

Chapter 8: Ground Water

The WDNR has statutory authority to protect, maintain, and improve groundwater within the state. DNR establishes the groundwater quality standards for the state, monitors groundwater quality, identifies and addresses groundwater quality problems and makes recommendations for preventing contamination. The Groundwater Section within the WDNR's Bureau of Drinking Water and Groundwater takes a leading role in these activities. The Groundwater Section also works closely with the Groundwater Coordinating Council (GCC) to insure coordination between state agencies with groundwater protection and clean-up responsibilities.

The 305(b) report gives WDNR the opportunity to characterize the quality of Wisconsin's groundwater and set goals for future needs identified by the report. The report gives a brief history of Wisconsin's groundwater laws, a description of each state agency with groundwater protection and cleanup responsibilities, a description of Wisconsin's major aquifer types, and a description of analytical efforts undertaken in the state to determine the condition of the resource.

Wisconsin's Groundwater Law

Wisconsin's Comprehensive Groundwater Protection Act, 410, was signed into law on May 4, 1984. The law expanded Wisconsin's legal, organizational and financial capacity for controlling groundwater pollution. Under Act 410, Wisconsin developed Chapter 160 Wisconsin Statutes. Chapter 160, dubbed the "Groundwater Law," has been called the most comprehensive regulatory program for groundwater in the country. All state agencies involved in groundwater protection must adhere to numerical standards that define the level at which regulatory agencies must act to clean up pollutants in groundwater. These standards are defined not only by public health, but also by the effect a pollutant can have on the environment and public welfare.

One of the most important features of the Wisconsin's groundwater law is something that is not in it – aquifer classification. Aquifer classification involves looking at the use, value or vulnerability of each aquifer and allowing some to be "written off", as not fit for human consumption. The philosophical underpinning of Wisconsin's groundwater law is the belief that all of our groundwater must be protected as future sources of drinking water.

Under chapter 160, Wis. Stats., the Department of Natural Resources (DNR) must establish state groundwater quality standards based on recommendations from the Department of Health and Family Services (DHFS). Setting standards is a continuous process. As substances are determined to be threat to groundwater or if they are detected in groundwater, they are placed on a priority list established by DNR in conjunction with other state agencies. The numerical standards are in chapter NR 140, Wis. Adm. Code. For each substance there is an enforcement standard (ES) which determines when a violation has occurred and a preventive action limit (PAL) which serves as a trigger for possible early remedial action.

Once groundwater standards are set, all state agencies must manage their regulatory programs to comply. Each state agency involved in activities that affect groundwater must promulgate rules to assure that the groundwater standards are met and to require appropriate responses when standards are not met. The role of each agency in implementing the groundwater standards is described below under "Wisconsin Groundwater Programs."

Under Chapter 160, Wisconsin Statutes, money from the Groundwater Account of the Environmental Fund has been used for problem-assessment monitoring, regulatory monitoring, at-risk monitoring and management-practice monitoring as well as creating a data management system for collection and management of the groundwater data.

The Groundwater Coordinating Council

The responsibility for managing Wisconsin's groundwater is delegated to many different government agencies. The Groundwater Coordinating Council (GCC) facilitates cooperation between the different agencies on non-regulatory issues. Since 1984, the GCC has served as a model for interagency cooperation among state government officials, the governor, and local and federal governments.

Representatives from the departments of Natural Resources; Commerce; Agriculture, Trade and Consumer Protection; Health and Family Services; Transportation; the University of Wisconsin System; Wisconsin Geological and Natural History Survey and governor's office serve on the council. The GCC advises and assists state agencies in the coordination of nonregulatory programs and the exchange of information related to groundwater.

Wisconsin Groundwater Programs

A summary of Wisconsin's Groundwater programs is provided in U.S. EPA Table 37 (5-2).

Table 37. Summary of Wisconsin's Groundwater Protection Programs (Table 5-2)

Programs or Activities	Check	Implementation Status	Responsible State Agency
Active SARA title III Program	•	E	DNR
Ambient groundwater monitoring system	•	E	DNR, DATCP, DOT, UWS, WGNHS, GCC
Aquifer Vulnerability assessment			
Aquifer mapping	•	E	WGNHS
Aquifer characterization	•	E	WGNHS
Comprehensive data management system	•	E	DNR, DATCP, DHFS, COMM, DOT, WGNHS
EPA-endorsed Core Comprehensive State Groundwater Protection Program (CSGWPP)	•	E	DNR
Groundwater discharge permits	•	E	DNR, COMM
Groundwater Best Management Practices	•	E	DNR, DATCP
Groundwater legislation	•	E	DNR, COMM, DATCP, DOT, DHFS
Groundwater classification			
Groundwater quality standards	•	E	DNR, DHFS
Interagency coordination for groundwater protection ordinances	•	E	GCC, DNR
Nonpoint source controls	•	E	DNR, DATCP
Pesticide State Management Plan	•	E	DATCP
Pollution Prevention Program	•	E	DNR
Resource Conservation and Recovery Act (RCRA) Primacy	•	E	DNR
Source Water Assessment Program	•	E	DNR
State Superfund	•	E	DNR
State RCRA Program incorporating more stringent requirements than RCRA Primacy	•	E	DNR
State septic system regulations	•	E	COMM
Underground storage tank installation requirements		E	COMM

Programs or Activities	Check	Implementation Status	Responsible State Agency
Underground Storage Tank Remediation Fund	•	E	COMM
Underground Storage Tank Permit Program	•	E	COMM
Underground Injection Control Program	•	E	DNR
Vulnerability assessment for drinking water/ wellhead protection	•	E	DNR
Well abandonment regulations	•	E	DNR
Wellhead Protection Program (EPA-approved)	•	E	DNR
Well installation regulations	•	E	DNR
Other Programs or activities (please specify)			

