

Minnesota Ground Water Association

Volume 12, Number 4: January, 1994

President's Column

Welcome to 1994! The new year brings a change in leadership to the MGWA. Out-going president Larry Johnson and secretary Bruce Olsen have ably guided MGWA during its 11th year and their energy and enthusiasm will not be easy to replace. Joining me in 1994 will be Rita O'Connell, who will serve the second year of her two-year term as treasurer, and President-Elect Cathy O'Dell and incoming secretary Rich Soule.

More information on the incoming officers is on page 8.

Our conferences and field trip in 1993 were well attended and drew participants and speakers from a number of organizations such as the Minnesota Section of the American Planning Association, the Sensible Land Use Coalition, and the Minnesota Environmental Initiative. We plan to continue working with these and other groups in 1994 to sponsor conferences and other events in order to build broad knowledge and respect for the resource. We will also continue to develop technical seminars so that we can deepen our understanding of ground water resources. This newsletter represents our communications and information-sharing element. Editor Jan Falteisek and Publication Manager Jeanette Leete do a great job of bringing together information from a variety of sources that are not widely published.

We enter the new year with a financially strong and active organization, focused on a resource of continued importance and of great interest to the general public. Our spring conference April 5th will be a half-day seminar on landfill gases. A seminar on isotope hydrology is also in the works.

Topics for our field trip and fall conference are not yet established, and your suggestions are welcome.

Finally, I'd like to take this opportunity to invite you to contact me or any of the officers with your suggestions, comments, criticisms, or complaints — we're here to provide a focal point and to coordinate the organization's activities and would be glad to hear from you.

—Doug Connell, MGWA President

Making the Land Use - Ground Water Connection at the MGWA Fall Conference

The day's program was introduced by Larry Johnson, MGWA's 1993 President. The conference was co-planned and sponsored by the Sensible Land Use Coalition, the Minnesota Environmental Initiative and the Minnesota Chapter of the American Planning Association. Each attendee received a copy of the new Metropolitan Council report *Guidance for Local Ground Water Protection in Minnesota*.

Martin Jaffe, Professor at the University of Illinois School of Urban Planning, was the keynote speaker on ground water protection. He suggested we "think of ground water contamination as irreversible" because of the time and money required to remediate problems. Therefore, according to Dr. Jaffe, prevention is the best approach to protect ground water resources and will generally revolve around local land use management. Trends noted by Dr. Jaffe in-

clude the availability of more technical information, new and tougher laws addressing potential ground water contamination sources, and the popular culture's "obsession with potability" as shown by bottled water sales. Local ground water protection initiatives have included data gathering, planning, and most recently, identification of risk zones. Now he sees local governments moving into the management phase by using health codes, zoning and other programs to manage risk to ground water resources.

Jerri-Anne Garl, head of the Environmental Protection Agency Region 5 Ground Water Branch, noted that "the connection between land use and ground water protection has taken some time to become accepted," but noted that "local controls are effective." Reviewing the alphabet soup of statutes, Ms. Garl noted that coordination is difficult since different programs have different goals, approaches, priorities and institutions. The approach now being taken to

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Winter 1994 Geology Seminars

Seminars are presented on Thursdays (unless otherwise noted) in the Department of Geology and Geophysics at 3:30 pm in 110 Pillsbury Hall, followed by refreshments in 121 Pillsbury Hall.

Feb 18 Prof. Marcia Bjornerud, Dept. of Geology, Miami University, Ohio, "Envisioning a New Geology Curriculum" 10:30 am 121 Pillsbury Hall

Feb 24 Dr. Lonnie Thompson, Dept. of Geology and Mineralogy, Ohio State University "High-resolution Climatic Ice Core Records on a Global Scale: Emphasis on Evidence for 'Recent Warming'", 10:30 am, 121 Pillsbury Hall.

Mar 3 Dr. Joseph Walder, Cascade Volcano Observatory, USGS, Vancouver, WA "Causes and Effects of Glacial Outburst Floods at Mount Rainier, Washington"

Mar 10 Dr. Joseph Walder, Cascade Volcano Observatory, USGS, Vancouver, Washington, "Eruptive Effects on Snow and Ice" 10:30 am 121 Pillsbury Hall

Fall Conference, from page 1

link various programs together is to use a state-centered protection strategy, the Comprehensive State Ground Water Protection Plan (CSGWPP). One element in such a state program would be a state program for well-head protection. Minnesota's well-head protection program is in the final stages of approval by EPA, Ms. Garl noted.

Comparing state ground water programs and where Minnesota ranks was the main focus of the talk by Larry Morandi of the National Conference of State Legislators. He noted that Minnesota and Wisconsin are Midwest leaders in ground water protection. When it comes to ground water protection, he noted that there are a variety of players active at the same time but with different levels of involvement and working at differing paces. He was concerned that ground water protection goals continue to be a subject of contention as is the regulatory term "practicable." Trends include underfunding of monitoring programs, particularly longer-term programs, weak ground water protection education programs, and the use of some information or standards that may or may not be well-defined at this point.

Terry Lee, Olmsted County Water Planning Coordinator, offered the local perspective on ground water protection and management. Better management of feedlots, old landfills, abandoned wells, and emergency response

were mentioned by Mr. Lee as current priorities to protect ground water. Reorganizing staff and resources and emphasizing local efforts and cooperation were used successfully by Olmsted County to effectively work toward accomplishing these goals.

The final speaker of the morning's plenary session was Wanda Johnson of the Ground Water Protection Federation. She explained that legislation tends to lack elements of ground water education, especially community-based ground water education. The Federation's goal is to try to fill the education gap by developing partnerships, using volunteers, involving children and creating a series of conferences and workshops (the Children's Ground Water Festival is being emulated in Minnesota, see page 9). Beginning as a wholly volunteer effort in Nebraska, the need for and effectiveness of this approach is demonstrated by their expansion to national education programs.

Four afternoon sessions brought in a variety of speakers from around Minnesota working in both public and private areas. The sessions enabled attendees to take a closer look at some Minnesota-specific issues, such as growth impacts on ground water, feedlot management, permitting and other tools, and information sources and applications.

—Jan Falteisek, Editor

New Standards Finished on Environmental Site Assessment Practices

The American Society for Testing and Materials (ASTM) Committee E-50 on Environmental Assessment and its Subcommittee E50.02 on Commercial Real Estate Transactions have completed two new standards on environmental site assessment practices.

