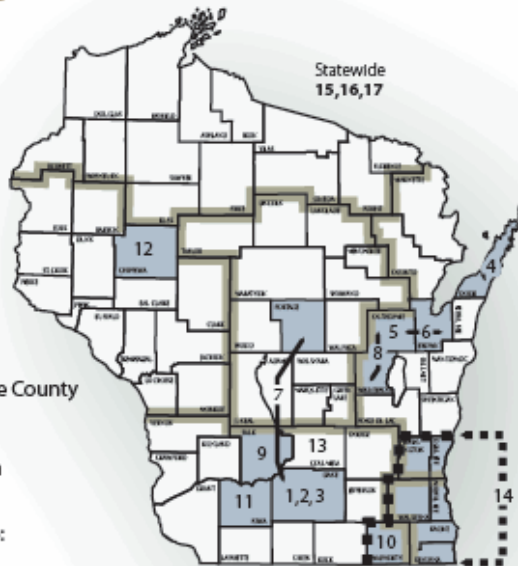
11. Groundwater resources of Iowa County
12. Groundwater quality inventory: Chippewa County
13. Groundwater resources of Columbia County

Regional

14. Hydrogeology of southeastern Wisconsin: Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Waukesha, and Washington Counties

Statewide

15. Groundwater level observation network
16. Techniques of aquitard evaluation
17. Hydrogeology of fractured rocks and karst in Wisconsin



Water resources



Wisconsin Geological and Natural History Survey
3817 Mineral Point Road, Madison, WI 53705-5100
608-262-1705 / WisconsinGeologicalSurvey.org
State Geologist: James M. Robertson

Figure 3.1 Current WGNHS water resources projects

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@wisc.edu; Web site: <http://www.uwex.edu/wgnhs/>.

UNIVERSITY OF WISCONSIN SYSTEM

The University of Wisconsin System (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. UWS staff members work with state and federal agencies and other partners to solve groundwater resource issues. Citizen outreach is accomplished through publications, media relations, public meetings, teleconferences, and water testing and satellite programs. Activities of several specific programs are described below.

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.

Research

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 WRI. Key areas of emphasis in FY 09 included research focused on various groundwater contaminants, including pathogenic bacteria, endocrine disrupting chemicals, phosphorus, nitrate/nitrite, methylmercury and arsenic.

During FY 09, the WRI directed a wide-ranging program of priority groundwater research consisting of 11 projects (see Table 1). These included short- and long-term studies both applied and fundamental in nature. They provide a balanced program of laboratory, field, and computer-modeling studies and applications aimed at preserving or improving groundwater quality. Groundwater issues investigated during the past year include:

- Occurrence and Generation of Nitrite in Ground and Surface Waters in an Agricultural Watershed
- A Thermal Remote Sensing Tool for Mapping Spring and Diffuse Groundwater Discharge to Streams
- Transport and Survival of Pathogenic Bacteria Associated With Dairy Manure in Soil and Groundwater
- Is Phosphorus-Enriched Groundwater Entering Wisconsin Streams?
- Monitoring Septic Effluent Transport and Attenuation using Geophysical Methods
- Influence of Wetland Hydrodynamics on Subsurface Microbial Redox Transformations of Nitrate and Iron
- Controls on Methylation of Groundwater Hg(II) in Hyporheic Zones of Wetlands
- Use of the 2009 Behavioral Risk Factor Surveillance Survey to Assess the Safety of Private Drinking Water Supplies
- Combination of Co-Precipitation with Zeolite Filtration to Remove Arsenic from Contaminated Water

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- "The Lethal and Sublethal Effects of Elevated Groundwater Nitrate Concentrations on Infaunal Invertebrates in the Central Sand Plains"
- Assessing Levels and Potential Health Effects of Endocrine Disrupting Chemicals in Groundwater Associated with Karst Areas in Northeast Wisconsin

These 11 projects, funded by the UWS, 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, UW-Green Bay, UW-Parkside and UW-Oshkosh.

The UWS selected five new groundwater research projects from this year's Solicitation for Proposals for support during FY 10 (July 1, 2009–June 30, 2010), and three projects, selected from the previous year's solicitation, will receive continuation support during FY 10 (see Table 2). The new projects are based at UW-Madison and UW-Milwaukee.

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 continuing education for K-12 teachers as an important component of its outreach and training effort. The UW-Madison Water Resources Library maintains an extensive curriculum collection of guides with innovative approaches and other educational materials for teaching water-related science in K-12 classrooms. The curricula are available for checkout by all teachers and residents in Wisconsin.

Grants Administration

In FY 07 WRI staff members developed a Web site (iPROPOSE) that enabled online submission and review of the Joint Solicitation for Groundwater Research and Monitoring proposals. Prospective investigators submit a proposal by filling out a series of forms and uploading their full proposal and budget. Assigned reviewers then complete their reviews through iPROPOSE by answering a series of questions online. Once all of the reviews are completed, the UW Groundwater Research Advisory Council is given access to anonymous reviews and original proposals to help decide which proposals to recommend for funding. The Web site provides a framework for consistently capturing the same information from all of the prospective investigators and reviewers, thus helping to ensure that each proposal is treated equally and fairly. In FY 08, the site was refined to increase the efficiency of the review process, including updates to the reviewer database, keywords and generating reports. iPROPOSE received several administrative enhancements during FY 09 to simplify and streamline the reviewer assignment process. New tools allow easier tracking of assigned reviewers and global management of their reviews. New features also allow fast and easy database record comparisons and merging.

Information and Outreach Activities

In 2007, the UW-Madison Water Resources Institute Web site (www.wri.wisc.edu) was rebuilt from ground(water) up to make it easier and faster for visitors to find information about WRI research projects and publications. Construction of the new site was a yearlong team effort led by James Hurley, assistant director for research & outreach, and his assistant Liz Albertson, a recent graduate from the UW-Madison Water Resources Management program. One of the goals of the Web site redesign was to provide the public with a real-time link to information about current research. To that end, the site was integrated with the UW Aquatic Sciences Center's interactive Project Reporting Online (iPRO) system, an online tool that allows principal investigators to report on the progress of their projects. The new site features a fresh design with better readability and vivid photography. The redesigned WRI Web site went online February 15, 2008,

and to date it has logged 19,080 page views and 3,289 unique visitors. The month of March was the most active month of the period was March, when 4,622 page views and 680 visitors were logged.

