

WISCONSIN GROUNDWATER COORDINATING COUNCIL

*Wisconsin's
buried treasure*

ANNUAL

REPORT



TO
THE LEGISLATURE

DECEMBER 1986

GROUNDWATER COORDINATING COUNCIL MEMBERS

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Department of Health and Social Services - William Schmidt
Department of Agriculture, Trade and Consumer Protection - Orlo R. Ehart
Department of Transportation - Theodore Stephenson
University of Wisconsin - Dallas Peterson
Department of Industry, Labor and Human Relations - Ed McClain
State Geologist (WGNHS) - Meredith Ostrom
Governor's Representative - Robert Fuller (until July 10, 1986)
Steve Born (effective July 11, 1986)

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Department of Health and Social Services - Sam Sinha
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Department of Agriculture, Trade and Consumer Protection - Frank Jones
Department of Industry, Labor and Human Relations - Jim Wilson
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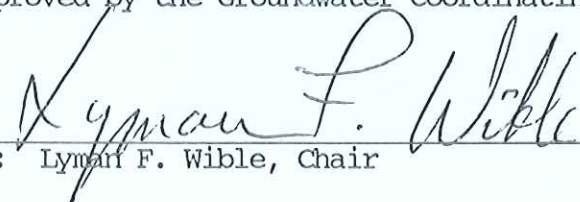
Planning and Mapping

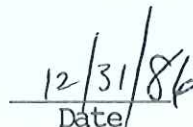
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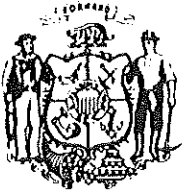
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Approved by the Groundwater Coordinating Council


BY: Lyman F. Wible, Chair


Date



State of Wisconsin

DEPARTMENT OF NATURAL RESOURCES

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The Honorable Governor Tommy G. Thompson
Senate Urban Affairs, Energy, Environmental Resources and Elections Committee
Senate Transportation, Tourism and Conservation Committee
Assembly Environmental Resources and Utilities Committee
Assembly Natural Resources Committee
Secretary Ronald R. Fiedler - Department of Transportation
Secretary John T. Coughlin - Department of Industry, Labor and Human Relations
Secretary Howard C. Richards - Department of Agriculture, Trade and Consumer Protection
Secretary Timothy F. Cullen - Department of Health and Social Services
Secretary Carroll D. Besadny - Department of Natural Resources
President Kenneth A. Shaw - University of Wisconsin
State Geologist Meredith Ostrom - Wisconsin Geologic and Natural History Survey

Enclosed is the 1986 Groundwater Coordinating Council Annual Report to the Legislature as required by state law. The Council was formed to help state agencies coordinate their groundwater related activities, and serves as a groundwater information-exchange forum.

This year's report highlights several serious water quality trends and shortcomings in state management efforts. Statewide groundwater efforts are showing:

- * An ever increasing problem with pesticide and volatile organic chemical contamination of groundwater.
- * In many urban and rural settings these chemicals are leaching to groundwater in concentrations exceeding state health standards.
- * Developing technology to prevent and clean up this contamination is a major issue to be addressed over the next several years.
- * There is a serious need for state agencies and the U.W. system to better coordinate their research activities.
- * There currently is not a satisfactory procedure for state agencies to communicate their research needs to university researchers.

In 1987 the Council will focus on resolving these identified management concerns. As leaders in state government, we need to work with you.. In 1987 the Council will periodically request assistance from you and your staff in formulating and implementing problem solutions.

Additional copies of this Report are available from the Department of Natural Resources, Bureau of Water Resources Management, Second Floor, State Natural Resources Building (state mail) or P.O. Box 7921, Madison, WI 53707 (U.S. Mail). We hope you, your staff, and the public will find the Report useful in protecting groundwater: Wisconsin's Buried Treasure.

Sincerely,

A handwritten signature in dark ink, appearing to read "Lyman F. Wible". The signature is fluid and cursive, with the first name "Lyman" and last name "Wible" being clearly legible, and "F." as a small middle initial.

Lyman F. Wible, Chair
Groundwater Coordinating Council

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Enc.

WISCONSIN GROUNDWATER
COORDINATING COUNCIL
ANNUAL REPORT
TO THE LEGISLATURE

DECEMBER 1986

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EXECUTIVE SUMMARY

Throughout 1986, the Groundwater Coordinating Council has been tracking how Wisconsin's new groundwater law is being implemented by state agencies. In addition, the Council has spent time reviewing which contaminants continue to threaten groundwater quality and considering how basic and applied research on groundwater can be more closely coordinated. This report summarizes the Council's activities for 1986.

The first section of the report describes how the state agencies that oversee natural resources development, health protection, transportation, agriculture and industrial development are incorporating groundwater standards into their day-to-day operations. Based on state statutes groundwater protection must be considered when handling pesticides, fertilizers, animal waste, flammable liquids and road salt. Groundwater concerns must also be addressed when using certain pesticides or disposing of commercial cleaners and solvents.

The second section of the report generally explains what has been learned from groundwater investigations during the last year. In summary, most of Wisconsin's groundwater is clean and uncontaminated by man-made products. Nevertheless, certain water quality trends are disturbing. The more we look, the more we discover that the groundwater under increasing numbers of Wisconsin communities has been fouled by human actions. Industrial solvents, commercial fuels, and household cleaning products, that are collectively called "volatile organic chemicals", are seeping into groundwater. These chemicals that are liberally used and often carelessly managed are making underground water supplies unsuitable to drink. The Council noted that removing these compounds from groundwater poses technological difficulties that might be unaffordable or unworkable.

Remaining sections of the report describe subcommittee actions to identify unresolved technological and administrative groundwater issues.

To address these shortcomings the Council took actions in six areas last year.

1. agreed to co-sponsor the 1987 Midwest Groundwater Conference to encourage researchers to share recent insights in groundwater management, modelling and investigative techniques. The conference will be held in Madison giving regulatory, legislative and academic professionals good access to the latest regional developments.
2. tentatively proposed a meeting to give legislators a progress report on efforts to set up groundwater protection programs throughout state government.
3. directed its research committee to set guidelines for reviewing research proposals vying for state funds offered by the new Groundwater Fund. Approximately \$450,000 in state funds supported groundwater research in 1986. These guidelines must be set before additional grants will be offered in 1987.

4. addressed the University of Wisconsin Board of Regents to stress the importance of coordinating groundwater research projects at the University with state agency needs and directions.
5. asked the University to establish a committee representing groundwater expertise from all campuses. This committee would:
 - * review the proposed groundwater nitrate research proposal and other research initiatives.
 - * set basic and applied research priorities at the University, with input from the Council, aimed at answering critical questions state agencies need to set policy.
 - * outline five-year groundwater research needs to help plan and budget funds.
 - * submit results of the above tasks to the Council for its review and possible consideration in current budget negotiations.
6. proposed an executive order and budget to improve coordination between state and local groundwater management programs.

INTRODUCTION

This is the second Annual Report to the Legislature by the Groundwater Coordinating Council as required by sec. 15.347, Wis. Stats. The report describes the condition of the groundwater resource and its management and summarizes the Council's activities from September, 1985 through December, 1986.

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

Membership of the Groundwater Coordinating Council includes the Secretaries of the Departments of Natural Resources; Industry, Labor, and Human Relations; Agriculture, Trade and Consumer Protection; Health and Social Services; Transportation; the President of the University of Wisconsin System; the State Geologist (WGNHS); and a representative of the Governor. Members are listed on the inside of the cover page.

The Groundwater Coordinating Council has met 7 times in 1986 and has taken the following major actions:

1. The Council adopted a motion to act as a co-sponsor for the 1987 Midwest Groundwater Conference which will be held in Madison.
2. The Council also adopted a motion favoring an annual open meeting where legislators would be invited to hear reports on the status of the state's groundwater program. The Council also directed the Information and Education Subcommittee to prepare an agenda for such a meeting.
3. The Council directed the Research Subcommittee to develop written protocols for the review and acceptance of groundwater monitoring proposals to be funded by the Groundwater Fund. The protocols are to be in place before additional funds are allocated for new projects.
4. The Council directed the Research Subcommittee to develop a proposal on how to convey to the University of Wisconsin Board of Regents the importance of a coordinated program of groundwater research.
5. The Council passed a resolution requesting that the University System establish a committee assuring broad representation from appropriate campuses and expertises involved in groundwater protection to:
 - a. review the proposed groundwater research DIN and other proposals;

- b. establish priorities for research in collaboration with and for consideration by the Groundwater Coordinating Council, to include regulatory agencies priorities as well as basic and applied research needs;
 - c. propose a plan for undertaking research needs (a 5-year plan dependent upon adequate funding);
 - d. if deemed warranted, develop a DIN for research needs for the FY 1987-88 budget review; and
 - e. submit it to the Groundwater Coordinating Council in time for inclusion in the executive budget and for possible endorsement by the Groundwater Coordinating Council prior to that time.
6. The Council proposed, and forwarded to the Department of Administration, a draft executive order and budget proposal to improve the coordination between state and local government groundwater management programs.

IMPLEMENTATION OF CHAPTER 160, WIS. STATS.

Chapter 160, Wis. Stats., requires each state agency with groundwater regulatory responsibilities to implement measures to protect the resource in accordance with groundwater quality standards. The following summarizes each agency's actions taken over the last 16 months to meet this responsibility.

Department of Agriculture, Trade and Consumer Protection (DATCP):

Regulation of Bulk Storage Facilities

Following the publication of Ag 162 and 163 Wis. Adm. Code, and distribution to all known facilities, DATCP staff co-sponsored full day training sessions for industry personnel at several locations across the state. A slide presentation was used to summarize the rule provisions and explain what management alternatives would be considered acceptable. Training guides were also provided to better explain those areas of the rules which produced the most questions. Industry representatives presented examples of facilities they had designed and installed, and gave their recommendations as to what designs work best. In many cases, industry recommendations were more restrictive than the rule requirements.

The training sessions were well attended, with over 200 facilities represented. The sessions were also video taped by DNR spills staff for future training of industry, DATCP and DNR personnel. As a follow-up to the training, DATCP inspectors were instructed to visit each facility not represented at the training session, and leave a copy of the training guide. This guide will also be part of the official record, to serve as the DATCP's working manual in conducting inspections. In addition to industry training, state field inspectors received extensive training in rule provisions and interpretation. This included 3 days of classroom instruction, plus a full day mock inspection exercise. A variety of instructional aids have been purchased or developed for the bulk inspections.

Wisconsin currently has 230 liquid fertilizer facilities, 20 bulk pesticide facilities and nearly 200 facilities with both bulk liquid fertilizer and pesticide storage. DATCP's goal is to do a thorough inspection of each facility at least once every two years. Follow-ups will be more frequent at problem facilities. Brief walk through inspections will also be conducted while inspectors are at a facility for other purposes. All full inspections will be followed-up with a letter to the facility describing those areas in which violations were noted and the necessary steps required to bring the firm into compliance.

At this time DATCP is taking an educational stance. Where continued or uncorrected violations are noted, however, enforcement action will be taken. DATCP staff hope to inspect all facilities at least once by January 1, 1988. More formal action can be justified once the loading areas and secondary containment are completed. The groundwater law provides substantial civil forfeiture penalties, and DATCP can, by order, require action be taken to correct any violation of the rules.

Of the inspections conducted to date, several problems are repeatedly noted. Corroded tank fittings, inadequate plumbing support and little or no security are the primary container violations. Few loading area pads and catch basins have been completed, but those in place commonly have violations including cracks in the pad and inadequate handling of collected pesticide rinsates. The rule prohibits storage of such rinsate in underground catch-basins. Most secondary containment systems constructed to date are built of concrete. The most common problem with these systems include unsealed cracks and expansion joints. Spills into secondary containment structures are typically not fully recovered. Discharge response plans and recordkeeping systems are commonly not fully implemented at the time of inspection, even though generic response plans and recordkeeping systems have been provided as part of the industry training sessions.

Investigation of Groundwater Problems from Pesticide Use

Since the summer of 1985 DATCP has been conducting a groundwater monitoring project for pesticides. The primary objective of this study is to determine the extent of groundwater contamination in some of the most susceptible areas of the state. The five pesticides of interest are atrazine, alachlor, aldicarb, carbofuran and tordon. Part of the motivation for this study is the belief that the investigation of pesticides in groundwater should be expanded beyond the limited zones of groundwater used by drinking water wells.