E 1527, Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process, features the Phase I site assessment process. It includes guidance on site reconnaissance, interviews with owners and occupants, interviews with local government officials, data evaluation, and report preparation procedures.

E 1528, Standard Practice for Environmental Site Assessments: Transaction Screen Process, is a companion practice providing an alternative approach to the conduct of an environmental site assessment of commercial real estate. It includes a Transaction Screen Questionnaire and a three-section guide to assist in completing this questionnaire. These sections consist of a Guide for Owner/Occupant Inquiry; a Guide to Site Visit; and a Guide to Government Records/Historical Sources Inquiry. The Transaction Screen is designed to be performed by a non-professional and, under certain circumstances, allows the user to conduct prudent inquiry without using the more elaborate Phase I process.

The legal appendix supports the Subcommittee's conclusion that performance of the Phase I (E 1527) or the companion practice, the Transaction Screen (E 1528), will permit users to satisfy the due inquiry requirement of the Innocent Landowner Defense to CERCLA liability (the Superfund act).

To order these ASTM standards, contact Customer Services Department, ASTM, 1916 Race St., Philadelphia, PA 19103, ph. (215) 299-5585.

—Ground Water Monitoring Review, Fall, 1993

Health Risk Limits Rules for Groundwater Contaminants Adopted

by Roberta Aitchison Olson,
M.P.H. and Elizabeth Wattenberg,
Ph.D., Minnesota Dept. of Health

Minnesota Rules defining health risk limits for 89 groundwater contaminants were adopted on November 15, 1993. The rules include a provision for calculating the health risk for mixtures of contaminants that affect the same organ or organ system. The Minnesota Department of Health has proposed some revision of the Minnesota Groundwater Protection Act to permit a broader definition of chemicals to be included in the health risk limits (HRLs).

A health risk limit (HRL) estimates the long-term exposure level of a substance or chemical, found to degrade groundwater, that is unlikely to result in deleterious effects to humans. A health risk limit is expressed as a concentration (in micrograms per liter), or calculated as a "hazard index."

The health risk limits were developed using the same methodology that generate the "recommended allowable limits" (RALs), an unpromulgated list of exposure guidance values for contaminants in drinking water. The HRLs will, in essence, replace the RALs which the Health Department used for the last decade.

The legislation directed the Minnesota Department of Health to develop health risk limits for substances found to degrade groundwater identified through groundwater quality monitoring.

Health risk limits only incorporate factors related to the protection of human health. Economic and technological factors, the protection of the environment, and the health of non-human species are considered in other sections of the Groundwater Protection Act.

The rules do not specify the application of health risk limits to any public program, service, or party. Groundwater protection programs in the state will determine uses for these standards.

Minnesota Department of Health Uses of Health Risk Limits

The Minnesota Department of Health plans to use the HRLs for several public health protection purposes as described below.

1. Advice on private wells. Because private wells are not regulated for contamination, HRLs will be used to evaluate contaminated wells and provide advice to consumers and well owners about the suitability of their water supply for consumption and other uses.

2. In instances where public water supplies contain contaminants for which there are no Maximum Contaminant Levels, health risk limits will be used as criteria to evaluate options for reducing exposure by the community.

3. The Department of Health will be using health risk limits as criteria in the course of reviewing environmental projects. For example, during the review of a landfill expansion request, monitoring data would be evaluated and compared to HRLs to, in part, determine potential project impacts on health.

Uses of Health Risk Limits by other Groundwater Programs

The Groundwater Protection Act provides for the application of health risk limits in the development of Best Management Practices and Water Resource Protection Requirements. However, the Minnesota Pollution Control Agency and Department of Agriculture have indicated plans to use health risk limits in broader ways than specified in the legislation. Such uses have yet to be developed and refined. The Department of Health will be available for consultation on issues pertaining to the development of health risk limits and their public health implications.

How Were Health Risk Limits Developed?

Health risk limits were developed using risk assessment methods and USEPA toxicologic data. USEPA's risk assessment methods undergo extensive review by

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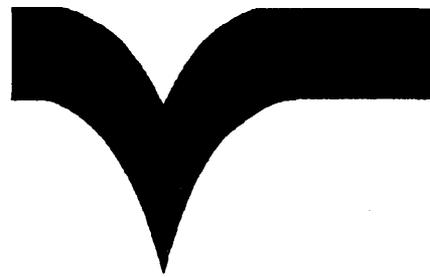
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USEPA scientists, as well as a public review process. Most states use USEPA methods.

The USEPA uses different methods to calculate safe levels of exposure to substances or chemicals that are carcinogens (cause cancer) and substances or chemicals that are systemic toxicants (do not cause cancer). The difference arises from the USEPA's assumption that systemic toxicants have a threshold dose below which they do not cause adverse effects. By contrast, the USEPA assumes that any dose of a carcinogen above zero presents some risk of causing cancer. Following are explanations of how health risk assessment issues were addressed in the rules.

1. Reference Doses and Slope Factors

The critical variable in the calculation of a health risk limit is the potency of the substance or chemical. The measure of potency for systemic toxicants is called the "reference dose" (RfD) and the measure of potency for carcinogens is called the "slope factor." The toxicologic data used to calculate reference doses and slope factors usually come from laboratory studies on animals. Human data from epidemiologic studies are used when available. The statute indicates that the Minnesota Department of Health use reference doses and slope factors published by the USEPA.

The department obtained the reference doses and slope factors used to calculate the health risk limits from the USEPA's Integrated Risk Information System (IRIS). This is an electronic database containing health risk and regulatory information on over 500 chemicals. The USEPA acknowledges IRIS as the USEPA source for reference doses and slope factors that has undergone the most thorough and standardized scientific review.

2. Multiple Routes of Exposure

Calculation of a health risk limit is based on a standard adult ingestion rate of two liters of water per day. The calculation of health risk limits does not account for multiple routes of exposure to groundwater

contaminants. Although skin absorption and inhalation are potentially important means of contact with groundwater contaminants, adequate models for assessing exposure through these pathways have not been developed. The USEPA maintains that exposure to drinking water contaminants from air or skin exposure is accounted for in the relative source contribution factor.