Water Resources Publications

In 2007, the UW Water Resources Institute published a 20-page illustrated pamphlet and two-page executive summary describing the activities of Groundwater Coordinating Council (GCC) since its creation 20 years ago. The pamphlet, entitled *Protecting Wisconsin's Buried Treasure*, documents the accomplishments, impacts and benefits of the Groundwater Research & Monitoring Program. Drawing on some of the most important issues identified in the pamphlet, two fact sheets were published in 2009: *Nitrate in Groundwater* and *Arsenic in Groundwater*. Two more fact sheets are in preparation on *Water Quantity and Groundwater Drawdown* and *Pathogens in Groundwater*. These publications will provide a complementary packet of information with long-term usefulness to all GCC member agencies. Coordinated by the GCC Education Subcommittee, this project represents a truly collaborative effort involving all GCC members. More than half of the printed copies of the pamphlet have been distributed to date, and a free electronic copy of the pamphlet in the ASC's online Publications Store has been downloaded 1,048 times between the date it was posted (11/1/07) and the end of May 2009.

In February 2006, WRI and the UW-Madison Department of Civil & Environmental Engineering published *Design Guidelines for Stormwater Bioretention Facilities* by Dustin Atchison, Ken Potter and Linda Severson. This manual provides design guidelines and a numerical model (RECARGA) that can be used for creating bioretention facilities for small-scale stormwater management that promotes infiltration of storm water in order to reduce its volume, improve its quality and increase groundwater recharge. This document continues to be extremely popular at the ASC Publications Store. Since its publication, a total of 490 print copies have been distributed and 21,321 downloads of the online PDF have been logged.

"Water Matters" Lecture Series

The WRI cosponsored "Water Matters: A Lecture Series" as part of the public programming accompanying the October 2008–January 2009 "Mami Wata: Arts for Water Spirits in Africa and its Diasporas" exhibition at the UW-Madison Chazen Museum of Art. Besides the Chazen and WRI, other major partners in this project were the UW Sea Grant Institute and the UW-Madison Department of Art History. Designed to enhance public awareness and understanding of water resources issues in the context of a changing climate, the series of five lectures featured presentations by the WRI director (Anders Andren) and faculty members from the UW-Madison American Indian Studies Program, Center for Limnology, Zoology Department and Life Sciences Communications; Northland College Department of Biology, and UC-Berkeley.

The series attracted a total of 295 attendees, and evaluations were submitted by 116 (39%). Evaluation data indicate 52% of the lecture attendees were adult campus visitors (the primary target audience), 48% were students (the secondary target audience), and 48% had no prior awareness of the WRI. Seventy one percent reported that they gained new insights as a result of the lecture they attended, and on a scale of 1 to 5 (5 = excellent), 89% gave the presentations a rating of 4 or 5. In addition, the "Water Matters" Web site, which featured audio of the American Indian "MadTown Singers" group, attracted 514 visits and 827 page views over a one-month period. One of the presenters, UW-Madison Center for Limnology Director James Kitchell, was featured on the October 19, 2008, "University of the Air," a Wisconsin Public Radio program that typically attracts more than 300,000 listeners.

Regional Climate Change Seminar Series

The WRI helped support "Climate Change in the Great Lakes Region: Starting a Public Discussion," a seminar series sponsored by the UW Sea Grant Institute and Wisconsin Coastal Management Program. From March through September 2007, eight climate-effects experts spoke at seven sites around Wisconsin to discuss what is known, what is predicted and what can be done to adapt to a changing climate. To continue and expand public discussion of what climate change means for the Great Lakes region, an 80-page summary report and a DVD featuring video and the PowerPoint® presentations from all eight seminars were published in 2008, either of which may be purchased or downloaded free of charge from the UW Aquatic Science Center's online Publications Store (aqua.wisc.edu/publications). To date, 760 copies of the printed summary report and 50 copies of the DVD have been distributed, and the online PDF of the report has been downloaded 2,129 times. A written summary and video of each seminar PowerPoint® presentation are also available for free download from the "The Seminars" section of the project Web site (www.seagrant.wisc.edu/ClimateChange), which has logged 1,471 page views in 762 visits by 657 unique visitors.

Groundwater Awareness Week

The WRI again contributed to a series of seven news releases for the annual "Groundwater Awareness Week" in March 2009 that were distributed via the UW-Madison WRI's statewide media mailing list and the UW-Extension network. Phone calls from media looking for more information indicate at least some of the information made it into several Wisconsin newspapers and on radio and television. The WRI also arranged for Stephen Ales, drinking and groundwater team supervisor for the Wisconsin Department of Natural Resources, and Kevin Masarik, outreach specialist for the UW-Stevens Point Center for Watershed Science and Education, to be guests on the March 25 broadcast of Wisconsin Public Radio's popular "Larry Meiller Show," a 45-minute live call-in talk show. Aired on WPR stations statewide, the program attracted a dozen callers from throughout the state, mainly with questions related to well water contaminants and testing issues. Program producers have said the number of calls show strong enough statewide interest in the topic to merit additional programs on groundwater topics in the future. This was reinforced by the strong follow-up interest in this topic as evidenced by more than 27 WPR member downloads of the MP3 video file of the program and 76 "plays" of the RealMedia streaming audio archive of the program on the WPR Web site.

AWRA Annual Conference

The WRI once again cosponsored the American Water Resources Association-Wisconsin Section's annual conference, "Wisconsin's Changing Water Resources," held March 5-6, 2009, in Stevens Point, Wis. Other sponsors included the UW-Stevens Point Center for Watershed Science and Education, Wisconsin Department of Natural Resources, Wisconsin Geological and Natural History Survey, and the U.S. Geological Survey's Wisconsin Water Science Center. About 170 water managers and scientists from throughout Wisconsin attended the conference, which featured more than 60 oral and poster presentations on a wide range of water resources topics. Plenary session topics included global effects of climate change, effects of climate change on Wisconsin lakes and future implications of climate change to Wisconsin. During the conference, the AWRA Wisconsin Section presented its Distinguished Service Award to WRI Assistant Director for Research and Outreach James Hurley in recognition of his exceptional contributions to water resources education, significant scientific contributions towards improving the water resources of Wisconsin and dedicated service to the AWRA organization.