The water quality results from this study are being compared to the standards established in NR 140 Wis. Adm. Code. A determination can then be made whether regulatory actions are needed to prevent these pesticides from entering groundwater in concentrations above the groundwater quality standard.

As of August, 1986 groundwater occurrence data have been collected for aldicarb, alachlor and atrazine (See Table 1). Of the eight sites that have been monitored for aldicarb, six have residues in groundwater equaling or exceeding the preventive action limit of 2 parts per billion (ppb), four have residues exceeding the enforcement standard of 10 ppb, and two sites have had no residues detected.

Alachlor has been monitored in the groundwater at six agricultural fields in the sandy outwash soils along the Wisconsin River. With the exception of the unusually high levels at the field in Dane County, alachlor residues in the groundwater samples have been quite low or below the level of detection (0.05 ppb). At the Dane County site, it is possible that a spill or back-siphoning incident has occurred, but no evidence of this has been established. Depending on the level at which the enforcement standard for alachlor is set, regulatory actions may be necessary to comply with the groundwater law.

Atrazine has also been monitored in the groundwater at seven agricultural fields along the Wisconsin River and in the central sands region. The levels of atrazine found in the groundwater samples are in the range of less than 1 to 30 ppb. The higher of these levels, however, are from the Dane County site, which also has unusually high levels of alachlor, and may be associated with a spill or back-siphoning incident. The level at which the official enforcement standard for atrazine is set will determine whether regulatory actions will be necessary to comply with the groundwater law.

Table 1
DATCP Groundwater Monitoring Summary
August, 1986

Chemical Name	Total Sites	Sites With Detects	Total Wells	Detect Range (ppb)	Mean Detect (ppb)
Alachlor	6	3	18	0.1-113	32.5
Aldicarb	8	6	25	1.0-110	9.9
Atrazine	7	6	21	.3-30.1	5.7

Source: DATCP

In response to the continued findings of aldicarb in both potable and monitoring wells, DATCP proposed to modify the existing aldicarb rule (AG 29.17) for the 1986 growing season. The proposed rule incorporated concepts such as a site evaluation system to rate the groundwater contamination potential at aldicarb intended use sites and required monitoring wells in certain circumstances. Administratively, the rulemaking process would have entailed an emergency rule for the 1986 growing season and a permanent rule for future years. The emergency rule was approved by the Board of Agriculture and taken to public hearing in January of 1986, but its implementation was preempted by legislative action. On April 10, 1986, Wisconsin Act 206 was enacted to regulate the use of aldicarb. Among other provisions, this Act prohibited DATCP from enforcing its emergency rule. In some ways, the legislative action is less stringent than the proposed administrative rule.

During 1986, DATCP was also involved in groundwater investigations at several pesticide and fertilizer storage and handling facilities. These investigations were conducted in conjunction with DNR and typically involved groundwater contamination caused by improper handling of pesticides at nearby facilities. Major investigations have been conducted at Auroraville, Oxford, and Edmund, Wisconsin. At the latter two sites, Departmental orders have been issued which require the facilities to improve their storage and handling practices.

Wisconsin Farmers Fund:

DATCP has a statutory responsibility to implement an animal waste management grant program which contains a component designed to prevent groundwater contamination. Specifically, DATCP has been directed to adopt rules for county-wide ordinances which set standards and criteria for construction of earthen manure storage facilities. The law stipulates that adoption of such ordinances by counties is voluntary. Additionally, DATCP has worked with the University of Wisconsin and Portage County to develop a prototype animal waste management plan which prioritizes areas in a given geographic boundary on the basis of groundwater contamination sensitivity.

Animal Waste Storage Ordinance

To date, a total of 18 counties have submitted their ordinance to DATCP for approval (See Map 1). The Land Conservation Board has recommended approval of all 18. Of these, 16 counties have actually adopted the approved ordinances and are in various stages of implementation. Barron County has the most experience with their ordinance (adopted in February, 1983), while Portage County has the least experience (adopted in June, 1986). Nine of these 16 counties have exceeded the minimum requirements by specifying that all types of storage facilities (earthen pits as well as concrete or steel structures) must meet acceptable design standards. Nine of these 16 counties have also required that construction permits issued under their ordinances be accompanied with a manure management plan. To date, a total of 111 construction permits have been issued by the counties involved; 60% of these permits were issued in Barron and Shawano Counties. Ten of the 16 ordinances are administered and enforced by the county land conservation department (LCD). Two are administered and enforced by the county zoning administrator (ZA), while the remaining 4 are jointly administered by both county agencies. Table 2 describes these details on a county by county basis.

Table 2

WISCONSIN FARMERS FUND
SUMMARY OF ANIMAL WASTE STORAGE ORDINANCES
Wisconsin Department of Agriculture, Trade and Consumer Protection
August, 1986

	Type of Practices Regulated			Administrative Details			
	Storage Ponds	Storage Structures	Waste Utilization	Effective Date	No. of Permits Issued	Administrative Authority	Enforcement Authority
Barron	Yes	Yes	Yes	Feb '83	35	ZA	ZA
Brown	Yes	Yes	No	Apr '86	2	LCD	LCD
Burnett	Yes	No	No	Feb '85	2	LCD	LCD
Chippewa	Yes	Yes	Yes	Mar '86	0	ZA LCD	ZA
Clark	Yes	No	No	Apr '85	14	LCD	LCD
Columbia	Yes	No	No	May '85	0	LCD	LCD
Florence	Yes	Yes	Yes	Pending	N/A	ZA	ZA
Green Lake	Yes	Yes	No	Apr '85	0	LCD	LCD
Marathon	Yes	No	No	Nov '84	13	LCD	LCD
Oconto	Yes	No	Yes	Mar '86	0	LCD	LCD
Outagamie	Yes	Yes	Yes	July '85	9	ZA	ZA
Pepin	Yes	Yes	Yes	Pending	N/A	ZA LCD	ZA LCD
Polk	Yes	No	No	Feb '85	0	LCD	LCD
Portage	Yes	Yes	Yes	June '86	0	LCD	LCD
St. Croix	Yes	Yes	Yes	Nov '85	1	ZA LCD	ZA LCD
Shawano	Yes	Yes	Yes	Jan '84	32	ZA LCD	ZA LCD
Waupaca	Yes	No	Yes	Apr '86	0	LCD	LCD
Winnebago	Yes	Yes	Yes	May '85	3	ZA LCD	ZA

DJ/T4/8/LR6

Source: DATCP

The response from the counties involved in the program has been generally positive. Perhaps the most beneficial aspect of the ordinance is the ability to screen environmentally sensitive sites and thereby require that adequate safeguards be put into place. It is fair to say that the ordinance is being viewed as an integral part of an overall groundwater management strategy. Some have linked the ordinance not only to groundwater management, but also to development of a strong agricultural base and maintaining natural resources for tourism purposes. More needs to be done to ensure that all counties adopt such ordinances.

Animal Waste Management Plans

Traditionally in Wisconsin most animal waste management planning for water quality purposes has been done from a surface water perspective. In 1985 Portage County, through the University of Wisconsin-Stevens Point, developed a prototype planning method for assessing groundwater contamination related to animal unit density. The planning methodology was approved by DATCP in February, 1986. Portage County anticipates that the implementation phase of the plan will begin mid-1987. Simultaneously with the development of the planning methodology, UW-Stevens Point has initiated a two-year research project directed at identifying groundwater impacts associated with barnyard runoff. The outcome of this research project may provide recommendations which affect the design, operation and maintenance of runoff control systems.

This project is a joint effort between the DNR, DATCP, UW-Stevens Point, Portage County and the Wisconsin Geologic and Natural History Survey. As Portage County gains more experience from their research project and planning efforts, DATCP will work to incorporate the findings into the planning efforts of other counties. As of June, 1986, two allocation plans have been implemented by DATCP which accumulatively have provided \$675,000 for clean-up effort in 8 counties (Barron, Brown, Burnett, Clark, Columbia, Oconto, Polk and Shawano). By combining the use of storage ordinances and plans, these funds will be targeted at the worst water quality problems first while maintaining a preventative approach to groundwater contamination.

DEPARTMENT OF INDUSTRY, LABOR AND HUMAN RELATIONS (DILHR):

DILHR has continued work to promulgate Chapter ILHR 10 concerning underground storage tanks for flammable and combustible liquids. This rule package was the subject of public hearings in November, 1985. The Department is completing its impact analysis for this package prior to submission for legislative review.

The Department also continued its work on the revision of Chapter ILHR 83 concerning private sewerage systems. An advisory code committee is nearing completion of a draft of rules dealing with large private sewage systems. This rule should be ready for public hearing by the end of 1986. Along with this rule package are changes in the soil tester licensing law concerning the creation of a second level of tester. The second level testers will be examined on their ability to conduct hydrogeologic analysis as well as their ability to perform detailed soil analysis aimed at protecting Wisconsin groundwater.

The Department also during the last year sought, and received an attorney general's opinion concerning ss. 66.063 and 145.20(2)(h), Stats., the later being a statute section promulgating the 1983 Wisconsin Act 410. The attorney general's opinion confirmed the need for conducting system evaluations prior to the issuance of building permits. Doing such system evaluations is a method of determining the existence of failing systems that contaminate groundwater.

The Department has also been involved in investigating the use of perforated storm sewers in the Central Sands Region of Wisconsin. This issue came to the attention of the Department in late 1985 and was communicated to the Groundwater Coordinating Council in early 1986. The Department is concerned that wide-spread use of subsurface soil absorption of storm water can present an immediate threat to groundwater resources. DILHR is currently investigating in conjunction with the DNR whether rule promulgation is needed to clarify where subsurface disposal of would be acceptable and what monitoring requirements would be necessary.

DEPARTMENT OF HEALTH AND SOCIAL SERVICES (DHSS):

In the last year the Division of Health within DHSS has developed recommended groundwater enforcement standards and preventive action limits for 14 substances. The recommendations were developed in accordance with the legislative mandate in section 160.09 Stats., and transmitted to the DNR in the document Public Health Related Groundwater Standards - 1986. The recommended levels are summarized in Tables 3 and 4.

In addition to standard setting, DHSS staff in conjunction with researchers from the UW have initiated a research project aimed at better evaluating the health effects of multiple contaminants in drinking water. The study will examine the health effects of atrazine and alachlor separately and in combination on laboratory test animals. The study will conclude in one year. It is anticipated that the results of this work will enable DHSS staff to better evaluate multiple contaminant situations and make better informed recommendations on appropriate responses.

DEPARTMENT OF TRANSPORTATION (DOT):

In the last year the DOT has put into place an administrative rule relating to groundwater protection. TRANS 277 Wis. Adm. Code, effective on May 1, 1986, was created as the result of 1983 Act 410, which created Sections 85.17 and Chapter 160 of the Wisconsin Statutes. This rule represents standards for the storage of highway salt which will protect the waters of the state from contamination by dissolved chlorides.