3. Contaminant Mixtures

Groundwater monitoring data may reveal the presence of more than one contaminant. Reference doses and slope factors listed in IRIS are usually calculated from studies of exposures to single chemicals. A mixture of chemicals, even if each chemical is present at a concentration below its health risk limit, may produce effects that would not be predicted based on exposure to each component of the mixture alone.

Sometimes a substance or chemical will act synergistically to increase the potency of another, as in the case of asbestos and cigarette smoke. Other times the opposite may be true, with an antagonistic effect. Or there may be no interaction if the chemicals act independently. Finally, mixtures of chemicals may act as though they are equal to the sum of their individual doses--an additive effect.

Data are not available on most mixtures. Most of the existing data on mixtures come from experiments with doses higher than those normally associated with exposures from groundwater. The possible increase of adverse effects, due to the presence of multiple chemicals, warrants a provision for chemical mixtures in the health risk limits rules. This is reflected in the list of toxicological endpoints in the Table of Health Risk Limits (page 6).

The mixtures provision applies an additive model from the USEPA's *Risk Assessment Guidelines of 1986* to address mixtures of chemicals or substances. The additive model is already incorporated into some federal guidelines and state standards (e.g., federal

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Publications Explain Geographic Info Systems

The University of Minnesota Extension Service has produced a set of three publications that explain Geographic Information Systems (GIS).

"The Basics of Geographic Information Systems," item number NR-FO-5926-NR, is the first publication in the GIS set and is available for \$6. This 16-page publication describes what a GIS is, its functions and components, and how it relates to maps and more traditional map data handling systems. It also provides advice on how to plan for the design, implementation, and maintenance of a GIS.

"Introduction to Data Analysis Using Geographic Information Systems," item number NR-FO-5740-NR, is the second part of the set and is available for \$5. It describes some of the computer programs or tools used by a GIS for map analysis. The 12-page publication also contains diagrams that illustrate the application of some of these analytical tools.

"Geographic Information Systems: A Glossary," item number NR-FO-6097-NR, completes the set of publications and is available for \$5. This 12-page reference booklet can be used by those who are just learning about a GIS, as well as those who are experienced GIS users. It contains diagrams depicting several items.

These publications can be ordered individually or a complete series at a cost of \$14. When ordering the series, request item number NR-PC-6136-NR.

Make checks payable to the University of Minnesota; include the correct item number. Send requests to the Minnesota Extension Service Distribution Center, Rm 20 Coffey Hall, 1420 Eckles Ave., St. Paul, MN 55108-6069. Minnesota residents must add 6.5 percent sales tax to their orders. Call (612) 625-8173 for availability and price changes.

guidelines for occupational airborne exposures, MPCA rules on Solid Waste and Surface Water).

From a public health perspective, underestimating the risk from additive or synergistic effects poses a greater concern than overestimating the risk from antagonistic or independent action. The USEPA guidelines for the health risk assessment of chemical mixtures includes a "decision tree." The first steps involve evaluating the health effects and toxicology data on the mixture or a similar mixture. If data exist only for the components of the mixture, which is most commonly the case, the USEPA guidelines recommend using an additive model for predicting risk. This additive model is reasonably protective since synergistic effects probably do not occur at low environmental exposures.

Like the health risk limits for individual substances or chemicals, the hazard index generated by this method is not an absolute quantitation of risk, but rather an indicator of acceptable exposure limits. A hazard index equal to 1.0 for a mixture is analogous to the health risk limit for an individual substance or chemical. A hazard index greater than 1.0 indicates that the mixture exceeds the health risk limit.

The USEPA Risk Assessment Guidelines recommend generating a separate hazard index for each group of chemicals defined by a common toxic endpoint. In accordance with the recommendations of both the USEPA and the National Research Council, all carcinogens fall under one toxic endpoint: cancer. The toxic endpoints for systemic toxicants are the affected organ or organ system. The same studies used by the USEPA to calculate the reference doses were used to identify the toxic endpoints for the systemic toxicants.

The toxic endpoints for systemic toxicants include: eyes; kidney; liver; stomach; developmental effects; and cardiovascular, endocrine, hematologic, immune, male reproductive, and nervous systems. The additive model will not be applied to substances or chemicals in a mixture that do not share a common toxic endpoint or that do

not have a toxic endpoint listed in the health risk limits table.

4. Detection Limits

Some health risk limits are below a level that can be detected using current and readily available analytical methods. The protection of public health, not technology, drives the health risk limits.

5. Selection of Substances or Chemicals

The selection of a substance or chemical for the health risk limits rules was based on two criteria: 1) detection in Minnesota groundwater; and 2) publication of a reference dose or slope factor in USEPA's IRIS database.

The Minnesota Pollution Control Agency (MPCA) provided the department with a list of chemicals and substances identified in Minnesota groundwater. This list was verified with the Minnesota Department of Agriculture and the Department of Health's section of Water Supply and Well Management.

Health risk limits were not developed for complex mixtures, such as gasoline, for which there is no reference dose or slope factor listed in IRIS. Instead, health risk limits were developed for the components of complex mixtures that have a reference dose or slope factor published in IRIS.

6. Carcinogens and Systemic Toxicants

Two different methods were used for determining health risk limits: one for carcinogens, and one for systemic toxicants. "Carcinogen" refers to those substances or chemicals that have a common toxicologic endpoint: cancer. "Possible human carcinogens" are not included in the definition of "carcinogens" because of the limited evidence that they cause cancer. Systemic toxicants refer to substances or chemicals that USEPA lists as "noncarcinogens" or as "possible carcinogens."

Expanding the List of Health Risk Limits

The Groundwater Protection Act specified using data from U.S. EPA's carcinogen assessment group, now embodied in EPA's Integrated Risk Information System (IRIS) to develop the HRLs. This

limitation prevents the development of health risk limits for some contaminants in Minnesota groundwater that are both prevalent and of public health concern. These include trichloroethylene, tetrachloroethylene, and alachlor. Currently, about 50 chemicals remain as unpromulgated RALs due to this situation. A revision of statutory language is being proposed to permit use of other quality sources of data to develop HRLs for such contaminants of concern. This would enable the Department to transfer all chemicals on the RAL list to the HRL list.