E – Established

CE – Continuing Effort

UD – Under Development

UR – Under Revision

DATCP – Wisconsin Department of Agriculture, Trade and Consumer Protection

DHFS - Wisconsin Department of Health and Family Services

DNR – Wisconsin Department of Natural Resources

COMM – Wisconsin Department of Commerce

DOT – Wisconsin Department of Transportation

GCC – Groundwater Coordinating Council

WGNHS – Wisconsin Geological and Natural History Survey

UWS – University of Wisconsin System

Department of Natural Resources

The DNR is the designated state agency to protect, maintain and improve groundwater within the state. The Bureau of Drinking Water and Groundwater regulates public water systems and private drinking water supply wells. The Groundwater Section assists in coordinating groundwater activities of the DNR, as well as other state agencies. The groundwater section has primary responsibility for adoption of groundwater standards contained in ch. NR 140, Wis. Adm. Code. Other duties of the Groundwater Section include development of the annual groundwater monitoring plan, coordination of the joint solicitation for groundwater-related monitoring and research proposals, review and management of groundwater monitoring projects, integration of groundwater into basin reports and watershed plans, and maintenance of a data management system for groundwater data.

The DNR is the lead agency for coordination of wellhead protection (WHP) and source water assessment program (SWAP) activities. Of a total 1104 community groundwater supply systems, 73, serving a combined population of 212,600, have approved WHP plans. The Source Water Assessment Program will provide information that will help communities produce high quality wellhead protection plans.

The Bureau of Waste Management regulates and monitors groundwater at proposed and active solid waste facilities and landfills. The Bureau for Remediation and Redevelopment oversees clean-up actions at spills, hazardous substance release sites, abandoned container sites, state funded responses, Brownfields, “high priority” leaking underground storage tanks, closed wastewater and solid waste facilities, dry cleaner sites, hazardous waste corrective action and generator closures, and sediment clean-up actions. The program runs the Dry Cleaner Reimbursement program and helps run the Brownfield Site Assessment Grant program. Remediation and Redevelopment is also responsible for the Geographic Information System (GIS) registry of closed remediation sites. This database is available on the internet and includes information on site location and remaining residual groundwater contamination above the NR 140 ES. Department of

Natural Resources Manual code 4822.1 instructs staff on coordination of groundwater contamination investigations and regulated monitoring of potable wells.

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

Department of Agriculture, Trade and Consumer Protection

The Department of Agriculture, Trade and Consumer Protection (DATCP) manages pesticides and pesticide practices to assure that established groundwater standards for these contaminants are not exceeded. This may include prohibition of certain activities including pesticide use. The agency also manages practices to “minimize” groundwater contamination to extent “technically and economically feasible.” DATCP regulates storage, handling, use and disposal of pesticides, and the storage of bulk quantities of fertilizer. DATCP is also responsible for coordinating the development of Wisconsin’s “generic” and “pesticide specific” state pesticide management plans for protecting groundwater from pesticides.

In 1993 the Agricultural Chemical Cleanup Program (ACCP) was established to address point sources of pesticide contamination. The ACCP reimburses responsible parties for cleanup costs related to pesticide and fertilizer contamination at facilities and in nearby wells. The ACCP also funds DATCP oversight of pesticide and fertilizer cleanup activities.

The Land and Water Resource management program provides funding primarily to counties to assist in protection of groundwater resources. Some of this funding is dedicated to the development and implementation of improved nutrient and pest management practices.

DATCP funds the Agricultural Clean Sweep program which helps farmers dispose of unwanted pesticides, farm chemical and empty pesticide containers.

Department of Commerce

The Department of Commerce enforces private onsite wastewater treatment system rules and the plumbing code. The Department is also responsible for regulating storage tanks containing flammable, combustible liquid and hazardous substances. Since 1991 the data base inventory of petroleum product tanks regulated by Commerce has increased from 143,681 to 174,725. Commerce is responsible for the Petroleum Environmental Cleanup Fund Act (PECFA) which funds cleanup at leaking underground storage tank sites. Since its inception, PECFA has reimbursed petroleum storage tank system owners approximately \$1.05 billion to remediate petroleum contamination in soil and groundwater. Commerce and DNR administer the Brownfields Site Assessment Grant program for property owners.

Department of Health and Family Services

Chapter 160, Wis. Stats., directs the Department of Health and Family Services (DHFS) to recommend health-based enforcement standards for substances found in groundwater. DHFS staff provide information on health risks posed by drinking water contaminants, and investigate suspected cases of water-borne illness. The agency has been active in determining the extent, health effects and providing information to the public on naturally occurring arsenic in Winnebago, Shawano, Outagamie and Brown Counties.

Wisconsin Geological and Natural History Survey

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

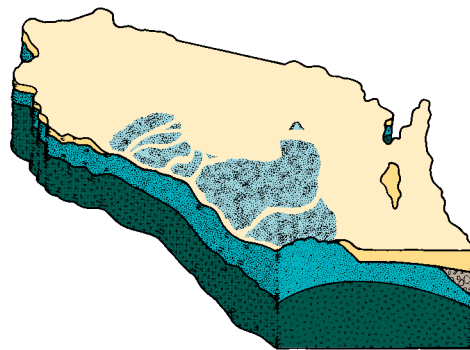
Department of Transportation

The Department of Transportation (DOT) regulates the storage of highway salt to prevent groundwater contamination by dissolved chloride. DOT is also responsible for potable well sampling at 29 rest areas and 113 waysides. Other DOT groundwater related activities include road salt research, hazardous material and waste investigation or remediation, wetland compensation and research, and stormwater management and research.