Wisconsin's Water Library Outreach Activities

During the past year, Wisconsin's Water Library has continued its involvement in outreach efforts while providing a full range of library services to faculty, staff and students of the University of Wisconsin System. The library provided outreach by providing in depth reference

assistance on a wide range of water-related topics. Some examples of reference queries answered included the history of dredging of the Baraboo River; research on statistics relating to Lake Michigan weather and water conditions; thorough inventory of periodical literature on water since the beginning of the 20th century; locating references on the safety of eating fish caught in Lake Mendota; research on temperature tolerance and preference and dissolved oxygen tolerance and preference for certain fish species; and a literature search on climate change effects (or varying water level change effects) on port, harbor or marina operations.

During the reporting period, in partnership with the Wisconsin Department of Natural Resources and the Wisconsin Wastewater Operator's Association (WWOA), the library continued its outreach to current and future wastewater operators of Wisconsin. The library cataloged the essential technical manuals into the library catalog and provided loans to WWOA members around the state in support of their required state license examinations as well as in support of the educational needs of their daily work.

Wisconsin's Water Library continues to catalog all groundwater research reports from projects funded by the Water Resources Institute into WorldCat and MadCat, two library indexing tools that provide both worldwide and statewide access to WRI research. By having this information permanently indexed, the research results are easily available to other scientists throughout the UWS as well as across the nation and the world.

Library staff continued to be involved in the Allied Drive Story Hours outreach program. Allied Drive is a neighborhood of Madison where many of the families live in poverty. The program is a partnership of eight specialized UW-Madison campus libraries, the UW-Madison School of Library and Information Studies, and the Madison School and Community Recreation Safe Haven Childcare Program in which each month a different campus library hosts a reading hour with themes relating to its specialized subject area. During FY 09, the story hour was expanded to serve second and third graders in addition to first graders and kindergarteners.

Library Web Sites

The main outreach tool for the library is the newly redesigned and launched library Web site (aqua.wisc.edu/waterlibrary). During FY 09, the library combined the three previous sites into one, seamless resource. For UWS faculty, staff and students, the Web site introduces services and resources tailored to them. An important part of this redesign was the update of the research tool, the Water Research Guide (<http://researchguides.library.wisc.edu/waterresearchguide>). The research guide contains books, journals, databases and other resources on water, science and the Great Lakes.

For Wisconsin residents, the library Web site is an outreach site for those who want to learn more about our state's water resources. It makes books and other materials in the library accessible to any Wisconsin resident. During the past year, library staff produced six bimonthly lists of *Recent Acquisitions* and added several special features or annotated reading lists on such popular topics as "Flooding in Wisconsin," "Understanding and Protecting Groundwater—Recommended Reading," and "Readings on Aquaculture." The most popular pages on the site are "Water Facts", a special feature page on Native Americans and the environment, and a reading list on Landscaping & Ponds.

Wisconsin's Water Library also includes the Water Library for Kids Web site (www.aqua.wisc.edu/waterlibrary/kids). This site features children's books with aquatic themes that have won awards or appeared on best books lists. Most books are for preschool through second grade children, although there are also materials for older kids. Besides fiction and nonfiction books, the Web site also provides ideas and resources for story hours. Users can

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browse recommended reading lists by topic (frogs, fish and fishing, Great Lakes, water pollution, etc.) and by age group. Any adult Wisconsin resident can check out books online and pick them up at their local public library.

During FY 09, the library initiated a new Web 2.0 service, AquaLog (aqualog2.blogspot.com), using Blog technology to provide daily, up-to-date, water-related news, publications and resources about Wisconsin and the Great Lakes region. AquaLog's posts are searchable by topic and a monthly archive is available. A researcher or a member of the public can receive notices of updates to the blog using an RSS feed.

The popularity of the all the library Web sites continues to grow. From July 1, 2008 through June 30, 2009, the WRI Library received 20,614 visits by 18,997 unique visitors who logged 39,382 page views.

Other Web Sites

WRI maintains several other Web sites in addition those described above. The UW Water Resources Institute Web Site (<http://wri.wisc.edu>) introduces users to the Wisconsin program and includes a variety of information for those interested in water-related issues and research. The project listing, project reports, groundwater research database, funding opportunities and conference information sections of the Web site are updated annually.

The ASC Publications Store (www.aqua.wisc.edu/publications) features publications from both the Water Resources and Sea Grant Institutes. WRI fact sheets on arsenic in groundwater (197 downloads), groundwater drawdown (716 downloads) and Wisconsin's groundwater resources (155 downloads) continue to be popular. Forty two print publications and 3,480 downloads of online publications were logged by the Publications Store from 7/1/08 through 6/18/09.

UWS FY 09 Publications Resulting from Groundwater Research & Monitoring Program Projects

WRI Reports

Edil, Tunder B. and Craig H. Benson, 2007. Validation of Transport of VOCs from Composite Liners. Water Resources Institute, University of Wisconsin, Madison, Wisconsin. 113 p.

Kraft, George J., 2007. Nitrate and Pesticide Penetration into a Northern Mississippi Valley Loess Hills Aquifer. Water Resources Institute, University of Wisconsin, Madison, Wisconsin. 10 p.

Geissinger, Peter, 2008. Multi-Parameter, Remote Groundwater Monitoring with Referencing Using Crossed Optical Fiber Fluorescent Sensor Arrays. Water Resources Institute, University of Wisconsin, Madison, Wisconsin. 21 p., + app.

Gotkowitz, Madeline B., David J. Hart and Charles Dunning, 2008. Groundwater Sustainability in a Humid Climate: Groundwater Pumping, Groundwater Consumption, and Land-Use Change. Water Resources Institute, University of Wisconsin, Madison, Wisconsin. 19 p., + app.

Hickey, William J., 2008. Enhanced Reductive Dechlorination of Chlorinated Aliphatic Hydrocarbons: Molecular and Biochemical Analyses. Water Resources Institute, University of Wisconsin, Madison, Wisconsin. 16 p.

Luczaj, John and Michael McIntire, 2008. Geochemical Characterization of Sulfide Mineralization in Eastern Wisconsin Carbonate Rocks. Water Resources Institute, University of Wisconsin, Madison, Wisconsin. 15 p.