Future Revisions of the Health Risk Limits

The rules include a provision for updating the health risk limits to keep them current with the information in IRIS. As more toxicologic studies are completed and evaluated, RfDs and slope factors may be added to IRIS. The USEPA may change an RfD or slope factor on IRIS due to new scientific data. Sometimes the USEPA removes an RfD or slope factor while they consider new data. This provides a method for adding a health risk limit, changing a health risk limit or removing a health risk limit as data on IRIS changes. Further information is available from the Minnesota Department of Health. Contact Larry Gust (612) 627-5053 or Betsy Wattenberg (612) 627-5050.

Preface to Table of Health Risk Limits and Toxicological Endpoints

The table of health risk limits and toxic endpoints follows on pages 6 and 7. Listed for each substance or chemical in the table are: the chemical name, a unique identifying number (CAS RN), the health risk limit value, and the toxicological endpoint, where appropriate. The superscript "c" indicates USEPA classification as a "possible human carcinogen." The health risk limits rules list, in addition to this information, the reference dose or slope factor for each chemical or substance. Health risk limits are expressed in microgram(s) per liter (ug/l).

Table of Health Risk Limits and Toxicological Endpoints¹

Chemical or Substance	CAS RN	Health Risk Limit (HRL) ug/L	Toxicological Endpoint	Reference ²
Acenaphthene	83-32-9	400	liver	
Acetone	67-64-1	700	kidney	
Aldicarb	116-06-3	1	nervous system	
Anthracene	120-12-7	2,000	—	
Antimony	7440-36-0	6	—	
Atrazine ^c	1912-24-9	20	cardiovascular system	IRIS 10/93
Barium	7440-39-3	2,000	cardiovascular system	
Benzene	71-43-2	10	cancer	
Benzoic acid	65-85-0	30,000	—	
Beryllium	7440-41-7	0.08	cancer	
1,1-Biphenyl (Diphenyl)	92-52-4	300	kidney	
Bis(chloroethyl)ether (BCEE)	111-44-4	0.3	cancer	
Bis(chloromethyl)ether (BCME)	542-88-1	0.002	cancer	
Boron	7440-42-8	600	male reproductive system	
Bromodichloromethane	75-27-4	6	cancer	
Bromoform	75-25-2	40	cancer	
Bromomethane (Methyl bromide)	74-83-9	10	stomach	
n-Butanol	71-36-3	700	nervous system	
Butyl benzyl phthalate ^c	85-68-7	100	—	
Butylphthalyl butylglycolate (BPBG)	85-70-1	7,000	—	
Cadmium	7440-43-9	4	kidney	
Carbon disulfide	75-15-0	700	developmental effects	
Carbon tetrachloride	56-23-5	3	cancer	
Chlorobenzene	108-90-7	100	liver	
Chloroform	67-66-3	60	cancer	
2-Chlorophenol	95-57-8	30	developmental effects	
Chromium VI	18540-29-9	100	—	
Cumene (Isopropyl benzene)	98-82-8	300	—	
Cyanide, free	57-12-5	100	endocrine system, nervous system	
Dibromochloromethane	124-48-1	10	liver	
1,2-Dibromoethane (Ethylene dibromide, EDB)	106-93-4	0.004	cancer	
Dibutyl phthalate	84-74-2	700	—	
Dicamba	1918-00-9	200	developmental effects	
1,2-Dichlorobenzene	95-50-1	600	liver	
3,3'-Dichlorobenzidine	91-94-1	0.8	cancer	
Dichlorodifluoromethane	75-71-8	1,000	—	
p,p'-Dichlorodiphenyl dichloroethane (DDD)	72-54-8	1	cancer	
p,p'-Dichlorodiphenyl-dichloroethylene (DDE)	72-55-9	1	cancer	
p,p'-Dichlorodiphenyl-trichloroethane (DDT)	50-29-3	1	cancer	
1,2-Dichloroethane	107-06-2	4	cancer	
1,1-Dichloroethylene (Vinylidene chloride)	75-35-4	6	liver	
1,2-Dichloroethylene, trans-Dichloromethane	156-60-5	100	—	
(Methylene chloride)	75-09-2	50	cancer	

¹ Minnesota Rules Parts 4717.7100 to 4717.7800, pursuant to the Minnesota Groundwater Protection Act of 1989 (Minnesota Statutes, Chapter 103H).

² All Health Risk Limits, except for Atrazine, were derived using data from the USEPA's IRIS database published in 2/93. Atrazine data was published on IRIS in 10/93.

Health Risk Limits and Toxicological Endpoints
Cont.

Chemical or Substance	CAS RN	Health Risk Limit (HRL) ug/L	Toxicological Endpoint
2,4-Dichlorophenol	120-83-2	20	immune system
2,4-Dichlorophenoxyacetic acid (2,4-D)	94-75-7	70	kidney, liver, hematologic system
Di(2-ethylhexyl)-phthalate (DEHP)	117-81-7	20	cancer
Diethyl phthalate	84-66-2	6,000	---
2,4-Dimethylphenol	105-67-9	100	hematologic system, nervous system
2,4-Dinitrophenol	51-28-5	10	eyes
Ethylbenzene	100-41-4	700	kidney, liver
S-Ethyl dipropylthio-carbamate (EPTC)	759-94-4	200	nervous system, cardiovascular system
Ethyl ether	60-29-7	1,000	---
Fluoranthene	206-44-0	300	kidney, liver
Fluorene (9H-Fluorene)	86-73-7	300	hematologic system
Heptachlor	76-44-8	0.08	cancer
Heptachlor epoxide	1024-57-3	0.04	cancer
Hexachlorobenzene	118-74-1	0.2	cancer
Hexachlorobutadiene ^c	87-68-3	1	kidney
Isophorone ^c	78-59-1	100	kidney
Linuron ^c	330-55-2	1	hematologic system
Manganese	7439-96-5	100	nervous system
2-Methyl-4-chloro-phenoxyacetic acid (MCPA)	94-74-6	3	kidney, liver
2-Methylphenol (o-Cresol) ^c	95-48-7	30	nervous system
3-Methylphenol (m-Cresol) ^c	108-39-4	30	nervous system
Metolachlor ^c	51218-45-2	100	developmental effects
Metribuzin	21087-64-9	200	kidney, liver
Nickel, soluble salts	7440-02-0	100	---
Nitrate (as nitrogen)	14797-55-8	10,000	hematologic system
N-Nitrosodiphenylamine	86-30-6	70	cancer
Pentachlorophenol	87-86-5	3	cancer
Phenol	108-95-2	4,000	developmental effects
Picloram	1918-02-1	500	liver
Prometon	1610-18-0	100	---
Propachlor	1918-16-7	90	---
Pyrene	129-00-0	200	kidney
Selenium	7782-49-2	30	---
Silver	7440-22-4	30	---
1,1,1,2-Tetrachloroethane ^c	630-20-6	70	kidney, liver
Toluene	108-88-3	1,000	kidney, liver
Toxaphene	8001-35-2	0.3	cancer
1,1,2-Trichloroethane ^c	79-00-5	3	immune system
Trichlorofluoromethane	75-69-4	2,000	---
2,4,6-Trichlorophenol	88-06-2	30	cancer
2,4,5-Trichlorophenoxyacetic acid (2,4,5-T)	93-76-5	70	developmental effects, hematologic system
2 (2,4,5-Trichlorophenoxy) propionic acid	93-72-1	60	liver
1,2,3-Trichloropropane	96-18-4	40	hematologic system, kidney, liver
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	200,000	---
1,3,5-Trinitrobenzene	99-35-4	0.3	---
Xylenes (mixture of o, m, p)	1330-20-7	10,000	nervous system