TRANS 277 requires each person in the highway salt distribution chain to meet standards for storage practices and facilities. These standards apply from the importation of the salt into the state through all distributors to the ultimate user. The storage of bulk quantities of sodium chloride and calcium chloride intended for application on both public and private roadways, parking areas and driveways by any user is regulated. Persons who store less than 1000 pounds of highway salt, or who purchase salt in bags, each of 100 pounds

Table 3

DHSS PROPOSED GROUNDWATER ENFORCEMENT STANDARDS AND PALS
FOR 8 VOLATILE ORGANIC COMPOUNDS (VOCS)
 June 1986

SUBSTANCE	STUDY	NOEL MG/KG (PPM)	U.F. ¹	ES ug/l (PPB)	PAL ug/l (PPB)	M, T, C*
<u>VOLATILE ORGANIC COMPOUNDS</u>						
1,1-Dichloro-ethane	Sub-chronic Rat, Guinea Pig, Dog Rabbit	2000 mg/m ²	1,000	850.0	85.0	T
1,2-Dichloro-benzene	Sub-chronic Oral - Rat and Mouse	125.0	1,000	1,250.0	125.0	M
1,2-Dichloro-ethylene (cis)	2 Year Chronic Rat; Used 1/1-Dichloro-ethylene Study	10.0	1,000	100.0	10.0	M
1,2-Dichloro-ethylene (trans)	2 Year Chronic Rat; Used 1/1-Dichloro-ethylene Study	10.0	1,000	100.00	20.0	
1,3-Dichloro-benzene	Sub-chronic Oral - Rat and Mouse	125.0	1,000	1,250.0	125.0	M
Ethylbenzene	Sub-chronic Oral - Rats	136.0	1,000	1,360.0	272.0	
Fluorotri-chloro-methane (Freon-11)	NCI Chronic Animal Study (2 Year Rat and Mouse)	349.0	1,000	3,500	700	
Tetrahydro-furan	Sub-chronic Animal Study	5.0	1,000	50.0	10.0	

*M = MUTAGEN; C = CARCINOGEN T = TERATOGEN/REPRODUCTIVE EFFECTS

¹U.F. = Uncertainty Factor

²1-in-a-million or 10⁻⁶ Risk Level

Source: DHSS

Table 4

DHSS PROPOSED GROUNDWATER ENFORCEMENT STANDARDS AND PALS
FOR 6 PESTICIDES
June 1986

SUBSTANCE	STUDY	NOEL MG/KG (PPM)	U.F. ¹	ES ug/l (PPB)	PAL ug/l (PPB)	M, T, C*
<u>PESTICIDES</u>						
Alachlor	2 Year Rat Oncogenicity	-----	-----	0.150 ²	0.015	C
Atrazine	2 Year Dog Feeding	0.35	10,000	0.350 ³	0.035	C
Butylate	2 Year Mice Feeding	20.0	1,000	200.00	40.0	
Cyanazine	30 Day Rabbit Fetotoxicity	1.0	1,000	10.0	1.0	T
EPTC (Eptam)	2 Year Rat Feeding	5.0	1,000	50.0	10.0	
Metolachlor	2 Year Rat Feeding	1.5	1,000	15.0 ³	1.5	C

*M = MUTAGEN; C = CARCINOGEN; T = TERATOGEN/REPRODUCTIVE EFFECTS

¹U.F. = Uncertainty Factor

²1-in-a-million or 10⁻⁶ Risk Level, From Alachlor PD-1

³A.D.I. Approach to Carcinogen Risk Quantification

Source: DHSS

or less, are not covered by TRANS 277. Neither the transportation of salt nor the actual application of salt on highways is regulated. The storage of liquid calcium chloride is regulated by a general provision, without detailed requirements for storage facilities.

TRANS 277 mandates that salt be stored on an impermeable base to prevent dissolved chlorides from leaching into the groundwater. A holding basin must be provided to contain precipitation runoff until the salt is recovered. Salt may not be stored too near surface waters. Salt must also be stored inside a building or covered by an impermeable or water resistant covering to prevent precipitation from falling on the salt.

Highway salt which is a mixture of sand and chloride, where the chloride does not exceed 5% of the mixture, by weight, and which is kept covered from April to October, is exempted from these requirements. Salt is added to sand, typically, to keep the sand friable. Without the added salt, which is usually less than 5% of the total weight of the mixture, the sand would freeze together.

TRANS 277 requires persons storing highway salt to also keep specified records and to report to the Department their abandonment of a storage site and any contamination complaints received. Also, in order for the Department to obtain the information necessary to enforce this rule and s. 85.17, Stats., a person storing highway salt is required to make a one-time report for each storage facility providing information such as the location and capacity of the facility. These reports will enable the DOT to locate and inspect private stockpiles of highway salt.

The staggered effective date provisions of TRANS 277 allows approximately 1.5 years for complete compliance of salt storage facilities. All owners of highway salt storage facilities must report their storage to the DOT by May 31, 1986. Required record keeping by persons storing chlorides begins after October 1, 1986. All salt storage must be covered with an impermeable cover by October 1, 1986. The construction of impermeable basins at storage facilities must be completed by October 1, 1987.

TRANS 277 also defines the specific points where the DNR may take test samples to check for contamination. The preventive action limits and enforcement standards for specific substances are set by section NR 141.12.

TRANS 277 provides for enforcement by compliance directives issued by DOT inspectors. Special orders for remedial action may also be issued by the DOT Secretary when preventive action limits or enforcement standards for chlorides are reached or exceeded, or when the DNR reports an adverse impact on surface waters. Provision is made for public involvement in the issuance of special orders.

Additional enforcement options are contained in s.85.17(5), Stats. The penalties for violation of s. 85.17, Stats., or TRANS 277, are stated in s. 85.17(6), Stats.

In addition to rulemaking, the Wisconsin DOT has been selected along with the state of Michigan to field test the deicing capabilities of a non-corrosive salt substitute, calcium magnesium acetate (CMA). The U.S. DOT will provide at least 100 tons of both improved CMA and CMA coated sand. The agreed upon test site will be USH 14 between Madison and Oregon where CMA will be applied to either the north or south bound lanes and salt to the other lanes. This highway testing will occur during the winter of 1986-87.

The contract administrator will be the State Maintenance Engineer for Highways. The Dane County Highway Department will store and apply the deicers under direction from WIDOT. The WIDOT will purchase 25 tons of CMA to insure that only CMA is applied to the test lanes if the 200 tons of CMA purchased by the USDOT does not arrive before the first snow. The WIDOT will install 8 pavement sensors on the test highway to record air and pavement temperatures, humidity, pavement wetness and wind velocity. These pavement sensors will be linked to a computer for data analysis and for prediction of pavement icing conditions. This set up and the analysis capability will cost about \$125,000 and be funded from the Special Maintenance state funded program.

The Bjorksten Research Laboratories will serve as the research agency under contract to WIDOT. The actual field testing will be funded from the federal highway planning and research funds (\$46,600) and matching state funds (\$8,300).

This project is a National Pooled-Fund Highway Planning And Research Study to field test high quality calcium magnesium acetate. A report will be prepared for use in developing future proposals to evaluate environmental concerns stemming from the use of CMA.

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY (WGNHS):

The Wisconsin Geological Survey does not have any direct regulatory responsibility for implementing Chapter 160 but plays a significant supporting role. The Survey's mission is to conduct natural resource surveys and research to aid in planning, public education and resource management. As such, the Survey plays a key role in assisting other state agencies in their regulatory assignments. The DNR and other state departments rely heavily on the Survey to provide basic information on geology, hydrogeology and soils. In fulfilling this role as technical advisor Survey staff have been active over the last year serving on all four subcommittees to the Council. In addition, Survey staff have provided considerable technical field assistance to the DNR in conducting both research efforts and contamination investigations. A summary of some of the Survey's recent field studies is presented in Appendix B.

DEPARTMENT OF NATURAL RESOURCES (DNR):

In the last year the DNR has put into place 2 administrative rules relating to groundwater protection. NR 140, which became effective October 1, 1985, sets the statewide groundwater standards, establishes locations where the standards apply and defines a range of responses that can be taken to correct standards violations. The rule will soon begin undergoing revision to add new standards and modify existing procedures. Amendments are proposed to add standards for

6 pesticides and 8 volatile organic chemicals based on recommendations from DHSS, to revise language regarding statistical procedures and to clarify some additional rule language. Also, on May 1, 1986, NR 149, the laboratory certification rule, became effective. By August 28, 1986, all facilities submitting environmental data must meet the requirements of the rule. The rule establishes minimum performance standards for laboratories conducting tests on environmental samples. The rule will insure the data used in regulatory decisionmaking is of acceptable quality or that the quality of the data can be determined.

In addition to rulemaking the DNR continues to carry out groundwater protection as part of its day to day regulatory responsibilities. Activities such as solid waste and wastewater disposal site plan reviews are part of the agency's normal operating duties which protect the resource. Data management is becoming another increasingly important day to day activity. Wisconsin statutes require DNR to "coordinate the collection of groundwater monitoring data and the exchange of these data among agencies...". In April, 1986 the DNR completed a design document for a computer system called the Groundwater Information Network that will enable the Department to meet its statutory responsibility.

The Groundwater Information Network will provide a consistent format for the storage of groundwater data from different DNR programs. The network will be a computerized system that will meet the following objectives:

- *provide a standard format for groundwater data
- *contain groundwater monitoring results, the location of sampling points and the location of contaminate sources
- *link groundwater data generated from various sources
- *provide for data capture, entry, verification and quality assurance procedures

In addition the Department has used a portion of its groundwater monitoring funds for data management. In 1985-86 the DNR contracted with an independent consultant to develop an inventory of groundwater data bases within the Department and other state agencies and to identify the data management needs and priorities of the state agencies.

Over the last year the DNR has maintained its commitment to groundwater management planning. The major goals of the Department's planning activities are:

- *assess Wisconsin's groundwater resource
- *assess existing groundwater authorities, policies and programs
- *develop strategies to optimize groundwater management in Wisconsin

In order to achieve the goals put forth, a three tiered planning approach has been developed for the state, regional and local levels. The focus of activity over the last year has been the state plan. As part of this effort the Department has prepared a state groundwater susceptibility map. This map

will serve as a general guide to illustrate where the greatest potential for problems may exist. In addition, planning staff are conducting an assessment of groundwater management programs in Wisconsin. Due out in January, 1987 this plan will aide state officials in identifying weak points in current protection efforts.

Lastly, the DNR has continued its extensive groundwater monitoring program. Over the last year the DNR has spent approximately \$850,000 on groundwater monitoring efforts. Of this approximately \$230,000 have been used to test public and private water supplies for VOC's, pesticides and radionuclides. The remaining funds have been used to support research studies into new methods of groundwater protection and to purchase necessary field equipment. These studies, listed in Table 5 are designed to reduce groundwater impacts by changing the way some land activities are done. Listed with each project title is the researcher conducting the investigation. These ongoing efforts were selected from a range of proposals submitted to the Department by various researchers. The projects chosen for funding were selected by DNR staff with input from experts within and outside the agency. This process of soliciting proposals and conducting a multiagency review will continue to be the general manner in which projects are selected for support from the Groundwater Fund. In selecting these projects efforts are made to match projects with identified research and program needs. As an example, the animal waste study in Portage County is intended to define the level of groundwater pollution, if any, from barnyards. The study will then make recommendations on how to change barnyard design and operation to reduce these problems. These studies are playing a major role in determining what management practices will best protect groundwater quality in the future.

The funding for the DNR's monitoring program and much of the rest of the state's groundwater protection efforts comes from the Groundwater Fund. The Fund was created by the legislature during the passage of the groundwater bill and consists of the sources listed in Table 6.

Table 5

FY 1986 DNR Funded Groundwater Research Projects

1. Study into the factors affecting pesticide movement in the unsaturated zone. (UW - Civil and Environmental Engineering Dept. - Madison)
2. Pesticide use field study conducted by DATCP staff. (DATCP staff)
3. Study into the fate and movement of aldicarb in groundwater near Plover, WI. (UW - Soils Department - Madison)
4. Evaluation of the use of indicator parameters to evaluate landfill impacts on groundwater quality. (DNR staff)
5. Evaluation of the groundwater impacts of large scale subsurface soil absorption systems. (UW - Civil and Environmental Engineering Dept - Madison)
6. Evaluation of the performance of gradient control landfill sites. (DNR staff)
7. Use of predictive groundwater models in reviewing disposal site plans. (UW - Civil and Environmental Engineering Dept. - Madison)
8. Evaluation of groundwater impacts from road salt use and storage. (DNR staff)
9. Evaluation of the groundwater impacts from farm barnyards. (UW - College of Natural Resources - Stevens Point)
10. Evaluation of the extent of factors leading to groundwater contamination by nitrate. (UW - Geology Dept - Milwaukee)
11. Evaluation of the extent of nitrate contamination in a given area of west central Wisconsin. (UW - Geology Dept - Eau Claire)
12. Study of the hydrogeology in a small basin in Door County. (Wisconsin Geological and Natural History Survey)
13. Evaluation of the factors leading to lead contamination of groundwater in Door County. (UW - Geology Dept. - Green Bay)
14. Development of an improved statistical method to evaluate groundwater standards violations. (UW - Civil and Environmental Engineering Dept - Madison)
15. Study of the groundwater impacts from the irrigation of agricultural fields. (United States Geological Survey)
16. Study into the best methods to seal the annular space of monitoring and water supply wells. (UW - Civil and Environmental Engineering Dept. - Madison)
17. Studies into the groundwater impacts of the land disposal of municipal and industrial wastewaters. (UW - Civil and Environmental Engineering Dept. - Madison)