Theses

- Jablonski, M. 2009. Comparison of the Role of Ionic Strength and Surface Charge Heterogeneity on the Initial Adhesion, Distribution, and Detachment of Two Escherichia coli Strains. Master's thesis, Department of Civil Engineering and Mechanics, University of Wisconsin-Milwaukee.
- Rigo, M.V. 2009. Plasmonic Optical Fiber Sensor for Oxygen Measurement. Ph.D. thesis, Department of Chemistry & Biochemistry, University of Wisconsin-Milwaukee.

Other Publications

- Gao, J., and J.A. Pedersen. 2009. Sorption of sulfonamide antimicrobial agents to humic-clay complexes. J. Environ. Qual. (in press)
- Lepore, B.J., and P. Barak. 2009. A Colorimetric Microplate Method for Determining Bromide Concentrations. Soil Sci Soc Am J, 73: 1130-1136.
- Lepore, B.J.; C.L.S. Morgan, J.M. Norman and C.C. Molling. 2009. A Mesopore and Matrix Infiltration Model Based on Soil Structure. Geoderma. (accepted).
- Li, Z., and H. Hong. 2009. Retardation of Chromate through Packed Columns of Surfactant-Modified Zeolite. J. Hazard. Mater, **162**, 1487-1493. <http://dx.doi.org/10.1016/j.jhazmat.2008.06.061>
- Liu, Z.; Y. Li and Z. Li. 2009. Relationship between land use and surface water quality in Wisconsin - a GIS approach. J. Integr. Environ. Sci., **6**, 69-89.
- Luczaj, J.A.; M.J. McIntire, A.M. Steffel and A.L. Duca. 2009. Geochemical Characterization of Sulfide Mineralization in Eastern Wisconsin Carbonate Rocks. 33rd American Association of Water Resources Wisconsin Section Meeting, Stevens Point, Wisconsin, March 5-6, 2009. Program and Abstracts, p. 38.
- Pedersen, J.A.; K.G. Karthikeyan and H.M. Bialk. 2009. Sorption of human and veterinary antibiotics to soils. Natural Organic Matter and Its Significance in the Environment. Wu, F.; Xing, B. (eds); Science Press: Beijing, China, pp. 276-299.
- Summitt, A.; D.J. Hart, K. Masarik and D. Fratta. 2009. Imaging the Fate of Septic Tank Effluent using Multiple Geophysical Techniques. Journal of Environmental and Engineering Geophysics (in preparation for publication - draft completed).
- Wilcox, J.D.; J.M. Bahr, C.J. Hedman, J. D. C. Hemming, M.A.E. Barman and K.R. Bradbury. 2009. Removal of organic wastewater contaminants in septic systems using advanced treatment technologies. J. Env. Quality 38:149-156.
- Zhang, X.; H. Hong, Z. Li and J. Guan. 2009. Removal of Azobenzene from Water by Kaolinite. J. Hazard. Mater. (in press) <http://dx.doi.org/10.1016/j.jhazmat.2009.05.073>

For More Information

Visit the WRI Web site (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) 262-0591, or email awandren@seagrant.wisc.edu.

UW-Extension's Central Wisconsin Groundwater Center

The Central Wisconsin Groundwater Center provides groundwater education, research and technical assistance to the citizens and governments of Wisconsin. Assistance includes answering citizen questions, helping communities with groundwater protection, describing the extent and causes of groundwater pollution, assessing drinking water quality, and working on groundwater policy. Recent policy work focuses on groundwater pumping and impacts on surface waters. The center is part of the Center for Watershed Science and Education, an office of UW-Extension Cooperative Extension Service and the UW-Stevens Point College of Natural Resources. More information can be found at <http://www.uwsp.edu/cnr/watersheds/>.

Drinking Water Programs. In 2008, the Center assisted over 3,335 households in having their water tested in conjunction with county Extension offices and the Watershed Center's Water and Environmental Analysis Laboratory. Of these, 13% exceeded drinking water standards for nitrate-nitrogen. Seventeen percent of samples were unsafe because of coliform bacteria. Twelve Drinking Water Education Programs helped nearly 1,200 well users in 11 counties to understand potential remedies for these problems and the relationship of land use practices to groundwater quality.

Water quality database. The Groundwater Center maintains a database of private well testing data from the Water and Environmental Analysis Regional Laboratory at UW-Stevens Point, and Drinking Water Education Programs conducted through the Center. There are currently 536,183 individual test results for approximately 69,185 samples covering the state; including 20 counties with 100 to 500 samples and 32 counties with 500 or more samples. Chemistry data includes pH, conductivity, alkalinity, total hardness, nitrate-nitrogen, chloride, saturation index, and coliform bacteria. In 1998, a new sampling program for iron, sodium, potassium, copper, lead, calcium, magnesium, manganese, zinc, and triazine was also initiated. Arsenic and sulfate were added late in 1999. The database primarily covers the period 1985 to the present. The database is PC-based and can be easily queried to be a significant source of information for local communities and groundwater managers. Reports that summarize county-wide results have been generated for Iowa, St. Croix and Dodge Counties.

Policy. The Center continues to play pivotal roles in a number of state groundwater issues. Working with partners in the private and public sectors on groundwater quantity policy and law has been a continuing priority for the Center.

Partnerships. Center staff works with agencies and private organizations, including the Wisconsin Agricultural Stewardship Initiative, Wisconsin Potato and Vegetable Growers Association Nonpoint Pollution subgroup, DATCP Atrazine Technical Advisory Committee, and Extension Nutrient Management Self-Directed Team. The Center continues to work closely with local governments, Land Conservation Departments, UW-Extension County Faculty and Basin Educators, Groundwater Guardian groups, and many local watershed based groups.

Ongoing Research

- Understanding the effects of groundwater pumping on lake levels and streamflows in central Wisconsin

Recent Publications and Reports

Kraft, G.J., B.A. Browne, W.D. DeVita, and D.J. Mechenich. 2008. Agricultural Pollutant Penetration and Steady-State in Thick Aquifers. *Ground Water Journal* 46(1):41-50.