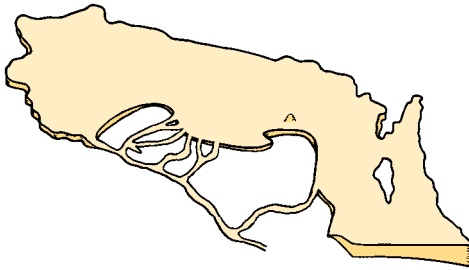
University of Wisconsin System

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

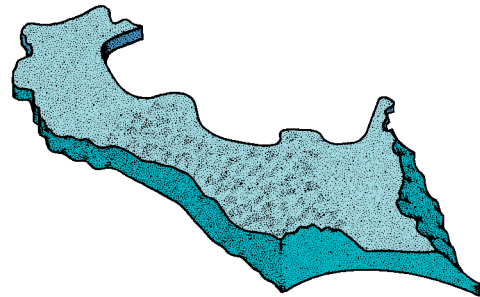
Figure 42. Wisconsin's Aquifers



Sand and gravel aquifer



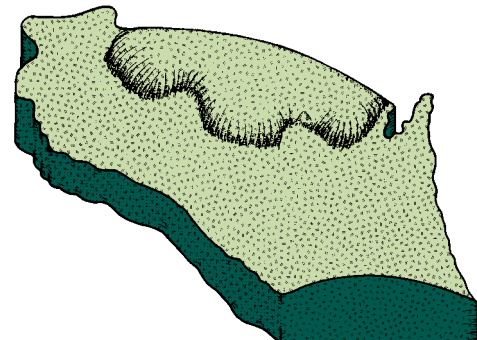
Sandstone and dolomite aquifer



Eastern dolomite aquifer



Crystalline aquifer



The guidance requests that the information in this table be provided based on aquifer or hydrogeologic setting. Wisconsin does not have this information so Table 38(5-3) is completed for the entire state.

Table 38. Groundwater Contamination Summary (Table 5-3)

Hydrogeologic Setting STATEWIDE
 Spatial Description (Optional) _____
 Map Available (optional) _____
 Data Reporting Period As of February, 2002

Source Type	Number of sites	Number of sites that are listed and/or have confirmed releases	Number of sites with confirmed groundwater contamination	Contaminants	Number of site investigations (optional)	Number of sites that have been stabilized or have had the source removed (optional)	Number of sites with corrective action plans	Number of sites with active remediation (optional)	Number of sites with cleanup completed (optional)
NPL	40	40	40	Varied					
CERCLIS (non-NPL)	76	76	NA	Varied					
DOD/DOE									
LUST	18,500	18,500	NA	BTEX	18,500		18,500	5,190	13,310
RCRA corrective action	27	27	27	Varied					
Underground injection	0	0	0						
State Sites	3,400	1,000							
Non-Point Sources	NA	NA	NA						
Other (specify)									

NPL – National Priorities List
 CERCLIS (non-NPL) – Comprehensive Environmental Response, Compensation and Liability Information System
 DOE – Department of Energy
 DOD – Department of Defense
 LUST – Leaking Underground Storage Tanks
 RCRA – Resource Conservation and Recovery Act
 NA – Information not available

Wisconsin’s Groundwater Monitoring Program

Each year since 1989, the WDNR has written a monitoring plan to identify and document the activities and priorities of its groundwater quality-monitoring program. The WDNR works with the GCC and other state agencies in evaluating existing monitoring information, available resources and future monitoring needs. Wisconsin’s groundwater law identifies five groundwater-monitoring categories (s. 160.27(2), Wis. Stats.): Management practice monitoring, problem assessment monitoring, at-risk monitoring, regulatory monitoring and monitoring plan. Data collected as part of Wisconsin’s monitoring plan was used to complete U.S.EPA Table 5-1 (Table 39).

Table 39. Major Sources of Groundwater Contamination (Table 5-1)

Contaminant Sources	Ten Highest-Priority Sources	Factors Considered in Selecting a Contaminant Source	Contaminants
Agricultural Activities			
Agricultural chemical facilities	•	A,C	A,B
Animal feedlots	•	A,C,D,F,G	E,J,K,M
Drainage wells	•	A,C,F	A,B,E
Fertilizer applications	•	A,C	E
Irrigation practices	•	A,C,F,H	A,B,E
Pesticide applications	•	A,C,F	A,B
On-farm agricultural mixing and loading procedures	•	A,C,D	A,B,E
Land application of manure (unregulated)	•	A,C	E,J,K,L,M*
Storage and Treatment Activities			
Land application (regulated or permitted)	•	A,C,D,F	E,J,K,L,M*
Material stockpiles	•	A,C,D,E,F	H
Storage tanks (above) ground	•	A,C,G	C,D,H
Storage tanks (underground)	•	A,B,C,D,E,G	C,D,H
Surface impoundment	•	A,C,D,F,G	E,J,K,L,M*
Waste piles	•	A,C,D,F,G	E,J,K,L,M*
Waste tailings	•	A,C,D,E,F	H
Disposal Activities			
Deep injection wells	•	A,C,F,G	A,B,D,E,G,J,K,L,M*
Landfills	•	A,B,C,D,E	A,B,C,D,H,I,J,K,L,M*
Septic Systems	•	A,C,D,E	E,H,J,K,L,M*
Shallow injection wells	•	A,C,D,E,H	C,D,G,H
Other			
Hazardous waste generators	•	A,C,D,F,G	A,B,C,D,H
Hazardous waste sites	•	A,B,C,D,E,G	A,B,C,D,H,I
Large industrial facilities	•	A,C,D,F,G	A,B,C,D,E,G,H,I
Material transfer operations	•	A,C,D,F,G	H,I
Mining and mine drainage	•	A,C,D,E,F	H
Pipelines and sewer lines	•	A,B,C,F	E,J,K,L,M*
Salt storage and road salting	•	A,C,D,F	G
Salt water intrusion	•	A,C,F	G
Spills	•	A,B,C,D,F,G	A,B,C,D,E,J,K,L,M*
Transportation of materials	•	A,C,D,F,G	A,B,C,D,E,F,G,I,J,M*
Urban runoff	•	A,C,D,F,G	A,B,C,G,J,K,L,M*
Small-scale manufacturing and repair shops	•	A,C,D,F,G	C,D,H
Naturally occurring substances	•	A,B,C,D,E,F,H	G,H,I