Source: DNR

Table 6

Groundwater Fund
FY 86 Revenues

<u>Revenue Type</u>	<u>Revenue Amount</u>
Fertilizer Sales Fee s. 94.64(4)(am)	\$ 147,343
Pesticide Sales Fee s. 94.681(2)	308,596
Storage Tank Installation Fee s. 101.14(5)	34,500
Sanitary Permit Fee s.145.19(6)	309,325
Waste Generator Fee s. 144.441(7)	664,245
Septic Tank Servicing Fee s. 146.20(4s)(d)	17,050
Land Disposal Fee s.147.02 and 147.033	84,400
 Total Fees	 \$1,565,459
 Investment Income	 27,191
 GPR Supplement	 623,300
 Total	 \$2,215,950

Source: DNR

Table 7

Groundwater Fund
FY 86 Expenditures

<u>Expenditure Type</u>	<u>Expenditure Amount</u>
DNR	
Permanent staff salary	\$ 659,879
Temporary monitoring staff salary	114,086
Fringe benefits	185,914
Supplies, Services, Contracts	563,399
Equipment purchases	97,958
Unbilled encumbrances	324,413
 DATCP	
Staff salary and support	118,700
 DHSS	
Staff salary and support	122,812
 Cash carry forward to FY 87	28,789
 Total	2,215,950

Source: DNR

CONDITION OF THE STATE'S GROUNDWATER RESOURCE

INTRODUCTION

Over the last year state supported monitoring efforts have continued to redefine the condition of Wisconsin's groundwater. As a result, we are finding an ever increasing amount of groundwater contaminated by both man-made and naturally occurring pollutants. Volatile organic chemicals (VOC's) continue to be the contaminants of greatest concern. Originating from numerous sources, including landfills, chemical storage facilities and industrial and commercial operations, VOC's are responsible for contaminating numerous public and private water supplies. In addition to VOC's, pesticide residues continue to be found in both monitoring and drinking water wells. Recent testing has focused on potential problems related to pesticide storage and handling facilities. However, results of new studies around selected agricultural fields are showing some potentially serious groundwater impacts. Lastly, naturally occurring radionuclides appear to be an expanding water quality problem. Sampling programs taking place in the granitic bedrock of northern and central Wisconsin and the sandstones in southeast Wisconsin are turning up additional contaminated water supplies.

The following paragraphs summarize what we know about groundwater quality in four major categories: natural groundwater quality, nitrates, volatile organic chemicals, and pesticides.

NATURAL GROUNDWATER QUALITY

The natural groundwater quality varies greatly in Wisconsin and depends upon the rocks and minerals with which the water is in contact. Often, groundwater derived from deeper aquifers or major drinking areas has greater mineral concentrations, because the water has been in contact with minerals longer. The naturally occurring problem constituents that are most common in groundwater are hardness, iron, manganese, sulfate, and radium. The problem with many natural constituents such as iron, sulfate, or manganese is not safety, but aesthetics. For example, high levels of iron can stain plumbing fixtures and laundry and give drinking water an unpleasant taste and odor. High levels of iron in groundwater have been found in numerous of places statewide. Occasional high levels of fluorides, manganese, sulfates, and lead are less common and more localized.

Naturally occurring radionuclides have become a major source of concern in Wisconsin. As of June, 1986, 39 community water systems have been found to have radium levels exceeding the drinking water standard. In addition from 1983-1986, 253 private and noncommunity wells have been tested as part of a special groundwater investigation. These wells are located statewide and are open to various geologic formations, including granite and sandstone. To date 31 of these wells have either exceeded the radium health advisory level or have abnormally high levels of uranium (see Figures 1 and 2). To follow-up on these results, the Department of Natural Resources, in conjunction with the State Geological Survey, is planning to sample an additional 50 wells in granitic bodies in the fall and winter of 1986. Part of the difficulty in evaluating the magnitude of this problem lies in the complex geology of the granitic formations. Radium and uranium sit at various locations within the

SUMMARY OF PRIVATE AND NONCOMMUNITY WELLS SAMPLED FOR RADIUM AND URANIUM

SUMMARY OF PRIVATE AND NONCOMMUNITY
WELLS SAMPLED FOR RADIUM AND URANIUM
1983 - 1986

County	Radium (Ra)	Uranium (U)
BAYFIELD	2	0
ASHLAND	3	0
IRON	2	0
VILAS	1	0
DOUGLAS	2	0
WASHBURN	2	0
SAWYER	5	0
PRICE	4	0
ONEIDA	3	0
FOREST	4	0
FLORENCE	3	0
MARINETTE	5	0
BURNETT	3	0
POLK	0	0
BARRON	4	0
RUSK	6	0
CHIPPEWA	4	0
TAYLOR	3	0
LINCOLN	5	0
LANGLADE	4	0
OCONTO	4	0
ST. CROIX	1	0
DUNN	6	1
CLARK	3	0
MENOMINEE	0	4
SHAWANO	1	1
PIERCE	2	0
EAU CLAIRE	2	0
PEPIN	2	0
WOOD	3	1
PORTAGE	4	0
WAUPACA	5	1
OUTAGAMIE	6	0
BROWN	2	0
DOOR	0	0
KEWAUNEE	0	0
MANITOWOC	0	0
WINNEBAGO	1	1
CALUMET	1	0
SHEBOYGAN	0	0
FOND DU LAC	17	6
GREEN LAKE	3	0
WAUKESHA	11	2
MILWAUKEE	0	0
JEFFERSON	3	0
WALWORTH	8	1
RACINE	3	0
KENOSHA	5	2
DADE	2	0
COLUMBIA	2	0
SAUK	4	0
ROCK	3	0
GREEN	2	0
LAFAYETTE	1	0
GRANT	1	0
CRAWFORD	0	0
YERDON	2	0
LA CROSSE	1	0
MONROE	2	0
JACKSON	2	0
TREMPER	1	0
EAU CLAIRE	2	0
BUFFALO	1	0
MANITOWOC	0	0
DOOR	0	0
KEWAUNEE	0	0
WINNEBAGO	1	1
CALUMET	1	0
SHEBOYGAN	0	0
FOND DU LAC	17	6
GREEN LAKE	3	0
WAUKESHA	11	2
MILWAUKEE	0	0
JEFFERSON	3	0
WALWORTH	8	1
RACINE	3	0
KENOSHA	5	2
DADE	2	0
COLUMBIA	2	0
SAUK	4	0
ROCK	3	0
GREEN	2	0
LAFAYETTE	1	0
GRANT	1	0
CRAWFORD	0	0
YERDON	2	0
LA CROSSE	1	0
MONROE	2	0
JACKSON	2	0
TREMPER	1	0
EAU CLAIRE	2	0
BUFFALO	1	0
MANITOWOC	0	0
DOOR	0	0
KEWAUNEE	0	0
WINNEBAGO	1	1
CALUMET	1	0
SHEBOYGAN	0	0
FOND DU LAC	17	6
GREEN LAKE	3	0
WAUKESHA	11	2
MILWAUKEE	0	0
JEFFERSON	3	0
WALWORTH	8	1
RACINE	3	0
KENOSHA	5	2

11 - NUMBER OF WELLS SAMPLED
Ra 1 - NUMBER OF WELLS EXCEEDING RADIUM STANDARD
U 1 - NUMBER OF WELLS EXCEEDING 10 pCi/l TOTAL URANIUM

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Figure 2

CURRENT RADIUM VIOLATION LIST-39 SYSTEMS
June 20, 1986

<u>System</u>	<u>County</u>	<u>Composite Sample Combined Radium 226 & 228 (pCi/l)</u>
Allouez, Town of	Brown	8.7
Appleton, Romanesko MHP	Outagamie	6.2
Ashwaubenon, Village of	Brown	6.0
Bellevue, Town of, Sanitary District	Brown	21.1
Brandon, Village of	Fond du Lac	6.0
Brownsville, Village of	Dodge	8.7
Caledonia, Caddy Vista Sanitary District	Racine	7.1
Downsville, Dunn Sanitary District No. 1	Dunn	20.6
Eagle, Village of	Waukesha	8.7
Fond du Lac, City of	Fond du Lac	8.6
Fond du Lac, Mary Hill Park Sanitary District	Fond du Lac	8.0
Fond du Lac, Taycheedah Correctional Institute	Fond du Lac	20.1
Franklin, City of	Milwaukee	8.1
Franklin, Security Acres Addition	Milwaukee	6.2
Germantown, Village of	Washington	9.3
Hales Corners, Tudor Oaks Retirement Center	Waukesha	7.4
Holland, Town of, Sanitary District No. 1	Brown	34.3
Hustisford, Village of	Dodge	8.5
Jefferson, City of	Jefferson	6.1
Jefferson, St. Colletta School #1	Jefferson	7.7
Kaukauna, City of	Outagamie	6.6
Kenosha, Carol Beach Water Company	Kenosha	5.9
Menomonie, City of	Dunn	5.9
Mukwonago, Village of	Waukesha	5.7
New Berlin, City of	Waukesha	10.6
North Fond du Lac, Village of	Fond du Lac	7.2
Oshkosh, Edison Estates Mobile Home Park	Winnebago	6.8
Peshtigo, City of	Marinette	9.0
Pewaukee, Town of, Hyland Coop (Subdivision)	Waukesha	7.6
Pewaukee, Town of, Sanitary District No. 3	Waukesha	8.2
Pleasant Prairie, Town of, Sanitary District, Industrial Park	Kenosha	8.6
Pleasant Prairie, Town of, Sanitary District, Timber Ridge	Kenosha	13.0
Princeton, City of	Green Lake	14.6
Racine, Crestview Sanitary District	Racine	10.6
Scott, Town of, Sanitary District No. 1	Brown	8.6
Suamico, Rustic Acres Mobile Home Park	Brown	7.6
Union Grove, Southern Wisconsin Center	Racine	9.1
Waukesha, City of	Waukesha	20.6
Waukesha, Northview Home & Hospital	Waukesha	10.2

Source: DNR

mineral structures that make up the crystalline rocks. Where these elements are located is a function of the the past history of the rock, particularly the past temperatures, pressures and water conditions. Since these rocks have a 1-3 billion year history of change, it is extremely difficult to predict where the radium and uranium "hotspots" are. The continued investigation of this problem in both the granites and sandstones will be a major groundwater management activity over the next several years.

NITRATES

The groundwater contaminant most often tested for is nitrate ($\text{NO}_3\text{-N}$). Nitrate is not usually harmful to adults or older children. In fact, we consume a great deal every day. But stomach acid in some infants is not yet strong enough to prevent the growth of certain bacteria which can convert nitrate to harmful nitrite. Nitrites change the blood hemoglobin so that it cannot transport oxygen. The result is methemoglobinemia, called the "blue baby syndrome", which can be fatal. However, if the condition is diagnosed, removing nitrate from the infant's diet will cause the symptoms to rapidly disappear. Methemoglobinemia is difficult to diagnose and, until recently, was not a reportable disease. Therefore, the number of cases of this disease is unknown.

A 1979-1980 DNR study of 11,396 small public water wells (wells serving schools, churches, motels, service stations, campgrounds, and the like) found that 311 -about 1 in 40 (2.7%) - exceed the standard of 10 mg/l of nitrate-nitrogen. More than one in 3 (33%) had detectable levels. Many of the wells with high nitrate levels were in the area of the state with highly permeable soils known as the central sands region. In 1985 a follow-up study was conducted at all small public facilities that showed a detectable level of nitrate in the 1979-1980 study. This amounted to about 5,800 water samples. The results of this study showed that there was no statistically significant upward or downward trend in nitrate values in these wells.

VOLATILE ORGANIC CHEMICALS

A volatile organic chemical (VOC) is a chemical that vaporizes under normal temperatures and pressures. Examples of VOC's include gasoline and industrial solvents or household products such as spot and stain removers, paints and thinners, drain cleaners, and air fresheners. Many VOC's are either known or suspected carcinogens for long term exposure. In the short term, high concentrations of VOC's can cause nausea, dizziness, tremors or other health problems.

Though many of these chemicals have been used for decades, it wasn't until very recently that the technology existed to accurately analyze and detect VOC's in water supplies. In 1980, the U. S. EPA funded the sampling of 500 municipal water supplies across the country for VOC's. In Wisconsin, ten municipal wells were selected randomly and ten municipal wells were selected based upon their susceptibility to contamination. The susceptible wells were located near potential pollution sources and in shallow aquifers having porous soils. Five of these 20 municipal systems were found to contain detectable levels of VOC's. Because of these initial findings, Wisconsin greatly expanded its VOC sampling program in 1983.