Darcy Lecturer Mary Jo Baedecker Reviews Hydrocarbon Fate in Aquifers

Dr. Mary Jo Baedecker, Henry Darcy Distinguished Lecturer for 1993, was at the University of Minnesota November 18th to deliver her lecture, *The Fate of Organic Compounds and Geochemical Processes in Contaminated Aquifers*.

Dr. Baedecker, a research geochemist with the U.S. Geological Survey in Reston, Virginia, reviewed the results of two of her research projects, one in northern Minnesota near Bemidji and the other on the Atlantic coastal plain in New Jersey.

In 1979, 10,000 barrels of crude oil were accidentally released onto the land surface near Bemidji, Minnesota. After emergency clean-up and further reclamation, 2,500 barrels of crude oil still remained on the water table, 6 to 10 meters below the surface.

The sandy site was instrumented in a variety of ways and since then plume movement and evolution of degradation processes in the plume has been the subject of a variety of studies. At the Bemidji site, four distinctive water chemistry zones in the plume were identified. Biodegradation was

noted early and these processes have been the subject of detailed studies.

The Atlantic coastal plain study area in New Jersey contains a plume of gasoline from a buried fuel tank that had apparently been leaking for a long time.

Some of the gasoline had accumulated on a perched water table, but some gasoline had penetrated a low permeability zone, possibly via boreholes, and reached the regional water table system. The perched plume was anoxic while the underlying plume was oxic. These systems were separated by only a few meters vertically, and differences between them could be difficult to detect by conventional site investigation techniques.

At both the New Jersey and Minnesota sites, significant natural hydrocarbon degradation was noted in both oxic and anoxic zones. Ferrous mineral precipitates were identified at both sites, but the sites differed in ferrous precipitate mineralogy.

According to Dr. Baedecker, better understanding of plume evolution under natural conditions, such as at these sites, will enhance the design and application of active hydrocarbon spill remediation projects in the future.

—Jan Falteisek, Editor

New Officers

President-Elect — Cathy O'Dell

Cathy O'Dell is a hydrogeologist presently working for Geraghty & Miller. She has a bachelors degree and a masters degree from the University of Minnesota. Cathy worked in marine geology for the U.S. Geological Survey for two years and has worked in environmental consulting since 1988.

Cathy will serve MGWA as President Elect in 1994, President in 1995 and Past President in 1996.

Secretary — Rich Soule

Rich has been the hydrogeologist for the Risk Assessment group at the Minnesota Department of Health for the last two years.

Prior to joining MDH, Rich worked as a consultant for Geraghty & Miller (3 years) and Barr Engineering (5 years).

Rich is also a part time student in the Civil Engineering Department at the University of Minnesota. At home he enjoys spending time with wife Deb, daughter Hannah (4) and Leah (6 mo.). Rich's favorite quote is, "If you don't rock the boat it'll never get anywhere."

Rich's term as Secretary and Membership Chair lasts two years - 1994 and 1995.

Join the Minnesota Ground Water Association!

If you are reading this newsletter second-hand, we'd like to take this opportunity to invite you to become a member of MGWA for 1993. Annual dues are \$15 for professional members and \$10 for students. Additional donations toward the use of 100% recycled paper will be gratefully accepted.

Just complete the form below and mail to: MGWA, c/o WRI, 4779 126th St. N, White Bear Lake, MN 55110.

Name _____
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Non-Profit Organizations Can Request Assistance From the Environmental Support Center

The Environmental Support Center in Washington, D.C., probably best known for its computer and software donation program, also assists non-profit organizations in other ways that can benefit the environment. Groups which may be assisted include those local, state or regional non-profit (non-governmental) groups that use a portion of their resources for environmental issues. Assisted groups generally advocate, organize, litigate or empower citizens to work on environmental issues, serve low-income or minority populations, and have limited resources.

Programs include training and organizational assistance, Apple computer donations, Lotus software donations, and organization of environmental group federations. The Environmental Support Center also holds an annual environmental leadership conference.

For more information, contact the Environmental Support Center, 1825 Connecticut Ave., N.W., #220, Washington, D.C. 20009, phone (202)328-7813, fax (202)265-9419.

Minnesota Children's Ground Water Festival Looking for Volunteers

Volunteers are needed to present ground water learning activities at the Children's Groundwater Festival May 3rd in Alexandria (see related article on page 12). The Festival is organized as an opportunity for fourth-graders to learn about water, particularly groundwater through hands-on activities. If you have a ground water-related display or learning activity suitable for fourth-graders, contact Larry Zilliox, Douglas County Extension, phone (612) 762-2381, ext. 203.

New Computer Flow Model Described in USGS Report

A computer flow model has been coupled with three channel packages to simulate surface flows and their interaction with ground water. The computer program (Streamlink) is documented in a report released by the U.S. Geological Survey (USGS), in cooperation with the South Florida Water Management District.