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- Browne, B.A., G.J. Kraft, W.D. DeVita, and D.J. Mechenich. 2008. Collateral Geochemical Impacts of Agricultural N Enrichment from 1963 to 1985: A Southern Wisconsin Groundwater Depth Profile. *J. of Env. Quality*.
- Lowery, B., G. J. Kraft, W. L. Bland, A.M. Weisenberger, and Phillip E. Speth. 2008. Trends in Groundwater Levels in Central Wisconsin. *In* Proceedings of Wisconsin's annual potato meetings. University of Wisconsin - Madison College of Life Sciences and UW-Extension. Madison WI.
- Lowery, B., W.L. Bland, G.J. Kraft, A.M. Weisenberger, M.L. Flores, and P.E. Speth. 2008. Local groundwater levels in Wisconsin. *In* Proceedings of the Wisconsin Fertilizer, Aglime & Pest Management Conference. University of Wisconsin - Madison College of Life Sciences and UW-Extension. Madison WI.
- Clancy, K., G.J. Kraft, and D.M. Mechenich. 2008. Knowledge development for groundwater withdrawal management around the Little Plover River, Portage County Wisconsin. Report to the Wisconsin Department of Natural Resources, Project NMG00000253. University of Wisconsin – Stevens Point.
- Kraft, G.J., K. Clancy, and D.M. Mechenich. 2008. A survey of baseflow discharges in the western Fox-Wolf watershed. University of Wisconsin – Stevens Point.
- Masarik, K., D. Neuendorf, D. Mechenich. 2007. Dodge County Groundwater: A community resource. County Groundwater Report. Center for Watershed Science and Education, Stevens Point, WI.

Other UW-Extension Water Programs

UW Environmental Resources Center (ERC). The UW Environmental Resources Center (ERC) hosts UWEX state specialists addressing water resources, land and water conservation, and forestry. ERC also coordinates a number of regional and national programs addressing water resources and national youth water education initiatives related to groundwater.

ERC Regional Water Programs and Conservation Professional Development: Through a federal partnership with USDA Cooperative States Research Education and Extension Service (CSREES), ERC hosts the Great Lakes Regional Water Program, a 6-state program involving collaboration among Land Grant Universities, state agencies, and federal agencies across the region (<http://www.uwex.edu/ces/regionalwaterquality/>). One of the programs emerging from this collaboration is a partnership providing multi-state professional development to conservation professionals. In 2008, Wisconsin programs included issues of manure management and fractured bedrock geology including:

- Presentation and tour to the WI Land and Water Conservation Board
- 60 manure applicators received 1.5 hrs continuing education on manure application in Karst areas
- Half day workshop on Karst incorporated into the Conservation Planning Training session in NE WI
- Karst manure and fertilizer management incorporated into farmer training in 3 counties.

ERC Youth Education: The ERC provides national coordination for two youth water education programs, *Educating Young People about Water* (EYPAW) and *Give Water a Hand* (GWAH). EYPAW offers four guides and a water curricula database to provide assistance for developing a community-based, youth water education program. The EYPAW Web site, <http://www.uwex.edu/erc/ey paw>, provides access to a database of more than 190 water-related curricula that may be searched by grade level or water topic. Goals of the GWAH curriculum are to protect and improve local water quality by encouraging youth to investigate local issues, and to

plan and complete a service project. Youth then address a problem they identify with the assistance of a local natural resource expert. Program materials 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
- *Evaluating USGS Water Education Resources* – an assessment of USGS materials to assist with USGS education program development decisions
- *Source Water Education* – a gap analyses of youth water curricula for source water education and riparian education resources.
- *Water Action Volunteers (WAV)* – a program for both kids and adults who want to learn about and improve the quality of Wisconsin's waterways through projects and hands-on activities.

Work continues on new water education initiatives including a national youth riparian curriculum, and the National Extension Water Outreach Education project to develop and promote best education practices for water education and to improve access to education resources and strategies. Find links to these programs on the ERC Web site at <http://www.uwex.edu/erc>.

Multi-Agency Land and Water Education Grant Program (MALWEG). UW-Extension coordinates the Multi-Agency Land and Water Education Grant Program (MALWEG), which has funded more than 170 nutrient management education projects since its inception in 1997. These projects have resulted in awards of over \$2.5 million in educational assistance funds to county-based conservation professionals in Wisconsin who in turn deliver research-based best management practices and expertise into the hands of farmers on an individual basis.

MALWEG partners, such as USDA-CSREES; Natural Resource Conservation Service; UW-Extension; Wisconsin DNR; the Basin Education Program and Discovery Farms, have contributed funding and time to this effort. The counties have also matched a considerable amount of resources to reach more than 1,600 farmers since 1997. More information can be found at <http://clean-water.uwex.edu/malweg/>.

Basin Education Initiative. The UWS cooperates on community-focused educational programs with other state agencies involved with water resources and natural resource issues. Since 1998, UW-Extension has worked in partnership to support state, county and local efforts to protect and improve surface and ground water quality and quantity across the state's 22 major river basins. Fifteen locally situated Basin Educators develop and conduct programs throughout each basin, accessing state-level support for educational material development and program evaluation. The educational programs address a broad range of groundwater-related topics, including drinking water, threats to groundwater quality, impacts of land-use changes and land management decisions on groundwater quantity, information about localized groundwater problems such as karst geology, water conservation and efficiency, and a variety of other water quality issues. More information can be found at <http://basineducation.uwex.edu>.

UW Nutrient and Pest Management (NPM) program. In 1990 a broad coalition of agricultural organizations, environmentalists, and the University sought funding for a water quality program for farmers and the agricultural community. The NPM outreach program has conducted on-farm demonstrations and education throughout Wisconsin to address groundwater and surface water contamination from agriculture and the profitability of recommended practices.

A major portion of the program's focus has been nutrient management – the careful, profitable use of fertilizers and animal manures in crop production. NPM recently revised and distributed the *Nutrient Management Farmer Education Curriculum* that includes a discussion of nitrates in groundwater. The curriculum has been taught throughout the state to hundreds of producers. NPM also coordinates training workshops for Nutrient Management Planners that teach agricultural and conservation professionals how to write nutrient management plans. To prevent pesticide contamination of groundwater resulting from field applications, program staff provided integrated pest management education and coordinated Wisconsin extension's WeedSoft development and delivery. WeedSoft is a computer program that helps growers make cost effective, environmentally sound weed management decisions. One module includes leaching ratings to assist growers in herbicide selection.

NPM continues to work with Wisconsin farmers to ensure they are not over-applying nitrogen and other inputs so as to minimize potential losses to groundwater. The NPM field staff completed on-farm demonstrations, manure spreader calibration, and taught many farmers how to write and update their nutrient management plans. More information on these efforts and many publications are available at the NPM web site (<http://ipcm.wisc.edu>).