Since 1983 several thousand public and private water supplies have been tested for VOC contamination. The results of this work are shown in Table 8. VOC's are the biggest single threat to groundwater quality in Wisconsin. Their widespread occurrence and ability to have both short and long term health impacts make them a serious concern to state groundwater managers. In addition VOC's seem to originate from an endless variety of sources. Groundwater contamination can result from the mismanagement of chemicals at a large industrial manufacturing plant or from a leaking underground storage tank at a small single pump gas station. This wide range of potential sources makes the prevention of groundwater contamination very difficult. Also, once contamination is found it is usually very difficult and expensive to identify the source and correct the problem.

To better understand the economic and environmental extent of the problem one can look at the number of community wells impacted by VOC's. Currently 88 community wells have some detectable level of one or more volatile organic contaminant. Of these, 30 have concentrations exceeding state health advisory levels. As a result, all 30 sites have had to enact some form of remedial action. These actions can include shutting down the well, blending the contaminated water with clean water to reduce the pollutant load, or installing some form of treatment at the well head. Two of these practices, treating the water or closing down a well, represent major expenses for the impacted community. The initial capital cost for installing a treatment unit is approximately \$150,000-200,000. To date, eight Wisconsin communities have chosen this alternative. In addition to the initial outlays, there are extra annual operation and maintenance expenses. If a community is forced to shut down a contaminated well, the potential costs can be even greater. The community will have lost its investment in the contaminated well. In addition it may face the costs of constructing a new supply well at approximately \$200,000 and the cost of hooking the well into its existing distribution system.

From an environmental and economic viewpoint VOC's are the number one groundwater contamination problem in the state.

PESTICIDES

Since the fall of 1983, the state has been actively investigating groundwater contamination from pesticides. For the first 2 years the main focus of this work was on evaluating groundwater problems related to pesticide use. Following the guidelines established in a 1983 monitoring plan, the state's monitoring efforts were directed at priority pesticides used in "sensitive" areas. "Sensitive" areas were described as areas of coarse soils and shallow water tables or areas of fractured bedrock at or near the land's surface. The priority pesticides were selected based on their potential to impact groundwater quality. Factors including solubility, soil mobility, toxicity, and level of use were used to create a qualitative ranking scheme. Forty-five chemicals of concern were identified and ranked into Categories 1, 2 and 3. The Category 1 compounds were of most concern and included the 22 compounds listed in Table 9. Using this report the state ran approximately 1,500 pesticide analyses between 1983-1985 to investigate possible pesticide use related problems. The majority of these analyses were run for Category 1 compounds. The results of this work showed few groundwater problems related

Table 8

SAS

SUMMARY OF GROUNDWATER VOC MONITORING
FOR 07/01/83 THRU 11/30/86

CHEMICAL CODE	CHEMICAL NAME	TOTAL NO. OF WELLS	WELLS WITH DETECTS	ENFORCEMENT STANDARD (UG/L)	WELLS EXCEEDING ENF. STD.	PREVENTIVE ACTION LIMIT (UG/L)	WELLS EXCEEDING PAL	HIGHEST DETECTION LEVEL (UG/L)
20425	TRICHLOROETHYLENE	4622	277	1.8	243	0.18	275	8800
20399	TETRACHLOROETHYLENE	4624	229	1.0	215	0.10	229	20000
20025	BENZENE	4525	130	0.67	130	0.067	130	14000
20167	1,2-DICHLOROETHANE	4444	117	0.5	117	0.05	117	450
20169	1,1-DICHLOROETHYLENE	4467	69	0.24	69	0.024	69	87
20236	ETHYLENE DIBROMIDE	189	49	0.01	49	0.001	49	150
20437	XYLENE (TOTAL)	4483	127	620.0	17	124.0	33	9000
20411	TOLUENE	4547	144	343.0	17	68.6	32	12000
20421	1,1,1-TRICHLOROETHANE	4566	264	200.0	10	40.0	48	2200
20434	VINYL CHLORIDE	4400	4	0.015	4	0.0015	4	42
20153	1,2-DICHLOROETHYLENE	4411	5	10.0	2	2.0	3	43
20171	1,2-DICHLOROETHYLENE	4521	111	NONE	0	NONE	0	8800
20095	CHLOROFORM	4442	108	NONE	0	NONE	0	58
20165	1,1-DICHLOROETHANE	4449	101	NONE	0	NONE	0	180
20233	ETHYL BENZENE	4477	90	NONE	0	NONE	0	1400
20427	TRICHLOROFLUOROMETHANE	4420	51	NONE	0	NONE	0	4100
20051	BROMODICHLOROMETHANE	4421	42	NONE	0	NONE	0	13
20147	DIBROMOCHLOROMETHANE	4420	24	NONE	0	NONE	0	32
20087	CHLOROETHANE	4412	19	NONE	0	NONE	0	46
20157	1,4-DICHLOROETHYLENE	4412	9	750.0	0	150.0	0	5.799999
20428	TRICHLOROTRIFLUOROETHANE	4413	7	NONE	0	NONE	0	1200
20073	CARBON TETRACHLORIDE	4421	4	NONE	0	NONE	0	4.5
20393	STYRENE	4411	4	NONE	0	NONE	0	6.2
20053	BROMOFORM	4419	3	NONE	0	NONE	0	7.4
20083	CHLOROETHYLENE	4411	2	NONE	0	NONE	0	410

Table 8 (continued)

SAS

2

SUMMARY OF GROUNDWATER VOC MONITORING
FOR 07/01/83 THRU 11/30/86

CHEMICAL CODE	CHEMICAL NAME	TOTAL NO. OF WELLS	WELLS WITH DETECTS	ENFORCEMENT STANDARD (UG/L)	WELLS EXCEEDING ENF. STD.	PREVENTIVE ACTION LIMIT (UG/L)	WELLS EXCEEDING PAL	HIGHEST DETECTION LEVEL (UG/L)
20155	1,3-DICHLOROBENZENE	4411	2	NONE	0	NONE	0	23
20401	TETRAHYDROFURAN	4410	2	NONE	0	NONE	0	11000
20071	CARBON DISULFIDE	4411	1	NONE	0	NONE	0	0
20007	ACROLEIN	4410	0	NONE	0	NONE	0	0
20009	ACRYLONITRILE	4411	0	NONE	0	NONE	0	0
20046	BROMOBENZENE	4411	0	NONE	0	NONE	0	0
20055	BROMOMETHANE	4411	0	NONE	0	NONE	0	0
20063	BUTYL ACETATE	4411	0	NONE	0	NONE	0	0
20093	2-CHLOROETHYL VINYL ETHER	4411	0	NONE	0	NONE	0	0
20108	O-CHLOROTOLUENE	4411	0	NONE	0	NONE	0	0
20110	P-CHLOROTOLUENE	4411	0	NONE	0	NONE	0	0
20148	1,2-DIBROMO-3-CHLOROPROPANEDBCP	4411	0	0.05	0	0.005	0	0
20174	DICHLOROIODOMETHANE	4411	0	NONE	0	NONE	0	0
20181	1,2-DICHLOROPROPANE, TRANS	4411	0	NONE	0	NONE	0	0
20183	1,3-DICHLOROPROPENE, CIS	4410	0	NONE	0	NONE	0	0
20185	1,3-DICHLOROPROPENE, TRANS	4410	0	NONE	0	NONE	0	0
20298	ISOPROPYLBENZENE	4410	0	NONE	0	NONE	0	0
20319	METHYL ETHYL KETONE	4410	0	NONE	0	NONE	0	0
20325	METHYLENE CHLORIDE	25	0	150.0	0	15.0	0	0
20396	1,1,1,2-TETRACHLOROETHANE	4409	0	NONE	0	NONE	0	0
20397	1,1,1,2,2-TETRACHLOROETHANE	4409	0	NONE	0	NONE	0	0
20423	1,1,1,2-TRICHLOROETHANE	4410	0	0.6	0	0.06	0	0

Source: DNR

Table 9
Pesticides of Greatest Concern for Groundwater Contamination
April, 1983

1. Alachlor
2. Aldicarb
3. Amitrole
4. Carbaryl
5. Carbofuran
6. Chloramben
7. DBCP
8. Dimethoate
9. Dinoseb
10. Disulfoton
11. ETU
12. Fonofos
13. Linuron
14. MBC
15. Metam-Sodium
16. Methomyl
17. Metolachlor
18. Oxamyl
19. PCNB
20. Phorate
21. Picloram
22. Terbofos

Source: DNR

to pesticide use. Seven different pesticide substances were identified in groundwater. Only two of these substances were found in concentrations greater than known health advisories. (See Table 10.)

There are several possible explanations which could account for the low number of pesticide problems. First, it may be that groundwater problems from pesticide use are not common. In the early stages of the program, state agency staff anticipated that there would be a significant number of problems found related to pesticide use. This assumption was based largely on the earlier aldicarb experience in Wisconsin. However, the data collected did not support this initial assumption. The known use related problems appear to be isolated occurrences. Widespread contamination was not uncovered as expected. Only 25 out of the approximately 550 wells tested showed detectable levels of pesticide residue. Of these wells only 3 contained levels above known health advisory levels. This represented less than 1% of the wells tested.

An alternative explanation for the low number of detects is that the wells tested were not located in the zone of contamination. The early pesticide program almost exclusively used private water supply wells as sampling points. This was because of the prohibitive cost and time that would be needed to install groundwater monitoring wells around a large number of agricultural fields statewide. Also by testing private wells, some assurance could be given to the water users that their water was safe for domestic uses. The difficulty was that in some instances that water supply wells tested were not located in the most ideal monitoring locations. Often the wells were not located directly downgradient from the field in question, or located too far from the field. As a result, it is possible that in some instances contamination plumes were missed because of the well location.

It is also possible that, for the wells tested, the wrong pesticide may have been analyzed. In Wisconsin there are no requirements for growers to report the compounds they use on their land. As a result, there were no readily available references to use to check the chemical use history of a particular field. Instead, state staff had to individually interview growers to determine what substances had been recently used on certain lands. This procedure had shortcomings. Often the landowner could not remember specifically which pesticides were used on certain fields. Consequently, state staff were sometimes unable to identify which compounds needed to be tested for downgradient from selected sites. Also in some instances the grower may have used a large number of substances on a given field over a series of years. In these cases investigators had to select which compounds should be tested for and which should not. If staff selected the wrong parameter, a substance which may be in groundwater may have been missed. These uncertainties related to pesticide use histories may have contributed to the low detection rate for the program. Lastly, it is possible that the wrong form of the pesticide was analyzed for by the laboratory. When pesticides are applied to the land they generally breakdown quickly into one or more breakdown products. These breakdown products can in some instances be more toxic and more mobile in the environment than the parent compounds. In reviewing the laboratory analyses, some questions have been raised as to whether the procedures used will detect all the chemical forms of pesticide

Table 10

Pesticides Found in Groundwater as a Result of
Pesticide Use - FY 83-85 Monitoring Program

- 1) Dinoseb*
- 2) Atrazine
- 3) Carbofuran
- 4) Chloramben
- 5) Dacthal
- 6) Metribuzin
- 7) EDB*

*Compound found in a concentration exceeding the health limit for drinking water.

Source: DNR

that may be present. There is some concern that the analytical procedures used may not be capable of detecting more than one form of the pesticide of concern. Thus, it is possible that laboratory methodologies may partially account for the low number of problems found.

In evaluating each of these possible explanations, in 1985 Department of Natural Resources staff reached the following conclusions based on the first two years of monitoring:

1. The 1983-85 pesticide use sampling results (excluding aldicarb) did not show this practice to be a major contributor to widespread groundwater problems in Wisconsin. Pesticide use related problems were found only in isolated water supply wells and were not widespread.
2. The problems associated in selecting suitably located wells to test, determining the specific parameters to test for, determining when to sample, and determining the presence of parent compounds or breakdown products did influence the outcome of the pesticide monitoring program. The level to which these factors may have influenced the results are now being evaluated through current monitoring efforts.
3. Pesticide storage and handling represented a greater potential risk for groundwater contamination than pesticide use.