The USGS computer model, MODFLOW, is commonly used for simulating ground water flow. It has been fitted River and Stream packages, which represent leakage between the ground water and surface water channels. The BRANCH unsteady riverflow model was coupled with MODFLOW using the MODBRANCH package to simulate the flow in the surface channels as well as the leakage with the aquifer. With all these options, however, it was still not possible to simulate direct discharge between a surface channel and the top of the aquifer (such as a wetlands or lake area). Nor was it possible for surface channels represented in each of the three packages (River, Stream, and MODBRANCH) to interact directly with each other. A new computer program had been developed allowing for these direct connections.

The use of Streamlink and data required are explained, and examples show its application in modeling canals with wetlands outlets-inlets, reducing the complexity of channel representations, and increasing the versatility of the entire model.

The report, "Documentation of a computer program (Streamlink) to represent direct-flow connections in a coupled ground-water and surface-water model," by Eric D. Swain, has been released as Water-Resources Investigations Report 93-4011. The report can be purchased from the USGS, Books and Open-File Reports Section, Federal Center, Box 25425, Denver, CO 80225.

Dowers Join Computers in Indian Water Search

Every year, thousands of new water wells are drilled in India and many more existing wells are deepened, but broadscale water shortages still exist. According to Indian officials, the problem lies in faulty location of well sites and indiscriminate drilling of boreholes resulting in an enormous waste of human and natural resources. To address the problems, the Indian Institute of Technology conducted a "Congress on Traditional Sciences and Technologies of India" in early December at Powai, Bombay.

The meeting gave equal time to high-technology solutions and such traditional methods of searching for groundwater as "dowsing", or water witching. In addition, a session on Indian Ground Water Hydrology was organized "to bring about a harmonious blend of the traditional and modern worlds of ground water sciences and technology for rapid socioeconomic development of the country." Indian ground water hydrology is unique in that it integrates science and spirituality. It is noted that the saints, seers, and sages of ancient India perfected a system of hydrology with a universal outlook.

—US Water News, October 1993

IGWMC Modeling Conference 1994

The 1994 IGWMC-sponsored ground water modeling conference will be held at the campus of Colorado State University (CSU), Fort Collins, Colorado, August 10-13, 1994. Abstracts on modeling related topics should be sent by February 15, 1994 to Ms. Janet Montera, Dept. of Civil Engineering, Colorado State University, Fort Collins, CO 80523. Complete manuscripts are due by April 30, 1994. For call-for-papers announcement, exhibitors information, and other conference logistics contact Ms. Montera, phone: (303)491-7425, fax: (303)491-7727.

New Wisconsin Remediation Guidance

Four new site remediation guidance documents have been published by the Wisconsin Department of Natural Resources (WDNR) and are currently available. They include:

- Guidance for Design, Installation and Operation of Groundwater and Product Recovery Systems;
- Guidance for Treatment Systems for Groundwater and other Aqueous Waste Streams;
- Guidance for Design, Installation and Operation of Soil Venting Systems; and
- Guidance for Design, Installation and Operation of In Situ Air Sparging Systems.

These remediation guidance documents address site characterization, treatability and pilot testing, system design, and system operation.

Questions on these guidance documents should be directed to George Mickelson at (608) 267-0858. Guidance documents can be ordered by contacting Wisconsin DNR, Remediation Document Sales SW/3, ERR Section, P.O. Box 7921, Madison, WI 53707.

—*Wisconsin Ground Water Association Newsletter, Fall 1993.*

MGWA Past Secretary Now Principal at Camp, Dresser & McKee, Inc.

Camp, Dresser & McKee, Inc. recently announced the promotion of Robert Beltrame to principal of the firm. Bob was MGWA Secretary and Membership Chair 1990 to 1991. Bob is an environmental scientist specializing in the analyses of geological, geophysical, and hydrogeological data. He has managed numerous remedial investigations and corrective action plans, including those for U.S. EPA Superfund projects. Currently, Bob is working as project manager for the Oak Grove landfill closure project.

New Well Fees Effective November 15, 1993

The fees charged by the Minnesota Department of Health (MDH) for well notifications, permits, well disclosures, and late license renewals were increased effective November 15, 1993. The table lists the current well fees.

Well Notification	\$100
GW Thermal Exchange System Permit	\$100
Vertical Heat Loop System Permit	\$100
Monitoring Well Permit	\$100
Monitoring Well Petroleum Site Permit	\$100
Elevator Shaft Permit	\$100
Water Well Maintenance Permit	\$100
Monitoring Well Maintenance Permit	\$100
Monitoring Well Petroleum Site Maintenance Permit	\$100
Dewatering Well Permit	\$100
Dewatering Well Permit (5 or more)	\$500
Dewatering Well Maintenance Permit	\$100
Dewatering Well Maintenance Permit (5 or more)	\$500
Late Renewal of License/Registration	\$50*
Well Disclosure	\$20

*The late fee is in addition to the regular license or registration renewal fee.

Any payments received by the MDH must be made for the amount listed above. Incorrect payments will be returned to the individual making the payment and may cause work delays.

—*The Minnesota Well Management Newsletter, December 1993*

New Maps Available

The Minnesota Geological Survey (MGS) recently released 1:100,000 Quaternary Geologic Maps for Chisago and Sherburne counties. Gary Meyer is the author of the Chisago map and Gary Meyer and Howard Hobbs are the authors of the Sherburne map.

The maps are available through MGS Map Sales, Phone (612)627-4782.

Wisconsin Proposes Changes to Ground Water Standards

The Wisconsin Department of Natural Resources (WDNR) is working toward amendments to ch. NR140, which established groundwater standards and created a framework for implementation of the standards. All but five of the substances included in the amendment are substances for which the U.S. EPA adopted federal maximum contaminant levels (MCLs) or action levels in 1991. Groundwater quality standards for thirteen new substances would be added. These substances include acetone, asbestos, chlordane, dichlorodifluoromethane, ethylene glycol, formaldehyde, heptachlor, heptachlor epoxide, methyl isobutyl ketone, nitrite, nitrate, polychlorinated biphenyls (PCBs), and styrene. Twenty-two substances would have revised groundwater quality standards; thirteen substances would have new standards less than existing standards while nine substances would have more stringent standards. Legislative review is still needed before the proposed changes can be finalized. Assuming no last minute changes, the proposed amendments would be effective in early 1994. For further information, contact David Lindorff, Wisconsin Department of Natural Resources, Bureau of Water Resources Management, P.O. Box 7921, Madison, WI 53707, ph (608) 266-9265.