- A. Human health and/or environmental risk (toxicity)
- B. Size of the population at risk
- C. Location of the sources relative to drinking water sources
- D. Number and or size of contaminant sources
- E. Hydrogeologic sensitivity
- F. State findings, other findings
- G. Documented form mandatory reporting
- H. Geographic distribution/occurrence
- I. Other criteria (please add or describe in narrative)

- A. Inorganic pesticides
- B. Organic pesticides
- C. Halogenated solvents
- D. Petroleum compounds
- E. Nitrate
- F. Fluoride
- G. Salinity/brine
- H. Metals
- I. Radionuclides
- J. Bacteria
- K. Protozoa
- L. Viruses
- M. Pharmaceuticals

Management-Practice Monitoring

The primary goal of management-practice monitoring is to evaluate management practices or provide effective management solutions to groundwater quality problems. This can include support activities like development of laboratory analyses techniques and geological resource description.

Problem-Assessment Monitoring

Problem-assessment monitoring is intended to define the nature and extent of groundwater problems in Wisconsin. Generally existing private drinking water supply wells are sampled to assess the significance of particular contaminants.

At-Risk Monitoring

At-risk monitoring is intended to define and sample at-risk potable wells in areas where substances have been detected in groundwater. At-risk and problem assessment monitoring both focus on drinking water wells. At-risk monitoring provides resources for sampling private domestic wells where there is a demonstrated concern that a well is "at-risk." Results of this monitoring are used to determine if the contamination is significant enough to warrant either Superfund or Environmental Repair fund investigations and if possible to trace the contamination back to the source.

Regulatory Monitoring

Monitoring requirements are contained in permits or administrative rules and apply to solid waste sites, hazardous waste sites and wastewater disposal facilities. This type of monitoring is used to determine if groundwater standards are exceeded at these regulated facilities and to obtain information necessary to respond at specific sites.

Monitoring Planning

Monitoring planning refers to preparing the plan for collection, management, and coordination of monitoring activities and exchange of information among other regulatory agencies.

Public Water System Data

Treated water from Wisconsin's public water systems is currently being monitored in accordance with the Federal Safe Drinking Water Act and Chapter NR 809, Wis. Adm. Code. The following table lists all the contaminants with enforceable standards that are currently regulated in Wisconsin under Administrative Code Chapter NR 809.

Table 40. Contaminants with Enforceable Standards Under NR 809 Total Coliform Rule (TCR)

Name of Contaminant	Maximum Contaminant Level (MCL) (mg/L unless noted)	Health Effects of Contaminant
Total Coliforms Fecal Coliforms Escherichia Coli	Less than 40 samples/mo., more than 1 positive. 40 samples or more a mo., more than 5% positive.	The presence of total coliform indicate that other disease causing organisms, like E. Coli, may be present in the drinking water. Total coliform detection in exceedance of the MCL triggers testing for fecal coliforms/E. Coli which are organisms associated with sewage or animal wastes.
Surface Water Treatment Rule (SWTR)		
Turbidity	1 NTU (average/mo.)	None, interferes with disinfection
Giardia lamblia Enteric Viruses Legionella Heterotrophic Plate Count	Treatment Technique	Giardiasis Gastrointestinal and other viral infections Legionnaire's Disease Gastrointestinal Infections
Lead and Copper Rule (LCR)		
Copper Lead	Treatment Technique Action Level at 1.3 for Copper and .015 for Lead	Gastrointestinal Effects, Cancer Risk, Kidney/ Nervous System Effects, Highly Toxic to Infants
Radionuclides		
Gross alpha Emitters	15 pCi/L	Cancer Risk
Gross beta particle and photon emitters	4mRem	Cancer Risk
Radium 226 plus 228	5pCi/L (combined)	Cancer Risk
Uranium	20 U _g /L (equivalent to 30 pCi/L)	Kidney Effects, Cancer Risk
Volatile Organic Compounds		
1,1-Dichloroethylene	0.007	Liver/ Kidney Effects
1,1,1-Trichloroethane	0.2	Nervous System Effects
1,1,2-Trichloroethane	0.005	Kidney/ Liver Effects
1,2-Dichloroethane	0.005	Cancer Risk
1,2-Dichloropropane	0.005	Cancer Risk
1,2,4-Trichlorobenzene	0.07	Liver/ Kidney Effects
Benzene	0.005	Cancer Risk
Carbon Tetrachloride	0.005	Cancer Risk
Chlorobenzene	0.1	Nervous System and Liver Effects
cis-1,2-Dichloroethylene	0.07	Nervous System and Liver Effects Liver/ Kidney/ Nervous/ Circulatory Effects
Dichloromethane (methylene chloride)	0.005	Cancer Risk
Ethylbenzene	0.7	Liver/ Kidney/ Nervous/ Circulatory Effects
ortho-Dichlorobenzene	0.6	Liver/ Kidney/ Blood Cell Effects
para-Dichlorobenzene	0.075	Cancer Risk