To follow-up on the first two years work and to further test its conclusions, DNR staff has continued a monitoring effort. From June 1985 to July 1986 the state has run approximately 200 pesticide analyses. The majority of these samples were taken near handling operations. The sampling done has identified several facilities with groundwater contamination problems. However at this time the level of the problem represented by handling facilities is unclear. Additional sampling over the course of the upcoming year will allow for a better determination of the extent of the problem. The Department of Natural Resources anticipates spending approximately \$60,000 over the next 12 months to further investigate pesticide impacts on groundwater from handling operations. Table 11 shows the results of all the pesticide monitoring done by the DNR over the last 3 years. A separate effort related to pesticide use is a study currently being conducted by the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP). DATCP staff have identified a number of fields for study and have installed monitoring wells directly downgradient of the field. The results of this study are summarized in Table 1. The fields monitored for the aldicarb study were specifically chosen to evaluate the effectiveness of the use restrictions contained in Ag 29.17 in meeting the groundwater standards. The results of this work put into question the ability of those restrictions to meet the established water quality standards. The results for alachlor and atrazine show that under some environmental and use conditions these pesticides are reaching groundwater also. However, the preliminary nature of the work does not allow determination of how extensive this problem may be. Further work is now being conducted to better evaluate the significance of these initial findings.

Lastly, the state will continue its aldicarb water supply monitoring efforts. As can be seen in Table 11 almost 1,200 wells have been tested for residues.

Table 11

SAS

1

SUMMARY OF GROUNDWATER PESTICIDE MONITORING
FOR 07/01/83 THRU 11/30/86

CHEMICAL CODE	CHEMICAL NAME	TOTAL NO. OF WELLS	WELLS WITH DETECTS	ENFORCEMENT STANDARD (UG/L)	WELLS EXCEEDING ENF. STD.	PREVENTIVE ACTION LIMIT (UG/L)	WELLS EXCEEDING PAL	HIGHEST DETECTION LEVEL (UG/L)
20012	ALDICARB, TOTAL	1239	315	10.0	115	2.0	249	111
00074	LEAD PB,TOT	312	103	50.0	13	5.0	82	3300
20236	ETHYLENE DIBROMIDE	36	9	0.01	9	0.001	9	12
20208	DINOSEB	180	6	13.0	4	2.6	4	2100
20394	SIMAZINE	29	7	2150.0	0	0.43	7	15
20070	CARBOFURAN	161	1	50.0	0	10.0	1	15
20119	2,4-D	67	1	100.0	0	20.0	1	100
20021	ATRAZINE	524	86	NONE	0	NONE	0	1500
20305	ALACHLOR	603	45	NONE	0	NONE	0	3000
20215	METOLACHLOR	276	36	NONE	0	NONE	0	440
20045	CYANAZINE	206	20	NONE	0	NONE	0	130
20326	METRIBUZIN	182	18	NONE	0	NONE	0	940
20062	BUTYLATE	45	9	NONE	0	NONE	0	4.9
00044	COPPER CU,TOT	30	6	1000.0	0	500.0	0	110
20068	CARBARYL	220	5	NONE	0	NONE	0	45
20228	EPTC	136	5	NONE	0	NONE	0	2.9
20149	DICAMBA	31	3	NONE	0	NONE	0	320
20109	TERBOFOS	105	2	NONE	0	NONE	0	0.3
20122	DCPA	8	2	NONE	0	NONE	0	760
20075	CHLORAMBEN	47	1	NONE	0	NONE	0	50
20192	DIMETHOATE	22	1	NONE	0	NONE	0	1.5
00022	ARSENIC AS,TOT	77	0	50.0	0	5.0	0	0
20013	ALDRIN	11	0	NONE	0	NONE	0	0
20024	BALAN	1	0	NONE	0	NONE	0	0
20100	CHLORPYRIFOS	29	0	NONE	0	NONE	0	0

Table 11 (continued)

SAS

2

SUMMARY OF GROUNDWATER PESTICIDE MONITORING
FOR 07/01/83 THRU 11/30/86

CHEMICAL CODE	CHEMICAL NAME	TOTAL NO. OF WELLS	WELLS WITH DETECTS	ENFORCEMENT STANDARD (UG/L)	WELLS EXCEEDING ENF. STD.	PREVENTIVE ACTION LIMIT (UG/L)	WELLS EXCEEDING PAL	HIGHEST DETECTION LEVEL (UG/L)
20104	CHLOROTHALONIL (BRAVO)	4	0	NONE	0	NONE	0	0
20123	DDD O.P	8	0	NONE	0	NONE	0	0
20125	DDD P.P	9	0	NONE	0	NONE	0	0
20127	DDE O.P	8	0	NONE	0	NONE	0	0
20129	DDE P.P	9	0	NONE	0	NONE	0	0
20131	DDT O.P	8	0	NONE	0	NONE	0	0
20133	DDT P.P	22	0	NONE	0	NONE	0	0
20143	DIAZINON	25	0	NONE	0	NONE	0	0
20148	1,2-DIBROMO-3-CHLOROPROPANDBCP	19	0	0.05	0	0.005	0	0
20187	DIELDRIN	20	0	NONE	0	NONE	0	0
20214	DISULFOTON	143	0	NONE	0	NONE	0	0
20217	FONOFOS	72	0	NONE	0	NONE	0	0
20225	ENDRIN	10	0	0.2	0	0.02	0	0
20288	HEXAZINONE	1	0	NONE	0	NONE	0	0
20306	LINURON	92	0	NONE	0	NONE	0	0
20310	METAM-SODIUM (VAPAM)	13	0	NONE	0	NONE	0	0
20312	METHOMYL	19	0	NONE	0	NONE	0	0
20314	MCPA	3	0	NONE	0	NONE	0	0
20316	MECOPRP	2	0	NONE	0	NONE	0	0
20342	PARAQUAT	7	0	NONE	0	NONE	0	0
20349	OXAMYL (VYDATE)	4	0	NONE	0	NONE	0	0
20351	PARATHION	18	0	NONE	0	NONE	0	0
20374	PENTACHLORONITROBENZENE	5	0	NONE	0	NONE	0	0
20384	PICLORAM	14	0	NONE	0	NONE	0	0
20403	PHORATE	120	0	NONE	0	NONE	0	0

Table 11 (continued)

SAS

3

SUMMARY OF GROUNDWATER PESTICIDE MONITORING
FOR 07/01/83 THRU 11/30/86

CHEMICAL CODE	CHEMICAL NAME	TOTAL NO. OF WELLS	WELLS WITH DETECTS	ENFORCEMENT STANDARD (UG/L)	WELLS EXCEEDING ENF. STD.	PREVENTIVE ACTION LIMIT (UG/L)	WELLS EXCEEDING PAL	HIGHEST DETECTION LEVEL (UG/L)
20417	2,4,5-TP	10	0	NONE	0	NONE	0	0
20433	DICHLORVOS (DDVP)	3	0	NONE	0	NONE	0	0

Source: DNR

This continued effort will be essential for determining the future levels of aldicarb in the resource and for evaluating the level of risk to water users of contaminated water.

Overall, the state has and will continue to expend considerable resources evaluating the level of groundwater problems related to pesticides. To date it appears that handling operations represent the greatest potential for groundwater problems. However, the current data does not clearly indicate the extent of the problem associated with pesticide handling. Pesticide use has not been shown to be a major contributor to widespread groundwater problems, but preliminary new data collected by DATCP staff may prove this to be wrong. Under certain circumstances pesticide residues may be reaching groundwater more frequently than previously believed. Lastly, aldicarb remains the most significant pesticide problem in the state, but it may be unique in its severity and extent of contamination. Much more work needs to be done before a clear evaluation can be made of the severity of the groundwater problems related to pesticide use and handling.

COUNCIL ACTIVITIES

SUBCOMMITTEE REPORTS

RESEARCH SUBCOMMITTEE

Goal - Prepare a research plan that identifies the most important groundwater research needs in the state, estimates the fiscal requirements to meet those needs, and assists decision-making in the budget process.

In 1985 the research subcommittee developed a list of the nonregulatory groundwater research activities of UW, DATCP, DHSS, DILHR, WGNHS and DNR. In 1986, the subcommittee has worked to prioritize research needs, match these needs with available researchers, and support new funding through existing means and procedures. No new funding avenues or initiatives are proposed at this time. The subcommittee has identified the need for a well-focused applied and basic research program to determine the movement, fate and toxicological properties of contaminants in the groundwater. Research needs have also been documented for understanding the distribution and hydrogeological properties of geologic materials and groundwater throughout the state.

Basic research refers to the development and testing of new concepts. It seeks to define the distribution, movement and chemistry of the state's groundwater. Applied research, which relies on a strong foundation of basic groundwater knowledge, is directed more at specific problem solving, immediate management decision-making, and the development or improvement of processes, products, and materials. Both types of research are complementary and reinforcing. Together they provide a pool of information which is available for problem-solving and decision-making.

Basic Research

For 1986 the subcommittee selected the broad category of contaminant transport as the top priority for basic research. Sub-categories of contaminant transport include:

1. Nitrate. Research, including mass balance modeling of the vadose and saturated zone is needed. Existing information indicates that the groundwater standard for nitrate will be exceeded by presently permitted agricultural and liquid waste disposal practices. More information is needed on the chemical and physical factors affecting nitrate movement.
2. Volatile Organic Chemicals (VOC). The DNR and DHSS considers VOC's in Wisconsin's groundwater to be the greatest current groundwater management concern. VOC's have both short and long-term health impacts and are frequently found in groundwater at concentrations well above current health standards. More research work is needed to define how these contaminants move and change in the environment.

3. Aldicarb and Other Pesticides. Aldicarb is the primary pesticide of concern found in Wisconsin groundwater. Aldicarb has been shown to reach groundwater as a result of normal operating uses in concentrations exceeding health standards. So far, most of the known occurrence of other pesticides in groundwater has usually been the result of poor storage and handling practices. However, recent information from research done by DATCP staff and Iowa researchers suggests that macropores in soil may be capable of transporting some of the "less mobile" pesticides to the groundwater. Research needs to be done to define the conditions that lead to groundwater contamination from pesticide use.
4. High Level Radioactive Waste. Groundwater flow and contaminant transport in fractured crystalline rocks at potential repository depths is unknown. If such a site might be located in Wisconsin much more must be known about the hydraulic and geologic properties of Precambrian crystalline rocks.
5. Hazardous Materials. Hazardous materials in general, including low level radioactive waste and petroleum products, need research regarding transport in soil and groundwater. The handling of hazardous materials is a leading cause for groundwater contamination by VOC's. Better procedures must be developed to reduce this major source of organic pollution of groundwater.
6. Vadose Zone. Water movement and contaminant transport in the vadose zone needs general study. Most all contaminants must move through the soil to reach groundwater. The chemical and physical processes occurring in the soil control what pollutants will reach groundwater. A better understanding of these processes is critical to improved resource protection.

To address the three highest basic research needs in 1986, the subcommittee has identified the following proposals and taken the actions indicated:

1. Nitrate. Dennis Keeney, U.W. Professor of Soil Science and subcommittee member, has submitted a research proposal on nitrate movement for consideration in the U.W. budget process. The subcommittee encouraged the submission such a proposal and strongly supports research on nitrate movement.
2. VOC's. A group of U.W. researchers are proposing, "A Research Program for Integrated Studies for Removal of Hazardous Organic Chemicals in Groundwater." A draft of this proposal is presented in appendix C. This is a major research effort and will probably require funding from several sources. The subcommittee endorses the concepts contained in the proposal.
3. Aldicarb and Other Pesticides. Several graduate students are currently studying pesticide transport with state and university financial support. The subcommittee supports these efforts and encourages the funding of additional such studies.

Applied Research

Applied research needs are as variable as the regulatory and management problems that agencies face. Research needs identified by DNR, DATCP, DILHR, DHSS and WGNHS are listed below.

Over the next year the subcommittee will continue to identify applied research needs and actively pursue funding for them at state and federal sources.

DNR Applied Research Needs

- I. The applied research needs identified by DNR cover a wide range of topics. Included are topics related to the prevention and containment or cleanup of groundwater contamination. The DNR is also keenly interested in understanding the environmental fate of contaminants in the soil and groundwater system. Their identified research needs are:

Problem Prevention Studies
Problem Containment Studies

Includes projects that will develop measures that will reduce or eliminate pollution sources.

and

projects that will develop measures that will mitigate (control or eliminate) existing water quality problems.