For more information on UW Extension programs related to groundwater, contact Ken Genskow, UW Environmental Resources Center, UW-Madison, 445 Henry Mall, Room 202 Madison, WI 53706, phone (608) 262-0020, fax (608) 262-2031, or email kgenskow@wisc.edu; or George Kraft, Center for Watershed Science and Education, 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 through testing, emergency response, education and outreach, and specialized research. The activities related to groundwater span 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 routinely 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 (Norovirus), parasites (Cryptosporidium, Giardia, and microsporidia), radioactivity, inorganic compounds (mercury, nitrate, arsenic) and organic compounds (atrazine, PCBs, PBDEs).

In addition to routine testing of fecal indicators and emerging contaminants, the WSLH now employs a "toolbox" of microbial source tracking assays. Microbial source tracking is used to determine sources of fecal contamination in water, whether from human or animal sources, using multiple microbial and chemical agents. The data is then used for making management decisions regarding fecal pollution control of groundwater.

Another important focus of the WSLH Drinking Water Quality Program is emergency response to incidents involving groundwater. For example, WSLH works with DHS and DNR to investigate outbreaks of illnesses of unknown (possibly food or water) origin. Staff provides

background information on the outbreaks 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 including, (1) instructional consultations for well owners and well drillers, (2) on-site training of municipal water supply operators, and (3) tours for a variety of international, educational, regulatory, and other governmental groups. Staff members have developed an interactive study guide dealing with safety, sampling, and chemistry for drinking water operators and publications related to drinking water. In FY 07 WSLH updated their well water activity sheet, “*Test your well water annually*” brochure, and other well water testing promotional materials for National Public Health Week. Staff members attend and present papers at a variety of conferences and symposia and publish research findings in professional journals.

Summary of groundwater-related research in FY 09:

- Assessing occurrence, persistence and biological effects of hormones released from livestock waste. Jocelyn Hemming, PhD, Wisconsin State Laboratory of Hygiene. (Funded by the U.S. EPA, project ongoing).
- Toxicological Relevance of Endocrine Disruptors and Pharmaceuticals in Drinking Water. Jocelyn Hemming, PhD, Wisconsin State Laboratory of Hygiene. (Funded by the American Water Works Association Research Foundation – AWWARF, project completed).
- Assessment of the potential of hormones from agricultural waste to contaminate groundwater. Jocelyn Hemming, PhD, Wisconsin State Laboratory of Hygiene. (Funded by the DNR through the GCC’s joint solicitation, project ongoing).
- Development of a PCR method for Adenoviruses as a means of distinguishing human from bovine contamination. Sam Sibley, University of Wisconsin State Laboratory of Hygiene. (Funded by the DNR through the GCC’s joint solicitation, project completed).
- Assessment of the Efficacy of the First Water System for Emergency Hospital Use. Sharon C. Long, PhD, Jeremy Olstadt, Wisconsin State Laboratory of Hygiene and Dennis Tomczyk, Hospital Emergency Preparedness, Wisconsin Division of Public Health. (Funded by the Wisconsin Division of Health, publication pending with the Journal of Disaster Medicine and Public Health Preparedness).
- Madison Metropolitan Sewerage District: Biosolids Research 2009-2010 and Madison Metropolitan Sewerage District: PFRP Equivalency Project, Sharon C. Long, PhD and Jamie R. Stietz, Wisconsin State Lab of Hygiene. (Project ongoing).
- Evaluation of PCR-based methods for *Rhodococcus coprophilus*. Sharon C. Long, PhD and Jamie R. Stietz, Wisconsin State Laboratory of Hygiene. (Funded by the DNR through the GCC’s joint solicitation, publication pending).

For more information, visit the following website (<http://www.slh.wisc.edu/>) or contact William Sonzogni, Wisconsin State Laboratory of Hygiene, 2601 Agriculture Drive, Madison, WI 53718, phone (608) 224-6200, or email sonzogni@facstaff.wisc.edu.

FEDERAL AGENCY PARTNERS

U.S. Geological Survey - Water Resources Discipline: Wisconsin Water Science Center

The mission of the U.S. Geological Survey - Water Resources Discipline 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. The

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Wisconsin Water Science Center accomplishes this mission 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 Wisconsin's water resources.
- Conducting analytical and interpretive water-resource appraisals describing the occurrence, availability, and physical, chemical, and biological characteristics of surface water and groundwater.
- 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 in order to quantitatively predict their response to stress.
- Disseminating 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 groundwater.
- 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 Water Science Center is currently conducting cooperative projects that have a significant groundwater component with the Wisconsin Department of Natural Resources (WDNR), UW Systems, UW-Extension (Wisconsin Geological and Natural History Survey [WGNHS] and Center for Land Use Education [CLUE]), Southeast Wisconsin Regional Planning Commission (SEWRPC), the Menominee and Stockbridge-Munsee Tribes of Wisconsin, the Rock River Coalition, and numerous county and city governments. The federal funds that support these projects come from the Cooperative Water Program, an ongoing partnership between the USGS and non-Federal agencies (<http://water.usgs.gov/coop/>). In addition the Wisconsin Water Science Center conducts projects that are funded entirely by USGS Federal programs. Recent and current projects that have a significant groundwater component are listed below.

Projects funded cooperatively with state and local agencies:

1. Operation and maintenance of the Wisconsin Observation Well Network; data collection, processing, archiving, and presentation (with WGNHS).
2. Development of the Water Use in Wisconsin summary report (produced at a 5-year interval); data collection and estimation, development of water-use coefficients and default values; evaluation compiled by aquifer, geographic, and political criteria (with WDNR). Simulation of groundwater/surface-water systems in the vicinity of Chenequa, Wisconsin using Local Grid Refinement of the SEWRPC southeast Wisconsin groundwater-flow model (with Village of Chenequa and SEWRPC).
3. Evaluating land use and climate change effects on a southern Wisconsin trout stream - results of the Black Earth Creek modeling study (with WDNR and local communities).
4. Assess the breeding range contraction of Great Lakes area Common Loons resulting from the alteration of habitat characteristics sensitive to climate change (with WDNR).
5. Simulation of groundwater/surface-water systems in the Rock River Basin of Wisconsin (with the Rock River Coalition and 40 contributors in the Rock River Basin).
6. Simulation of the effects of water diversion from Shell Lake, Washburn County, on the shallow groundwater – lake system (with the City of Shell Lake and the WDNR).