Name of Contaminant	Maximum Contaminant Level (MCL) (mg/L unless noted)	Health Effects of Contaminant
Volatile Organic Compounds		
Styrene	0.1	Liver/ Nervous System Effects
Tetrachloroethylene (PCE)	0.005	Cancer Risk
Toluene	1	Liver/ Kidney/ Nervous/ Circulatory Effects
trans-1,2-Dichloroethylene	0.1	Liver/ Kidney/ Nervous/ Circulatory Effects
Trichloroethylene (TCE)	0.005	Cancer Risk
Vinyl Chloride	0.0002	Cancer Risk
Xylenes (total)	10	Liver/ Kidney/ Nervous System Effects
Synthetic Organic Compounds (Pesticides)		
2,3,7,8-TCDD (Dioxin)	0.00000003	Cancer Risk
2,4-D	0.07	Liver/ Kidney Effects
2,4,5-TP (Silvex)	0.05	Liver/ Kidney Effects
Acrylamide	Treatment Technology	Cancer Risk/ Nervous System Effects
Alachlor	0.002	Cancer Risk
Aldicarb	0.003	Nervous System Effects
Aldicarb Sulfone	0.002	Nervous System Effects
Aldicarb Sulfoxide	0.004	Nervous System Effects
Atrazine	0.003	Liver/ Kidney/ Lung/ Cardio. Effects/ Cancer Risk
Carbofuran	0.04	Nervous/ Reproductive System Effects
Chlordane	0.002	Cancer Risk
Dalapon	0.2	Kidney/ Liver Effects
Di(2-ethylhexyl)adipate	0.4	Liver/ Reproductive Effects
Dibromochloropropane (DBCP) (1,2-Dibromo-3-Chloropropane)	0.0002	Cancer Risk
Diethylhexyl Phthalate	0.006	Cancer Risk
Dinoseb	0.007	Thyroid/ Reproductive Organ Effects
Diquat	0.02	Ocular/ Liver/ Kidney/ Gastrointestinal Effects
Endothall	0.1	Liver/ Kidney/ Gastrointestinal/ Reproductive Effects
Endrin	0.002	Liver/ Kidney/ Heart Effects
Epichlorohydrin	Treatment Technology	Cancer Risk
Ethylene Dibromide (EDB) (1,2-dibromoethane)	0.00005	Cancer Risk
Glyphosate	0.7	Liver/ Kidney Effects
Heptachlor	0.0004	Cancer Risk
Heptachlor Epoxide	0.0002	Cancer Risk
Hexachlorobenzene	0.001	Cancer Risk
Hexachlorocyclopentadiene (HEX)	0.05	Kidney/ Stomach Effects

Name of Contaminant	Maximum Contaminant Level (MCL) (mg/L unless noted)	Health Effects of Contaminant
Synthetic Organic Compounds (Pesticides)		
Lindane (gamma-hexachlorocyclohexane)	0.0002	Liver/ Kidney/ Nervous/ Immune/ Circulatory Effects
Methoxychlor	0.04	Liver/ Kidney/ Nervous/ Developmental Effects
Oxamyl (Vydate)	0.2	Kidney Effects
PAHs (Benzo(a)pyrene)	0.0002	Kidney/ Liver Effects
Polychlorinated Bi-Phenyls (PCBs)	0.0005	Cancer Risk
Pentachlorophenol	0.001	Cancer Risk
Picloram	0.5	Kidney/ Liver Effects
Simazine	0.004	Cancer Risk
Toxaphene	0.003	Cancer Risk
Inorganic Compounds		
Antimony	0.006	Decrease Longevity, Blood Effects
Arsenic	.050	
Asbestos (fiber length >10 um)	7 MFL	Lung Tumors/ Cancer Risk
Barium	2	Circulatory System Effects
Beryllium	0.004	Bone/ Lung Effects/ Cancer Risk
Cadmium	0.005	Kidney Effects
Chromium (total)	0.1	Liver/ Kidney/ Circulatory Effects
Cyanide	0.2	Spleen/ Brain/ Liver Effects
Fluoride	4.0	Dental Fluorosis
Mercury (total)	0.002	Kidney/ Central Nervous System Disorder
Nickel	0.1	Nervous System/ Liver Effects
Nitrate (as N)	10	Methemoglobinemia
Nitrite (as N)	1	Methemoglobinemia
Selenium	0.05	Nervous System Effects
Thallium	0.002	Kidney/ Liver/ Brain/ Intestinal Effects

U.S. EPA Table 41 (5-4) provides data from Wisconsin's public water supply database for the entire state. Information is not currently available by hydrologic setting or aquifer. Vulnerability assessments are not completed for all public wells. Information on public water system susceptibility and potential contaminant sources will become available as the Source Water Assessment Program progresses.

Groundwater Quality

Groundwater quality varies greatly throughout Wisconsin. Primary human-caused contaminants of concern are Volatile Organic Chemicals (VOCs), nitrate and pesticides. Iron, manganese, sulfate, arsenic and radium are naturally occurring groundwater contaminants that present health concerns present in Wisconsin groundwater. Microbial contaminants including viruses, bacteria, and parasites are becoming a concern.

Volatile Organic Chemicals

Over 80 different VOCs have been found in Wisconsin drinking water supply wells. Thirty different VOCs have been found to exceed the enforcement standard (ES), affecting over 770 drinking water supply wells. Trichloroethylene is the most common VOC detected in Wisconsin groundwater. Sources of VOCs include landfills, underground storage tanks, and hazardous substance spills.

Wisconsin has 90 active licensed solid waste landfills, all of which are required to monitor groundwater. In addition, the DNT currently tracks monitoring at 9,400 LUST sites, 4,000 waste disposal facilities and about 1,400 high priority Environmental Repair sites. Many of these sites have been identified as sources of VOCs.

In 1998 and 1999 the DHFS sampled private wells down-gradient of 19 small, closed landfills in one Wisconsin county. Several of the private wells had sample analytical results for VOCs above the MCLs. Subsequently, 16 old, closed landfills around the state were investigated for VOC contamination. Of the 113 private wells monitored, VOCs were detected in 31 wells. Fourteen wells had VOCs in concentrations exceeding the MCLs.

Hazardous waste treatment storage and disposal facilities are another source of VOCs to groundwater. The DNR Bureau for Remediation and Redevelopment is investigating or remediating contamination at 27 sites.

Approximately 800 hazardous substance spills are reported to DNR each year. Groundwater monitoring is performed when necessary to delineate the extent of contamination.