Possible Projects for FY 88 Funding

1. Source reduction studies

- a) spill control measures
- b) landfill design and operation studies
- c) wastewater land disposal design and operation studies
- d) pesticide use, storage and handling methods
- e) aldicarb use restrictions
- f) large scale subsurface absorption systems
- g) petroleum storage (above and below ground) studies
- h) nitrate source studies

2. Problem mitigation studies

- a) pump and treat technologies
- b) cut-off wall methodologies
- c) in-situ treatment technologies
- d) point-of-use treatment devices

II. Technical Support Studies

Includes projects that will develop new methodologies or knowledge necessary to reduce pollutant loadings to groundwater.

Possible Projects for FY 88 Funding

1. Contaminant fate studies

- a) investigation into the factors controlling VOC movement and fate in the saturated and unsaturated zones
 - 1) benzene
 - 2) PCE-TCE-DCE-vinyl chloride system
- b) investigation into the factors controlling pesticide movement and fate in the saturated and unsaturated zones
 - 1) alachlor
 - 2) atrazine
 - 3) metolachlor

III. Resource Quantity Studies

Possible Projects for FY 88 Funding

1. Interbasin (interstate) transfers of water

- a) physical and economic impacts
- b) technical feasibility studies

2. Groundwater overdraft of studies

3. Areas of limited supply studies

DATCP Applied Research Needs

DATCP applied research needs are geared strongly to their regulatory responsibilities related to pesticide and fertilizer use. Their identified research needs are:

- 1. Environmental fate of pesticides, particularly herbicides, under field use conditions (movement and breakdown in the rhizosphere, vadose zone and surface and groundwater; absorption; leachability; transport; volatility and predictability factors associated with product use).
- 2. Under Wisconsin conditions, are agricultural chemical residues leaching to groundwater in nonirrigated areas at the same or similar rate as they are in irrigated areas?
- 3. To what extent do high capacity irrigation wells change the direction of groundwater flow and contaminant movement and to what extent do high capacity wells draw contaminants down to lower zones of groundwater? What are the effects of these situations on agricultural chemical and groundwater management?

4. How extensive is the problem of over irrigation in the state? How many operations adhere to the evapotranspiration method of irrigation scheduling? Is over irrigation leading to groundwater contamination by pesticides and fertilizer?
5. Are chemigation practices creating potential problems of increased leachability of agricultural chemicals or off target application of pesticides?
6. Research is needed on the proper groundwater sampling protocol and on improvements in water quality laboratory methods.

DILHR Applied Research Needs

DILHR regulatory responsibilities, include, among other things, the use of seepage beds for wastewater disposal and the use of home drinking water treatment devices. As such many of their research needs are along this line. Their identified research needs are:

1. Research is needed on groundwater quality and quantity changes under the seepage beds of large scale subsurface disposal systems.
2. The effects on groundwater quality and quantity of using perforated pipe for storm sewer drainage needs to be investigated.
3. The performance of home treatment devices and techniques for the purification of drinking water needs to be evaluated.

DHSS Applied Research Needs

The biggest challenge facing health protection agencies nationwide is to evaluate the health impacts of single and multiple contaminants in drinking water. Because of this, a key research need identified by DHSS staff was additional studies on pesticide and VOC health impacts. Their identified research needs are:

1. Research is needed on the health impacts of single and multiple contaminants in drinking water. Specifically, applied research is needed to study the mutagenicity and immunotoxicological effects of the pesticides atrazine and alachlor, which currently contaminate groundwater in some Wisconsin wells.
2. Research is also needed in the area of microbial contamination due to waste disposal problems.

WGNHS Applied Research Needs

The WGNHS is the key applied and basic research body supplying state regulatory agencies with the resource information needed to implement groundwater regulation. As such, much of their research activity is geared to answer questions raised by state regulatory staff. In addition, WGNHS has identified a wide range of applied research needs as shown below.

1. Hydrogeological properties of glacial materials.
2. Groundwater recharge process in Wisconsin.
3. Precipitation and groundwater level and recharge correlation.
4. The delineation of mappable groundwater basins and flow systems in Wisconsin.
5. Hydrogeology of carbonate (limestone and dolomite) rock aquifers.
6. Evaluation of soil characteristics that govern infiltration and recharge.
7. Hydrogeology of low permeability geologic formations.
8. Hydrogeology of crystalline rock aquifers.

Lastly, in 1985 the DNR included individual Research Subcommittee members in its team of reviewers for selecting projects to be supported by the Groundwater Fund. For fiscal year 1987 the Council has directed the Research Subcommittee to develop written protocols for the review and acceptance of groundwater monitoring proposal to be funded by the Groundwater Fund. The protocols are to be in place before additional fund are allocated for new projects. The Council has also directed the Research Subcommittee to develop a proposal on how to convey to the University of Wisconsin Board of Regents the importance of a coordinated program of groundwater research. Activity is taking place now to fulfill both of these requests.

MONITORING AND DATA MANAGEMENT SUBCOMMITTEE

During 1985, the subcommittee developed the following goals:

Goal 1 - Develop an integrated groundwater monitoring plan that most efficiently uses available resources to provide the information needed to manage and protect groundwater resources.

Goal 2 - propose a plan for establishing a data management system that ensures state agencies can access accurate, up-to-date information on the state's geology and groundwater resources.

The Monitoring and Data Management Subcommittee prepared an inventory of monitoring activities being conducted by each of the state agencies as a first step to meet goal #1. This inventory was included in the First Annual Report of the Groundwater Coordinating Council.

The Monitoring and Data Management Subcommittee met five times since the First Annual Report of the Groundwater Coordinating Council. The Subcommittee's efforts during this period focused on Goal #2. The Subcommittee provided direction and information to a data management consultant retained by the Department of Natural Resources. This consultant was retained to fulfill Section 2033(8), Wisconsin Act 410 which directed the Department of Natural Resources to utilize a portion of its monitoring funds for groundwater data

management. The Subcommittee was directed by the Council to act as the steering committee for this consultant. The Subcommittee also provided recommendations to the Department of Natural Resources on Management Practice Monitoring projects requesting funding for FY 87.

The data management consultant completed a report in February, 1986 that included an inventory of groundwater data in Wisconsin, identified state agency needs and priorities and made recommendations on how to:

- 1) improve the quality of the groundwater data being generated and
- 2) improve the exchange of groundwater data between agencies.

The inventory summarizes groundwater quality, contaminant source and geological information being generated by state agencies and identifies whether the data is automated or in a manually retrievable form. The summary of each agency's groundwater data includes a description of the format in which the data is presently stored; whether there is a geolocator(s) attached to the data, and if so its type; a copy of the form on which the information is captured; and if computerized, a summary of the computer system used and standard outputs from the system.

The following is a listing of the recommendations contained in the Groundwater Data Management report prepared by Informatics, General and action taken by the subcommittee as of December, 1986:

Recommendation #1: A system should be developed to computerize well construction reports and automatically convert all field located geological data (currently being manually entered) into the USGS Groundwater Site Inventory file.

Action taken: The M&DMS agreed to provide support and assistance to DNR's efforts to automate well construction reports.

In addition, the M&DMS will promote the education of well drillers to improve the accuracy of information (especially location information) on well construction reports.

Recommendation #2: A pilot project for unique well numbering and labeling should begin as soon as possible.

Action taken: The M&DMS agreed that counties interested in accepting delegation for administering the well code should be identified and invited to participate in the development of the procedures to uniquely identify wells in their county. Based on the response, one or two counties would be selected to pilot the effort.

Recommendation #3: A pilot project on field data entry and field location of wells using portable personal computers and field location of wells using portable personal computers and the LORAN-C unit should be initiated to aid in the collection of accurate data from the field.

Action taken: The M&DMS has concurred with need for collection of accurate data and agreed to exchange information on the procedures being utilized to collect accurate data from the field.

Recommendation #4: In order to be able to monitor and utilize labeled wells correctly and gather the data accurately, the subcommittee should establish and maintain statewide uniform data verification and quality control procedures for all agencies.

Action taken: The M&DMS agreed to document procedures presently being used for groundwater monitoring and develop recommended data verification and quality control procedures.

Recommendation #5: The subcommittee should also monitor or assist in the development of the combination well construction report, well driller permit and laboratory sample analysis form that is currently in the draft stage in the WDNR Bureau of Water Supply.

Action taken: The M&DMS agreed to provide comments on the proposed form being developed by the WDNR Bureau of Water Supply.

Recommendation #6: To assist in gathering and maintaining sample result data, the subcommittee should evaluate the feasibility of all future certified laboratories using a compatible format for the testing and recording of sample results.

Action taken: The M&DMS agreed to promote the use of a consistent format for the recording of sample results in the laboratory certification program.

Recommendation #7: The subcommittee should establish and maintain contacts with other states, universities and businesses to maintain a state-of-the-art knowledge of groundwater management activities.

Action taken: The M&DMS concurred with this recommendation and will establish contacts as the need arises.

On August 20, 1986, the subcommittee developed the following recommendation to be approved by the Groundwater Coordinating Council:

That the Groundwater Coordinating Council endorse the establishment of a unique well numbering system in Wisconsin that would be available for use by all state, federal and local agencies that sample groundwater.

PLANNING AND MAPPING SUBCOMMITTEE

The Planning and Mapping Subcommittee met twice during 1986. Discussions focused on the following topics:

- * Appropriate map scales for groundwater planning
- * Outline, timetable and review procedures for the state groundwater plan
- * Review of draft reports 1, 2 and 5 of the state groundwater plan

- * Guidelines for Local Groundwater Planning (Report 12 of the state groundwater plan)
- * Selection criteria for county resource inventories and assessments
- * The need for evaluation of county groundwater plans once there are more of them in existence
- * The relationship between local groundwater planning and ongoing efforts to modernize land records at the county level

Recommendations were made to the State Cartographer and Land Records Subcommittee on Classifications and Standards for standardized map scales to be used when publishing mapped information. These are as follows:

Statewide Mapping - 1:500,000 or 1:1,000,00
 Regional Mapping - 1:250,000
 County Level Mapping - 1:100,000
 Local Level Mapping - 1:24,000

Members of the subcommittee also met with representatives from the Land Records Committee to discuss the relationship between land records modernization and groundwater planning needs. The group identified things that can be done in the interim, until computerized land records systems are on line, in order to facilitate compatibility with these systems. These "compatibility concepts" should be addressed in Report 12 of the state groundwater plan, "Guidelines for Local Groundwater Planning."

EDUCATION SUBCOMMITTEE

Goal - Develop a public education initiative that will provide state residents with the information they need to understand and participate in the management of Wisconsin's groundwater.

The Groundwater Coordinating Council Education Subcommittee met on June 27, 1985 to discuss developing the subcommittee's report for the Groundwater Coordinating Council's annual report to the Legislature. It was determined that the subcommittee report will list educational activities which have been and are being conducted by the University of Wisconsin System, the Wisconsin Geological and Natural History Survey, the Department of Natural Resources, and the University of Wisconsin Extension Service.

It was also recommended that following a listing of activities, a general statement assessing the extent and appropriateness of activities would be developed. The analysis conducted in developing this assessment statement would then provide the basis for making recommendations regarding additional education needs. This report does not represent educational activities with the Department of Public Instruction (DPI) or, the vocational, technical, adult education program, or programs conducted in parochial schools. A summary of agency educational activities follows.

UW

The University of Wisconsin System, through its institutions, offers credit instruction related to groundwater in courses, sequences of course work and/or

independent study that are within several degree programs. However, there are no degree programs formally titled as Geohydrology, Hydrogeology or Groundwater Management.

Programs that may include, or in some cases require, the study of groundwater or its management follow:

1. Baccalaureate programs in Earth Science at Madison, Green Bay, Oshkosh.
2. Baccalaureate programs in Geology at Eau Claire, Oshkosh, Parkside, Platteville and River Falls.
3. Baccalaureate program in Geology and Geophysics at Madison.
4. Baccalaureate and Master's programs in Geological Sciences at Milwaukee.
5. Doctoral program in Geosciences at Milwaukee.
6. Master's and Doctoral programs in Geology and Geophysics at Madison.
7. Baccalaureate program in Water Resources at Stevens Point.
8. Master's program in Water Resources Management at Madison.
9. Baccalaureate, Master's and Doctoral programs in Agricultural Engineering at Madison.
10. Baccalaureate, Master's and Doctoral programs in Engineering at Madison.
11. Baccalaureate program in Soil and Crop Science at Platteville.
12. Baccalaureate programs in Soil Science at Madison, River Falls, and Stevens Point.
13. Master's and Doctoral programs in Soil Science at Madison.

UWEX

The University of Wisconsin Extension system has redirected existing staff resources to develop seven identifiable programs related to groundwater quality.