Wisconsin projects funded entirely by USGS:

1. Availability and use of fresh water in the United States: Lake Michigan Pilot Study
http://water.usgs.gov/ogw/gwrp/activities/wateravail_pilot.html.

2. Relation between groundwater flow and beach health (water quality) at Horseshoe Bay in Door County
3. Hydrologic and biogeochemical budgets in temperate lakes and their watersheds, northern Wisconsin Long Term Ecological Research site, <http://infotrek.er.usgs.gov/doc/webb/index.html>.
4. Western Lake Michigan Drainages National Water-Quality Assessment <http://wi.water.usgs.gov/nawqa/index.html>.
5. Spatial and temporal shallow groundwater recharge rates in Wisconsin

Compilation of Wisconsin 2005 Water-Use Data. Every 5 years the USGS Wisconsin Water Science Center is responsible for presenting data collected and/or estimated for water diversions and withdrawals to the USGS National Water-Use Information Program. A report, detailing water use in Wisconsin, is published using the data compiled for this program. This program serves many purposes such as quantifying how much, where, and for what purpose water is used, tracking and documenting water-use trends and changes, and facilitating cooperation with other agencies to support hydrologic projects. The Water-Use Information Program is evolving from being a data-collection and database management program to a water-use science program, emphasizing applied research and development of techniques for statistical estimation of water use, as well as analysis of water using behaviors (National Research Council, 2002). The USGS Wisconsin Water Science Center will continue to develop new and strengthen existing partnerships to broaden the understanding of water use in Wisconsin.

In 2007, there were seven investigations of the USGS Wisconsin Water Science Center that incorporated a water-use component. The majority of these investigations integrate water-use data into hydrologic models that evaluate the impact of water use on water budgets, groundwater-flow paths, and baseflow contribution to surface-water features. These data and the periodic report are becoming increasingly critical in understanding water use, supporting Groundwater Management Areas around the state, and supporting implementation of the Great Lakes Compact.

The USGS Wisconsin Water Use 2005 report (Buchwald, 2009) has been released and can be accessed through the USGS Publication Warehouse at <http://pubs.er.usgs.gov/>. Additionally, information about this study along with summaries of data and information on Wisconsin water use can be found at the following web site: <http://wi.water.usgs.gov/data/wateruse.html>.

Evaluating land use and climate change effects on a southern Wisconsin trout stream: Results of the Black Earth Creek modeling study. A well-known trout stream and Outstanding and Exceptional Resource Water – the Black Earth Creek (BEC) watershed in northwest Dane County – is undergoing land use conversions from agricultural to residential and commercial. Currently the long-term impacts of urbanization on the base flow and stormflow (flood peaks) is not well characterized. Urbanization may increase both stormflow (Steuer and Hunt, 2001) and non-point source loads of nutrients, pesticides, and sediments. Because increased surface flows divert water that would normally recharge to the groundwater system; urbanization can result in less groundwater being discharged as base flow to streams. By understanding the interactions between surface water and groundwater systems, the effectiveness of water management alternatives used to mitigate the effects of urbanization can be evaluated. A coupled groundwater/surface-water computer model of the basin has been constructed using the newly developed USGS code GSFLOW (Markstrom et al. 2008). This approach includes all elements of the hydrologic cycle including rainfall, snowmelt, evapotranspiration, interflow, streamflow, baseflow, and groundwater flow resulting in a quantitative characterization of the entire hydrologic system.

There have been three phases of recent study of the Black Earth Creek watershed cooperatively funded by communities in the watershed, WDNR, and USGS. The first phase of the project

involved modeling surface and groundwater flow using existing data for the area. Results of the modeling effort provided direction for additional fieldwork needed to enhance the model in Phase 2 of the study. In Phase 3 the model was used to assess the effects of climate change and possible land-use development scenarios and mitigation strategies (Westenbroek, 2009).

Rock River Basin Groundwater-Flow model

A study of the shallow groundwater-flow system in the Rock River Basin was undertaken from 2007 to 2009 by the U.S. Geological Survey in cooperation with the Rock River Coalition (RRC). The primary objectives of the study are to improve understanding of the hydrogeology of the Rock River Basin, evaluate groundwater/surface-water interaction and base flow contribution to the Rock River and its tributaries, estimate amounts and rates of groundwater flow, and highlight areas that would benefit from additional data collection. These objectives have been achieved through the development of a numerical screening model to simulate the groundwater-flow system of the basin. The screening model describes the regional characteristics of the groundwater-flow system, and is a tool that can be used to test alternative plans to manage the resource (for example, effects of pumping well locations and rates on stream base flows). Additionally, the screening model provides a framework from which local or site-specific models can be developed with little additional data collection. Two public meetings have been held to present the results of the study, and work continues with the RRC and WGNHS to encourage the use of the model by communities and consultants in the basin to address water management problems.

Great Lakes Basin Pilot study to improve fundamental knowledge of the water balance of the basin, including the flows, storage, and water use by humans. At the request of Congress, the USGS is assessing the availability and use of the Nation's water resources to gain a clearer understanding of the status of our water resources and the land-use, water-use, and natural climatic trends that affect them. The goal of the National Assessment of Water Availability and Use Program is to characterize how much water we have now, how water availability is changing, and how much water we can expect to have in the future.

Water availability is a function of many factors, including the quantity and quality of water and the laws, regulations, economics, and environmental factors that control its use. The focus of the Great Lakes Basin Pilot study is on improving fundamental knowledge of the water balance of the basin, including the flows, storage, and water use by humans. An improved quantitative understanding of the basin's water balance not only provides key information about water quantity but also is a fundamental basis for many analyses of water quality and ecosystem health.

For Wisconsin this Pilot study is providing important hydrologic data sets, an assessment of historical water use (Buchwald and others, in preparation), detailed recharge maps developed with the Soil Water Balance model (Dripps 2003; Westenbroek and others, 2009), and a calibrated groundwater-flow model (Feinstein and others, in preparation) providing information critical to water management and implementation of the Great Lakes Compact.