Pesticides

Pesticide contamination of groundwater results from field applications, pesticide spills, misuse or improper storage and disposal. The most commonly detected pesticides in Wisconsin groundwater are metabolites of alachlor and metolachlor, atrazine and its metabolites, metribuzin, and cyanazine amide. Pesticide monitoring is conducted by DATCP. The following are recent monitoring studies:

Monitoring Reuse of Atrazine Prohibition Areas – DATCP is monitoring the limited reuse of the herbicide atrazine in selected areas where its use has been prohibited since 1993. Fourteen of the sites have two years of data. A statistically significant upward trend in atrazine levels occurs at eight of the sites.

Pesticide and Groundwater Impacts Study – The effect of normal pesticide application on different soil types is being monitored at 25 different sites across the state. Since 1992, over a thousand well samples have been collected and analyzed. In 2000, the last year for which data is available, eight compounds were detected in groundwater. Atrazine and nitrate were found at levels above an ES. Alachlor ESA, a break down product of alachlor, was detected in 41 of the samples. Cyanazine amide, a metabolite of cyanazine, was found in 9 percent of the samples in 2000.

The “2000/2001 Survey of Agricultural Chemicals in Wisconsin Groundwater” is a statistical analysis of pesticides in Wisconsin groundwater. Groundwater samples were collected from a stratified random sample of wells in the state. The samples were analyzed for agricultural chemicals including pesticides and nitrates. Results show that statewide an estimated 37.7% of wells sampled have detectable levels of herbicides or their metabolites. The estimate for total atrazine (atrazine and its metabolites) is 11.6% of the wells in the state. Number of wells with total Atrazine greater than the ES is estimated at 1.1%. The total number of wells with detects of Alachlor ESA is estimated at 27.8%, Metalachlor ESA is estimated at 25.2% and nitrate greater than the ES

(10 ppm) is estimated at 14.1%. The number of wells with detects of atrazine parent compound is estimated at 5.1% and the number of wells estimated to have nitrate detects is 61.7% of the wells in the state.

Chloroacetanilide Herbicide Metabolites in Wisconsin Groundwater – In a study completed in 2000, 27 monitoring wells, 22 private drinking water wells and 23 municipal wells in Wisconsin were sampled for alachlor, metalachlor acetochlor, and their ethane sulfonic acid (ESA) and oxanillic acid (OA) metabolites. Wells were selected based on previous detections of pesticides or proximity to agricultural fields. Over 80 percent of the monitoring wells and drinking water wells contained the ESA and OA metabolites of alachlor and metolachlor. Fifty-two percent of the municipal wells had at least one herbicide detection though none exceeded the drinking water standards.

Triazine Screen Sampling – In 1991, the Wisconsin State Laboratory of Hygiene (SLOH) began a public testing program using an immuno assay screening test for triazine-based compounds. DNR groundwater databases contain more than 14,000 triazine screen results. In 42% of samples analyzed, a triazine-based compound was detected. Thirteen percent and 1.6% of sample analytical results exceeded the PAL and ES respectively.

Nitrates

Nitrate-nitrogen is the most commonly found groundwater contaminant in Wisconsin. Of 10,112 private wells sampled in the state since 1991, 20 % exceeded the ES of 10 mg/l and 50% exceeded the PAL of 2 mg/l. The majority of these wells are located in agricultural areas.

Arsenic

Naturally occurring arsenic in Wisconsin groundwater has become an important issue since it was first detected in 1987. The problem is especially prevalent in Outagamie, Shawano, Winnebago and Brown counties. In 2001, well sampling occurred in 15 townships in these counties. This data has not been evaluated yet; however, in two of the townships, almost 50% of the samples exceeded 5 parts per billion (ppb) while 21.8% exceeded 10 ppb. In 2000, 3,300 public water supply systems were sampled for arsenic. Results show that 80 of these exceeded the 10 ppb standard.

Radioactive Compounds

Two studies have been initiated by the DNR to evaluate radioactive compounds in groundwater. In 2000, DNR staff collected samples from 100 community and non-transient noncommunity public water supply wells which will be analyzed for total uranium alpha activity, total thorium alpha activity, radium 226 and polonium 210 alpha activities. Preliminary results indicate total Uranium is the major contributor to high gross alpha activities. A second study is looking at radon in drinking water supplies. DNR staff will sample 340 non-community non-transient and other than municipal water systems per year. Project results will determine the impact of new EPA standards for radon in drinking water. Preliminary results tend to support earlier findings that indicate approximately 50% of public water systems monitored in Wisconsin exceed the proposed radon standard of 300 picocuries per liter (pCi/L).

Groundwater/Surface Water Interactions

Understanding groundwater/surface water interactions is a priority for the state of Wisconsin. Several management-practice monitoring projects dealing with groundwater/surface water interactions at specific locations in the state have been funded by the GCC joint solicitation process. These studies include:

- Assessment of Impacts on Groundwater/Lake and Wetland systems
- Groundwater-Surface Water Interactions in the Nine Springs Watershed
- Watershed-Scale Nitrate Contamination and Chlorofluorocarbon Ages in the Little Plover Basin: A Study at the Groundwater/Surface Water Interface
- The Direct Effect of Agricultural Chemical on Wisconsin's Declining and Endangered Amphibians

- Relationships Between Water Quality in Stream Base Flow and Private Wells and Land use in the Tomorrow/Waupaca River Watershed
- Acute and Chronic Toxicity of Nitrate to Brook Trout (*Salvelinus fontinalis*)
- Importance of Groundwater in Production and Transport of Methyl Mercury in Lake Superior Tributaries
- A Basin-Scale Denitrification Budget for a Nitrate Contaminated Wisconsin Aquifer: A Study at the Groundwater/Surface Water Interface
- Effect of Clean and Polluted Groundwater on Daphnie Reproduction and Development

Groundwater Quantity

Groundwater is plentiful in Wisconsin, but concern is growing about its limits. Natural shortages of groundwater have occurred due to weather conditions and geologic setting. Human activities also cause quantity problems. Groundwater withdrawals in the Lower Fox River Valley, southeastern Wisconsin and Dane County have caused substantial decline in groundwater levels and have affected surface waters.