1. Basic groundwater education.
2. Drinking water quality education.
3. General groundwater resource evaluation - including identifying areas of high groundwater pollution potential.
4. Legal options for protecting and managing local groundwater resources.
5. Irrigation scheduling to protect groundwater.

6. Livestock waste management to protect groundwater.
7. Solid waste management to protect groundwater.

Many education programs for citizens and local officials have been conducted on these topics.

Other education activities modified to create a greater recognition of the relationship of management practices to groundwater quality include:

1. Modifying the pesticide certification training program to identify the relationship of proper pest management to surfacing groundwater pollution.
2. Recognizing the relationship of fertility management programs to the potential of nitrate contamination of groundwater.
3. Recognizing that integrated pest management programs can significantly effect the potential for groundwater contamination.

Efforts to identify and develop education materials and programs on agricultural practices to minimize groundwater contamination resulted in a contract between UWEX and DNR. This resulted in a draft report which provides an overview of research findings related to agricultural groundwater pollution.

A summary of the above programs and the information and education materials which have been developed to support implementation of these programs which are included in Appendix D.

Creation of a Central Wisconsin Groundwater Information and Education Center has improved the ability to supply the above information to individuals and units of government. Along with facilitating use of the above information, staff for the Center are developing an information and education data base. This base is being used to aid schools, citizens and units of government in applying basic principles related to groundwater quality to local groundwater protection and management needs. The Center's staff are also working closely with University faculty and Soil Conservation Service staff to identify agricultural management practices to protect groundwater quality.

WGNHS

As part of its educational program, WGNHS has produced the following publications:

1. Groundwater Levels in Wisconsin: County Summaries: This continuing project is designed to distribute information on groundwater levels and their fluctuations. Pamphlets are developed periodically for a county and contain a brief explanation of the most common misconceptions about groundwater occurrence and movement, a summary of well depths and depth to water, and various graphs showing the historical trends of water level fluctuations. Since 1980, pamphlets were published for Marathon, Rock and Juneau Counties. Another one, for Calumet County, is in preparation.

2. Groundwater Education Brochures: General information about the groundwater of Wisconsin is needed for the public and for educators. As part of this project, research and other information is published in a format suitable for general audiences. Publications are distributed by the GNHS, UW-Extension, and DNR. In addition, demonstration models, movies, slide/tapes, and other educational tools are developed to illustrate principles of groundwater movement and distribution.
3. Guide to Wisconsin's Groundwater Information: The GNHS is cooperating with the USGS on a comprehensive reference book which will provide basic information on the occurrence, movement, quality, and use of groundwater in Wisconsin; availability and use of groundwater data; and agencies that supply basic research data.
4. Bibliography and Index of Wisconsin Groundwater: The objective of this continuing project is to systematically collect literature references on groundwater in Wisconsin and periodically public bibliographic updates. The supplement for 1978-1983 was published in 1984. This and all the previous entries (1834-1972 and 1973-1977) are being computerized now and complete groundwater bibliography for 1834-1984 will be published in a single volume during the next biennium.
5. Guide to Groundwater Monitoring Techniques in Wisconsin: In recent years the GNHS has received repeated and varied requests for information on monitoring groundwater quality and groundwater flow near waste disposal facilities, well fields, and contamination sites. This groundwater monitoring guide will summarize the technical considerations needed in designing a monitoring program and will contain state-of-the-art information on monitoring technology application to Wisconsin. The guide will be of use to regulatory officials, private organizations, students, and others interested in groundwater monitoring.
6. Groundwater Protection Principles and Alternatives for Rock County: Coordinated interagency involvement in developing this prototype. It is being successfully used to educate and illustrate basic components needed for the development of local groundwater protection and management plans.
7. Assisting UWEX pilot project in Portage County. This pilot is increasing understanding of approaches to identify and evaluate soils, geologic and land use information to identify high priority areas for groundwater education.

DNR

The DNR has carried out the following functions in implementing a groundwater education program:

1. Continued developing "Groundwater Report" newsletters - 2 were developed in 1985-86.
2. Reprinted posters on groundwater and land use relationships to the hydrologic cycle.

3. Continued use of groundwater exhibits at fairs, farm progress days and other public events.
4. Provided groundwater information to County Code Administrators through participating in training workshops.
5. Provided technical support for local and regional education programs.
6. Participated in Extension educational telephone network programs on groundwater.
7. Developed and distributed news releases and other information materials related to preparation of the State Groundwater Management Plan.
8. Provided groundwater information to water works operators through a workshop conducted in cooperation with UW-Extension.
9. Worked with communities in cooperation with UW-Extension to develop and implement household toxic waste collection (Clean Sweep) programs.
10. Conducted teacher training workshops on groundwater education.

DILHR

DILHR staff has carried out the following actions to improve implementation of their groundwater regulatory programs:

1. Conducted mandatory continuing education courses for county inspectors (zoning administrators, sanitarians, land use inspectors, and plumbing inspectors). DILHR also provides training for the plumbing and soil testing industries on a voluntary basis.
2. Conducted the first annual certified soil testers Education Telephone Network.
3. Participated in UW-Education Telephone Network programs in groundwater management.
4. Collected information on underground storage tanks, developed and disseminated news releases and other information material on these tanks.

DATCP

To improve the general understanding of farm chemical use and handling, DATCP carried out the following work:

1. Conducted six industry training sessions on Ag 162 and Ag 163 bulk storage requirement.
2. Assisted in organizing "Project Safe" an aerial pesticide applicators training and demonstration workshop.
3. Advised and worked with other agencies and local units of government on groundwater protection efforts.
4. Administered the pesticide applicator training program in cooperation with UWEX.

5. Completed an annual groundwater monitoring report and made the information available to interested others.
6. Participated in Extension groundwater ETN programs.
7. Developed manure storage needs for groundwater protection rating guide in cooperation with the Soil Conservation Service.
8. Developed a prototype livestock waste management plan for groundwater protection methodology in cooperation with DNR and UWEX.
9. In process of analyzing the status of county manure storage ordinance development.
10. Initiated a project to evaluate the impact of barnyard runoff filter strips on groundwater.

DHSS

DHSS staff have conducted the following educational efforts:

1. Provided citizens, legislators, industry, state governments, poison control centers, and media with toxicological information on groundwater contaminants in private wells and in public water supplies explaining the NR 140 enforcement standards.
2. Participated in community meetings and presented the toxicological and epidemiological aspects on substances of concern and their importance.
3. Provided consultation to the local governments and their public health staff related to groundwater problems and concerns.
4. Worked with DNR and UW-Extension to complete pamphlets on groundwater contamination and risk assessment.
5. Chaired a committee on UW/EPA Health Advisory Technical Review.
6. Participated in UW-Education Telephone Network education series on groundwater management.
7. Continued discussions with pesticide companies on pesticide toxicology information related to their products.

DPI

Initiated efforts to identify ways to integrate groundwater education into school curriculums.

Assessment of Education Activities

Education activities which have been conducted to date have resulted in an increase in public awareness and understanding of groundwater contamination problems and concerns. Some education programs are helping local officials and citizens recognize what local regulatory and voluntary actions can be

pursued to help protect and manage groundwater resources. Several counties and local units of government have initiated efforts to develop groundwater protection and management plans. Without recognition of this relationship and an understanding of what actions can be taken to protect the groundwater resources it is not likely that substantial local action will be taken to protect groundwater.

A draft of existing education activities developed by the information and education and training subcommittee of the Legislative Council's Groundwater study committee in 1982, is included in Appendix E. This table identifies the types of education activities being conducted by various agencies that relate to groundwater management.

Substantial education activity is being developed and carried out by individual agencies. There is some coordination and cooperation between agencies in the development and implementation of educational materials and programs. However, in many cases programs are developed and conducted independent of any coordination, with agencies that have responsibility for groundwater protection and management. A great deal of data is being gathered through groundwater research and monitoring activities. This data is being evaluated and used by agencies in efforts to better understand the extent and nature of groundwater contamination in Wisconsin and to develop policies and administrative rules that will assist in protecting the groundwater resources. The creation of the Groundwater Information and Education Center and the development of the State Groundwater Plan will help to make this data more available and understandable to citizens and units of government that are interested in and concerned about contamination. Interagency coordination and use of information that becomes available remains an area of need.

Recommendations

1. Substantial need exists to continue improving coordinated interagency efforts that enhance local official and individual land manager's recognition of the relationship of land use to groundwater quality.
2. Further analysis of the type of education activities being conducted by agencies should be conducted. The results of this analysis should be used to improve interagency coordination when designing education materials and programs.
3. Major efforts are still needed to develop a support mechanism that facilitates increased local government recognition and understanding of the nature of groundwater protection needs to facilitate development and implementation of local actions to protect groundwater.
4. Additional research is needed to identify causes of groundwater pollution and practices that can be used to minimize or avoid future pollution.
5. Applied research and demonstration of agricultural practices that have the potential for reducing groundwater contamination should be conducted at field scale to identify practices that are most effective and practical.

ASSESSMENT OF CURRENT MANAGEMENT PROGRAMS

State agency staff are currently assessing their groundwater management programs. The results of this assessment will be documented as part of the state groundwater management plan. The assessment will be written by DNR staff and will be completed by early 1987. This evaluation will cover a number of areas including priority agency resource needs, adequacy of current staffing levels and the federal role in various program areas.

A list of the programs to be included in this evaluation tentatively includes the following:

Department of Natural Resources (DNR) - Municipal and Industrial Wastewater; Groundwater Management and Planning; Private and Public Water Supply, Well Compensation, High Capacity Wells; Laboratory Certification; Hazardous Waste and Residuals Waste Management; and Nonpoint Source Pollution

Department of Agriculture, Trade and Consumer Protection (DATCP) - Pesticide use; Pesticide and Fertilizer Bulk Storage; Animal Waste; Bottled Water, and Dairy Inspections

Department of Industry, Labor and Human Relations (DILHR) - On Site Wastewater Disposal; Underground Storage Tanks

Department of Health and Social Services (DHSS) - Community Health and Prevention; Environmental Health; Regional Health Departments

Department of Transportation (DOT) - Salt Storage and Use

This report will not be a program audit of the type performed by the Legislative Audit Bureau. Rather it will be a cooperative assessment on the part of all agencies involved in groundwater management and protection. The information collected for this evaluation will be used to examine groundwater management and protection in Wisconsin. More specifically, this report will identify areas for improved inter and intra departmental coordination, as well as to identify gaps in programs activities and responsibilities.

The specific program areas to be reviewed as part of this assessment are shown in Appendix G.

COUNCIL RECOMMENDATIONS FOR
IMPROVING GROUNDWATER MANAGEMENT AND PROTECTION

1. The Council recommends that a specific decisionmaking protocol be developed for use by DNR in allocating research funds from the Groundwater Fund. The Council has directed the Research Subcommittee to develop a proposed protocol and that the procedure be in place prior to any future funding for applied or basic research projects. Each biennium the DNR funds approximately \$500,000 in groundwater research activities. To insure that these funds are used to best address priority resource management concerns a standard decisionmaking procedure is necessary. Also a formalized procedure will provide for better accountability of the funding decisions made by DNR staff.
2. The Council recommends that the state establish a unique well numbering system that would be available for use to all federal, state and local agencies. The use of a unique numbering system will simplify the data management activities associated with tracking water quality results for an individual well. Given the enormous quantities of groundwater data being generated it is imperative that this part of an effective data management procedure be instituted as soon as possible.
3. The Council recommends that all state agencies continue, and where necessary enhance their efforts in assisting local governments in developing and implementing groundwater management programs. Everyone seriously involved in groundwater management in Wisconsin agrees that local governments are the key to effective resource protection. The authorities granted local governmental bodies make them the ideal entities for implementing many of the regulatory measures for preventing groundwater contamination. Consequently it is critical for effective resource protection that state and local governments work closely and cooperatively.

Council Statements of Support

1. The Council continues to give it's complete support to continued research in the fields of contaminant transport, best management practice development and resource description and definition. To properly protect the resource many technical questions need to be answered. Without the practical applied knowledge it is impossible to develop logical effective regulations. The continued support of a strong research component is critical to continued improvement in resource management.
2. The Council supports the continuing public education efforts of all agencies particularly those aimed at improving local government capabilities for protecting and managing groundwater quality. As stated previously, local governments will be key players in future management activities. To insure their effective participation, continued education of local officials is a necessity.