—*Wisconsin Ground Water Association Newsletter, Fall, 1993*

Calendar

February 14-18, 1994. *The Princeton Groundwater Pollution and Hydrology Course.* FFI: (813)855-6898.

March 1-2, 1994. *Farming Sandy Soils: Strategies for Management Nutrients and Pesticides in the Upper Midwest.* To be held in St. Cloud. FFI: Linda Schroeder (612)972-3908.

March 21-23, 1994. *Assessment of Models for Groundwater Resources Analysis and Management.* To be held at the Turtle Bay Hilton, Oahu, Hawaii. Contact Dr. Aly El-Kadi (808)956-6331.

March 21-24, 1994. *Application of Computer Models To Ground Water Problems Using The Analytic Element Method.* A short course offered by Strack Consulting, Inc. Contact Andrine Strack (612)483-0954.

March 23, 1994. *Minnesota Department of Health Annual Well Conference,* Thunderbird Hotel, Bloomington, MN. FFI: Mike Convery, Minnesota Department of Health, Well Management Unit, P.O. Box 59040, Mpls, MN 55459-0040, (612)627-5155.

March 27-31, 1994. *Seventh Annual Symposium on the Application of Geophysics to Engineering and Environmental Problems (SAGEEP),* Boston, MA. FFI: EEGS, Mark Cramer, P.O. Box 4475, Englewood, CO 80112, (303)771-6101.

March 30-31, 1994. *Fourth Biennial North Dakota Water Quality Symposium,* Holiday Inn, Fargo, North Dakota. FFI: Bruce Seelig, Symposium Coordinator, Extension Agricultural Engineering, P.O. Box 5626, North Dakota State University, Fargo, ND 58105, (701)237-8690, fax (701)298-1008.

April 11-13, 1994. *Ground Water Flow Through Fractured Media.* A short course offered at the Department of Engineering Professional Development at the University of Wisconsin-Madison/Extension. Contact Mary Meinholz (608)262-5566.

April 17-19, 1994. *National Conference on Hydrology and Engineering Geology of Karst Terranes,*

Nashville, Tennessee. Co-sponsored by E3 and Eckenfelder, Inc. FFI: Jim Quinlan (615)833-4323 or Geary Schindel (615) 255-2288.

April 19-21, 1994. *International Conference - Analytic Element Modeling of Groundwater Flow,* Indianapolis, Indiana. Sponsored by Indiana University School of Public and Environmental Affairs. FFI: Jack Wittman, SPEA Room 419, Indiana University, Bloomington, IN 47405, ph (812)855-5971, fax (812)855-7802.

April 14-16, 1995. *Together: Communities Creating a Sustainable Future,* Minneapolis, MN. Sponsored by the National Community Educational Association. FFI: NCEA, 3929 Old Lee Highway, Suite 91-A, Fairfax, VA 22030-2401, ph (703)359-8973, fax (703)359-0972.

April 28-29, 1994. *GSA North-Central Section Meeting,* Kalamazoo, Michigan. For information, contact Alan Kehew, Department of Geology, Western Michigan University, Kalamazoo, MI 49008, (616)387-5495, fax (616)387-5513.

May 3, 1994. *Minnesota Children's Ground Water Festival.* Douglas County Fairgrounds, Alexandria. FFI: Larry Zilliox, Douglas County Extension, (612)762-2381 ext 203.

May 13-15, 1994. *Midwest Friends of the Pleistocene Annual Meeting,* Cincinnati, Ohio. Information: Tom Lowell, Dept. of Geology, University of Cincinnati, Cincinnati, OH 45226, (513)556-4165.

May 23-25, 1994. *Eighth National Outdoor Action Conference and Exposition,* to be held in Minneapolis by NGWA.

June 12-16, 1994. *Fifth International Conference on Ground Penetrating Radar,* Kitchener, Ontario, Canada. Information: GPR '94, Waterloo Centre for Ground Water Research, University of Waterloo, Waterloo, Ontario N2L 3G1, Canada (519)885-1211, fax (519)725-8720.

More details available from:

AWRA, Amer. Water Resources Assoc., 5410 Grosvenor Lane, Suite 220, Bethesda, MD, 20814. (301)493-8600, fax (301)483-5844.

U.S. EPA Region V and Purdue University Offer Environmental Software

Twenty public domain programs for IBM-PC/AT or compatibles dealing largely with different aspects of water pollution prevention have been developed and are being offered by the U.S. Environmental Protection Agency and Purdue University. The programs are interactive, educational and color-graphic. Some are broad-scale introductions to particular topics, and others are relatively thorough design or construction minicourses. The high-quality subject matter is applicable to a wide variety of situations and audiences. Programs offered include material on waste water treatment, drinking water, water conservation, general water education, and agricultural practices.

The programs are offered at no charge to schools and governmental agencies who send the necessary number of blank formatted high-density diskettes. The general public may obtain the programs at nominal cost. Programs may be duplicated and an additional diskette is offered to assist duplication.

Additional programs are under development and planned spring releases include programs on well-head protection, an expert system on sludge and septage application, and additional farmstead management models.

For further information, contact Alfred E. Krause, U.S. Environmental Protection Agency, 77 W. Jackson, WCP-15J, Chicago, IL 60604-3590, Karen Reshkin at (312)886-9379 or Karen Holland at (312)886-0238.

NGWA and the Association for Ground Water Scientists and Engineers, 6375 Riverside Drive, Dublin, OH 43017 (614)761-1711.

IGWMC, Institute for Ground Water Research and Education, Colorado School of Mines, Golden, Colorado 80401-1887. (303)273-3103, fax (303)273-3278.

MGWA Spring Conference — April 5

This year's spring conference topic is *Landfill Gases, Genesis, Detection, and Control*.

The conference will be held April 5, 1994 at the Earle Brown Center on the St. Paul campus of the University of Minnesota. Land fill gases have become a hot topic for those involved in land recycling, solid waste and Superfund work.

Since there will be new legislation and regulations for landfills, this promises to be an explosive topic in the coming year. Registration materials will be mailed to you shortly.

'TreeMediation' is used to treat shallow aquifers

Since bioremediation has become a recognized groundwater cleanup method, an Ohio company is hoping that its "TreeMediation" will become as widely accepted.

Just as the 'bio' in bioremediation refers to microorganisms used to metabolize or otherwise chemically neutralize toxic pollutants, trees are said to accomplish the same thing in TreeMediation.