The Wisconsin Geological and Natural History Survey (WGNHS) and the U. S. Geological Survey (USGS) have maintained and operated a statewide groundwater observation-well network for collecting water-level measurements since 1946. The data is stored in a database and is available to the public on request. Starting in 1994, the wells were tested and for hydraulic connection with the surrounding aquifer. Well replacement was funded by the WDNR in 1999 and 2000.

Coordination of Groundwater Monitoring and Research

Four state agencies have had up to \$750,000 available each year for groundwater-related monitoring or research. WDNR, UWS Groundwater Research, DATCP Pesticide Research, and Department of Commerce Sewage System research each fund groundwater monitoring and research projects. The GCC provides consistency and coordination among the funding agencies.

Future Directions in Groundwater Protection

Below are some of the priorities set by the Groundwater Coordinating Council for the most recent joint solicitation.

- **Investigation of adverse impacts from groundwater withdrawals:** In FY 97, DNR staff with help from the Groundwater Quantity Technical Advisory Committee, completed a report on the groundwater quantity issue (see "Condition of the Resource - Groundwater Quantity" for the Executive Summary of this report). In the report, localized areas with groundwater quantity problems are identified and the effects of groundwater withdrawals on surface waters and long-term groundwater availability are discussed. There is a need to further quantify hydrographic relationships of surface and groundwater. The GCC should continue to encourage research efforts that will provide information useful in addressing this issue.
- **Investigation of recently discovered groundwater contaminants:** Recent research conducted in Europe and the U.S. indicates that traces of pharmaceuticals (including antibiotics and hormones) and pesticide breakdown products are common contaminants found in groundwater and surface water. Current testing methods do not allow adequate detection of these possible contaminants. Research is needed to determine whether these substances pose a threat to Wisconsin's groundwater resource. There is also a need to evaluate the sources, fate, transport, and chemistry of p-Isopropylbenzene (cumene), aluminum, molybdenum and strontium (non-radioactive form) in groundwater; evaluate existing databases; and sample at-risk potable wells for these contaminants.
- **Investigation of naturally occurring substances in groundwater:** Continued problems of elevated arsenic, low pH, and other water quality problems in domestic wells exist over large areas of northeast Wisconsin. DNR needs more information about the extent and causes of these problems in order to give advice to homeowners and well drilling contractors. Additionally elevated sulfate and total dissolved solids have been found in some new deep municipal

wells in the Lower Fox River Valley making the wells unusable. In some other existing deep wells as far south as Milwaukee the total dissolved solids have been steadily increasing over the years. These sulfate and TDS levels pose a problem for local water managers, and the origin of the dissolved solids is not completely understood.

- **Provide resources to local governments for Smart Growth/Comprehensive Planning activities.** Recent legislation has required local units of government to develop a comprehensive plan by 2010 in order to undertake land use activities. This plan must address 9 elements, including natural and agricultural resources, housing, utilities, and land use. This planning process presents a unique opportunity to address and implement groundwater protection at the local level. The GCC will seek ways to assist local communities in their planning efforts to encourage groundwater protection.
- **Promote consistency between the agencies on data management issues:** Through updates to the DNR's groundwater data system and the Directory of Groundwater Databases, state and local government agencies now have more convenient access to groundwater data. This effort must be maintained by continuing to identify what data needs exist and ways to make data easily accessible. Data consistency must be promoted by use of translatable geolocational coordinate systems and consistent data elements for use in a GIS environment. The GCC will continue to provide leadership and communication on data management through its subcommittees. This continued effort displays the GCC's commitment to management of the resource through sound scientific methods.
- **To act as a coordinating and facilitating mechanism for the publication and distribution of information and educational materials on groundwater related issues:** The public has benefited from the consistent educational messages that have been endorsed by the Education Subcommittee. The Education Subcommittee will continue to provide its leadership and assistance to state agencies providing educational materials to the public. Priorities for the future include promoting water stewardship, awareness of water quantity issues, and providing materials for local communities to assist in their comprehensive planning activities.
- **Distribution of findings from groundwater research or monitoring projects:** There has been considerable progress in preparing summaries of the results of groundwater-related monitoring and research projects funded through the joint solicitation process. More than 90 of these summaries are now available on the UW-WRI web site maintained by UW-WRI. The rate of response to the web site posting of research findings has been very encouraging so far. To maintain and enhance this response it will be important to add new summaries annually as they become available, create a more visually appealing set of front-end pages for the site, and publicize the web site location and content more widely. More work needs to be done to target interested audiences and distribute summaries and final reports more widely.
- **Identify tools that can be used to better predict Wisconsin's groundwater susceptibility to contamination:** Studies have demonstrated the need for developing statewide data layers that would facilitate better groundwater vulnerability assessments. These data layers include land use, soils, regional groundwater flow, hydrogeologic characteristics such as aquifer materials, and potential point sources of contamination such as underground storage tanks and pesticide spills. The studies also illustrate the importance of locational data for contaminant sources. The GCC's Planning & Mapping and Monitoring & Data Management Subcommittees have prioritized, promoted, and helped facilitate the development of data layers as part of a larger data integration initiative. Through the DNR's Source Water Assessment Program, which will be implemented by 2003, this work will continue and will result in improved predictive capabilities.
- **Research on land use management and its impact on the groundwater resource:** Additional research is needed on the effect of various land uses (e.g. urbanization) on groundwater quality and quantity. Several projects that study the impacts of land use on groundwater have been and continue to be funded through the joint solicitation. These projects must be managed in such a way as to maximize their relevance to state land use problems. This issue crosses agency lines and promises to be an important issue for years to come.
- **Continued evaluation of alternatives to onsite sewage systems:** Although the DNR and Commerce have funded monitoring projects in this area, additional work is needed to find state-of-

the-art private sewage system technologies that provide efficient, cost-effective options and protect groundwater resources.