Development and use of the USGS Coupled surface-water groundwater model code at the Northern Wisconsin Long Term Ecological Research site

Simulations of climate-change effects on groundwater systems have often been simplified, using estimates to characterize changes in the hydrologic cycle. The recently developed USGS groundwater/surface-water code, GSFLOW (Markstrom et al., 2008), combines two widely used models: PRMS and MODFLOW. Using this approach, the effect of projected rainfall and temperature changes, due to climate change, on stream flow and groundwater recharge can be predicted.

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Two relatively simple climate scenarios were examined using a GSFLOW model of the USGS Trout Lake Water, Energy and Biogeochemical Budgets (WEBB) study site in northern Wisconsin, USA (Hunt et al. 2008). The first evaluated a uniform 4.4° C increase in air temperature that represented one projected year 2100 condition. The second evaluated the same uniform increase in air temperature, but added the effects of extreme precipitation events by combining weekly precipitation into a single day in each week (changing precipitation timing, but not total annual amounts). Expected decreases in lake stage and stream flow were observed; more interestingly, results suggested that climate change may result in changes in the sources of water to ecosystems, as illustrated by a rain-dominated soft-water lake changing to a groundwater influenced flow-through lake. Inclusion of extreme precipitation events was somewhat mitigated when combined with the increase in temperature because the soil zone had more storage available. The effect on the biotic system was evaluated using simulated changes in hydrograph shape metrics. Both climate scenarios resulted in decreases in expected macroinvertebrate abundance and richness, with the lowest expected quality at a stream site that periodically went dry during the simulations. Even though the simulations could be improved with more sophisticated climate processes and scenarios, these results demonstrate a potential utility for GSFLOW modeling for today's resource management actions.

Web Site – Protecting Wisconsin's Groundwater Through Comprehensive Planning. In cooperation with the UW-Extension Center of Land Use Education and the Wisconsin DNR a web site has been developed to make Wisconsin groundwater information and data accessible and usable, thereby encouraging government officials and planners to incorporate groundwater into their comprehensive-planning processes (<http://wi.water.usgs.gov/gwcomp/index.html>). This web site provides summaries of, and access to, data and information on geology, general hydrology, and groundwater quantity and quality generated by state, local, federal, and independent sources. The data and information take the form of maps, reports, data bases, and web resources. All data are from publicly accessible sources. This web site also provides guidance for incorporating groundwater information into comprehensive plans, and presents case studies of municipalities that have worked hard to understand their groundwater resources and develop groundwater goals, objectives, and policies.

From January 1 through May 18, 2009 the website is averaging over 600 successful requests for information per day, and nearly 100 successful requests for pages per day. 1,700 distinct files have been requested and more than 1,200 different individuals or organizations from dozens of countries have visited the site over that period. The complete Web Server Statistics are available at: http://wi.water.usgs.gov/server_stats/2009/usgs/wi.water_gwcomp_i.html#req

Through the Local Government and Planning Subcommittee, the GCC will seek ways to further assist local communities in their planning efforts to encourage groundwater protection. Long term hosting and maintenance of this web site is undetermined; other than correcting identified errors this site is currently static. Funding for development of this web site came from the Wisconsin Department of Natural Resources through the GCC's Joint Solicitation for Groundwater Research & Monitoring. Additional funds were provided by the US Geological Survey Cooperative Water Program.

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USDA Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) is a federal agency within the US Department of Agriculture. The NRCS works with private landowners to promote conservation of natural resources. In Federal fiscal year 2008 (Oct. 1, 2007 to Sept. 30, 2008), NRCS, in cooperation with county Land Conservation Departments, planned over 385,000 acres of conservation systems and implemented conservation practices to improve water quality on over 572,000 acres in Wisconsin.

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. In 2008, 1221 farmers implemented nutrient management plans through the Environmental Quality Incentives Program in Wisconsin.

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- *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. Last year pest management was implemented on 208 farms and plans developed for 93.
- *Animal waste storage*: Proper waste storage siting and design is imperative to protect groundwater from contamination by animal waste. Last year 74 animal manure storage structures were planned and 49 were installed.
- *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. CNMPs entail a thorough review of the farmstead, ensuring that manure and wastewater are properly stored and handled, stormwater remains clean or is captured, and drinking water wells are properly protected. It may also include feed management to reduce phosphorus in manure and other manure use alternatives such as biofuel production and composting. Last year, CNMPs were written for 83 farms, and 260 implemented.
- *Managed grazing*: Pastureland is divided into small paddocks and intensively grazed for 1 or 2 days and then rested for 25-35 days. About 329 prescribed grazing plans were implemented covering 20,000 acres. Prescribed grazing was applied to 11,367 acres.
- *Wetland Reserve Program*: Restores wetlands through permanent or 30-year easements or 10-year contracts. The total number of acres enrolled in WRP is approximately 47,000. The Wetlands Reserve Program in 2008 recorded 22 easements covering 1,343 new acres.
- *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. In 2008, 1,144 contracts were completed for \$21.2 million in financial assistance for farmers..
- *Well decommissioning*: Proper decommissioning is essential to prevent contaminants from entering groundwater through abandoned wells, which are direct conduits to the groundwater. NRCS decommissioned 35 wells last year.

2008 Accomplishments through Conservation Technical Assistance Program

- Conservation Plans Written on 385,639 acres
- Wetlands Created, Restored or Enhanced = 2,735 acres
- Comprehensive Nutrient Management Plans Written = 274
- Comprehensive Nutrient Management Plans Applied = 219
- Watershed or Area-wide Conservation Plans Developed = 13
- Land with Conservation Applied to Improve Water Quality = 572,293 acres
- Cropland with Conservation Applied to Improve Soil Quality = 490,272 acres
- Land with Conservation Applied to Improve Irrigation Efficiencies = 5,866 acres
- Grazing and Forest Land with Conservation Applied to Improve the Resource Base = 43,941 acres

The agency also provides leadership with its Standards Oversight Council – an Interagency Committee to revise and maintain Conservation Practice Standards. Practice standards benefit the public by helping to protect groundwater. For example NRCS Practice Standards for Feed

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Storage Leachate and Runoff Control, and for Milking Center Wastewater Treatment System are being finalized in 2008-9.

To find out more information about NRCS, go to the home page at

<http://www.wi.nrcs.usda.gov>, contact Renae Anderson at 608-662-4422 ext. 227.