- **Investigation of the causes and effects of nitrate in groundwater:** The GCC will support the agencies and the UWS in obtaining information pertinent to the human health implications of consuming nitrate contaminated groundwater and the effect of discharge of this groundwater on surface waters and their ecosystems. In addition, it will continue to facilitate consistent education to provide a clear message on the many causes and effects of nitrate in groundwater for urban and rural citizens.
- **Solutions to groundwater nonpoint pollution problems:** A 1997 DATCP report indicates that 8.5% of Wisconsin's wells still contain detectable atrazine residues. In addition, 10% exceed the nitrate standard. These rates are substantially higher in agricultural areas. Agriculture is the major source of these pollutants. More work is needed to determine how far Wisconsin groundwater will deteriorate without a substantial change in farming practices, and what practices will sustain both agriculture and groundwater quality.

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

Wisconsin's Groundwater Summit

The Wisconsin Groundwater Coordinating Council (GCC) facilitated an important and timely event called "Wisconsin's Groundwater Summit" held on October 30, 2001 in Waukesha, WI. The purpose of the Summit was to bring together a broad representation of groundwater users and stakeholders to discuss current issues facing groundwater protection and management and to develop ideas and solutions to better protect Wisconsin's groundwater quality and quantity. Discussion was lively and wide-ranging, covering a variety of issues affecting Wisconsin's groundwater. Solutions encompassed educational efforts, research needs, data management, institutional needs, as well as policy recommendations. The discussion and materials developed as a result of the Summit will assist and guide State agencies, the university system, and the GCC in carrying out future groundwater protection programs.

135 delegates representing more than 50 agencies, organizations, and local governments attended the Summit. Groups included environmental and conservation groups, agricultural groups, industrial users, water utility groups, local and tribal government, planning agencies, state and federal agencies, and university researchers and educators.

The general format of the Summit was a set of keynote presentations and a panel discussion in the morning, followed by an afternoon of breakout sessions where participants were asked to address specific issues and suggest solutions. Quantity issues dominated the discussion in the morning session and in the breakout sessions.

Quality issues raised included emerging contaminants (pesticide metabolites, pharmaceuticals, viruses, and arsenic) and nonpoint pollution (nitrate and pesticides).

Some of the other key themes that emerged from the summit included:

- water conservation
- high capacity well reform
- reevaluating water pricing structures
- exploring options for "regionalization" of water management
- connecting land use and groundwater protection
- Smart Growth
- local government involvement
- building a "Groundwater Constituency"

- providing information and opportunities for further dialogue
- promoting innovative educational programs
- clarifying water rights related to groundwater
- strategic long term resource monitoring
- surface water connections
- recognizing ecosystem services as well as economic benefits of groundwater

Over the next year, the GCC and agency staff will be compiling results of the small group sessions, developing a set of strategic action items, and putting together full conference proceedings.

Groundwater - Conclusions

Wisconsin's comprehensive approach to groundwater protection as envisioned in Chapter 160, Wisconsin Statutes, will continue to drive state program development. Monitoring in support of identifying groundwater problems and providing solutions, defining the nature and extent of groundwater contamination problems, and insuring that groundwater standards are met at specific sites will continue. Public forums provide state agencies with information on how programs are working and what direction agencies will take in the future. Groundwater quality data and supporting hydrogeologic and contaminant mapping will continue to increase our understanding of groundwater and surface water resources in the state. In the future, groundwater data, including source water area delineations and assessments will be available to the public to improve land use planning and aquifer protection.

Water Quality Report to Congress - Conclusion

Recently the Wisconsin Academy of Sciences, Arts and Letters provided a forum in which over 700 citizens, policy makers, private sector, academic and governmental leaders discussed the status of and future direction for "Waters of Wisconsin" (WOW). Over 200 individuals reflecting this variety of backgrounds were involved in planning and carrying out the conference. One outcome from the Conference is the development of strategic plan which identifies specific actions for targeted areas of water management in the state. The groundswell of interest and participation in this conference reflects the changing nature of needed solutions for water protection and restoration — public/private partnerships, holistic approaches, cooperative decision making.

Immediately following the conference, Wisconsin's new governor, Jim Doyle, endorsed Wisconsin's Year of Water with the statement, "I strongly endorse designating 2003 as the Year of Water in Wisconsin. With the tremendous leadership of the Wisconsin Academy and others, I know we will take this occasion to build on the tremendous Waters of Wisconsin event, celebrate water as our most precious natural resource, participate in a statewide effort to understand and appreciate our waters, and to work together on projects that conserve and sustain our waters for future generations."

This sentiment is reflected in WDNR's commitment to continue to evolve and grow in our approach to managing surface and groundwater resources to meet the needs of both the resource and of the people of Wisconsin.

A Year of Water page has been added to the Academy website and can be found at <http://www.wisconsinyearofwater.org>



Our Mission:

To protect and enhance our natural resources:
our air, land and water;
our wildlife, fish and forests
and the ecosystems that surround them.

To provide a clean, sustainable environment
and a full range of outdoor opportunities.

To insure the right of all Wisconsin citizens
to use and enjoy these resources
in their work and leisure.

To work with people
so that we understand their views
and can carry out their will.

And in this partnership with our citizens,
consider the future
and those who will follow us.



The Wisconsin Department of Natural Resources provides equal opportunity in its employment, programs, services and functions under an Affirmative Action Plan. If you have any questions, please write to Equal Opportunity Office, Department of the Interior, Washington, D.C. 20240.

This publication is available in alternate format (large print, Braille, audio tape, etc.) upon request. Please call 608-267-7694 for more information.





Wisconsin Department of Natural Resources Bureau of Watershed Management

PUB-WT-254 2003