"Treemediation takes plant remediation a step further by utilizing trees as an alternative to 'pump and treat' technology," said Edward Gatliff, director of the Analytical Sciences Division of Bowser-Morner, Inc., the Dayton, Ohio-based company that has developed the ground water cleanup method. The TreeMediation process, Gatliff explained, takes advantage of the extensive root systems of trees and other vegetation to extract water from shallow aquifer systems.

The uptake of water can also substantially influence the local hydraulics of a shallow aquifer, controlling the migration of the contaminant plume, he said. "This 'pumping' effect flushes water upward through the soil column and can be much more effective at remediation than traditional pump and treat systems," Gatliff stated.

So far, he pointed out, TreeMediation has been used in aquifers up to 20 feet deep. Gatliff contended that the design of traditional pump and treat systems for shallow ground water formations has proven problematic. Mechanical pumping appears to be effective in controlling the migration of groundwater contaminants, he maintained, but is ineffective in cleaning up ground water to a "pristine" condition.

"As a passive method for the control of contamination in shallow low yield aquifers and for in situ remediation of selected contaminants, TreeMediation is very attractive," Gatliff said. The first test site for the method is two years old this fall, and other existing sites have completed one year of the process. Projects have been implemented in five states, he said. In particular, TreeMediation projects have proven effective in treating pesticide contamination, Gatliff pointed out. At one of the test sites, he said, surface soil with herbicide concentrations exceeding 1000 parts per million (ppm) was reduced to less than 10 ppm.

— *U.S. Water News, October, 1993*

Minnesota Children's Ground Water Festival May 3rd in Alexandria

Plans are set to hold the first Children's Groundwater Festival in Minnesota, May 3rd in Alexandria. Patterned after Children's Groundwater Festivals begun in Nebraska, the Festival will be held at the Douglas County Fairground for all (600-plus) Douglas County fourth-graders. Program organizers say that of the 26 learning stations planned, surface water activities are well-covered but more ground water learning stations are needed (see related article). For more information, contact Larry Zilliox, Douglas County Extension, phone (612) 762-2381, ext. 203.

Minnesota Department of Health Annual Well Conference

March 23, 1994

8:00 a.m. Registration
8:25 a.m. General Session, Moderator, Dan Wilson (Geological Framework as a Basis for Water Quality; Status of Minnesota's Ground Water; Quality of Drinking Water Supplies in Minnesota; Health Concerns with Minnesota Ground Water; Bentonite Grouts)

12:30 p.m. *Concurrent Session 1* for Well Contractors, Moderator, Peter Zimmerman (Flowing Wells; Safety at the Drill Site)

12:30 p.m. *Concurrent Session 2* on Environmental Issues, Moderator, Michael Convery (Tunnel Projects and Environmental Problems; Ground Water Sampling Guidance)

12:30 p.m. *Concurrent Session 3* for Limited Licensees, Moderator, Edward Schneider (Well Disinfection; Selecting Pumps and Well Screens)

Registration at the door will be \$60; preregistration (by February 23, 1994) is \$50. 6.0 CEU's are available for attendance at this conference. For further information, call Mike Convery at (612)627-5155.

BWSR Offering Workshops in Natural Resources Education

If you have ever been asked, or volunteered, to provide classroom or informal education for youth, this workshop developed by the Minnesota Board of Water and Soil Resources and to be held in four locations around the state in late February and early March may be for you. The workshop is designed to assist you in working effectively with teachers and children of all age groups. For more information, contact Barb Liukkonen, Board of Water and Soil Resources, Room 403, 394 Lake Ave. S., Duluth, MN 55802, phone (218) 723-4752.

Chrysalis Scholarship

The Association for Women Geoscientists Foundation (AWGF) is pleased to announce Chrysalis, a scholarship for a woman who needs money to complete her thesis. Seven hundred fifty dollars will be awarded. This money is to be used for typing, drafting, childcare, or whatever it takes to finish the thesis and complete a Masters or PhD degree program in a geoscience field.

At least 2 Scholarships will be awarded on March 31, 1994.

Criteria

- The applicant must be a woman whose education has been interrupted for at least one year.
- The applicant must be a candidate for an advanced degree in a geoscience field.
- The applicant must be completing her thesis during the current academic year.

Application Procedure

The applicant should submit:

1. A letter which contains a short statement of her background, of her career goals and objectives, her involvement in both the geosciences and her community, how she will use the money, and explain the nature and length of the interruption to her education.

2. Two letters of reference, the first from her advisor and the second from a person of her choice who can attest to her qualifications for this award. The reference letters should state the applicant's prospects for future contributions to both the geosciences and her community. The letter from her thesis advisor should also include when the candidate will finish her degree and what requirements are yet to be completed.

All application materials should be clearly labeled with the applicant's name and address and should be sent to: Chrysalis Scholarship, Association for

Women Geoscientists Foundation, G&H Production, 518 17th St #930, Denver, CO 80202

Deadline for application is March 1, 1994.

Ground Water Guidebook Available

There are still copies of the Metropolitan Council report *Guidance for Local Ground Water Protection in Minnesota* available.

The Minnesota Ground Water Association printed special copies of the report so that it could be made available at the MGWA Fall Conference.

The remaining copies can be purchased for \$15 each, including postage (inside the U.S.).

Requests can be sent to: MGWA, c/o WRI, 4779 126th Street North, White Bear Lake, MN 55110-5910. Checks should be made out to MGWA.

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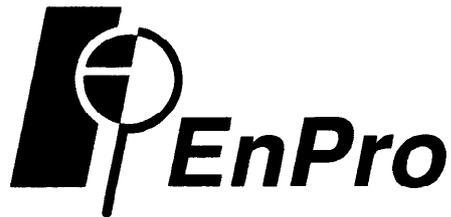
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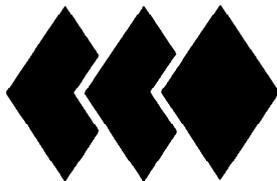
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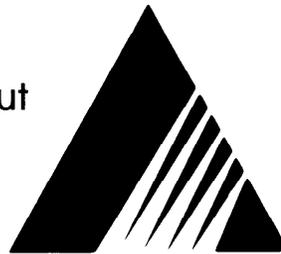
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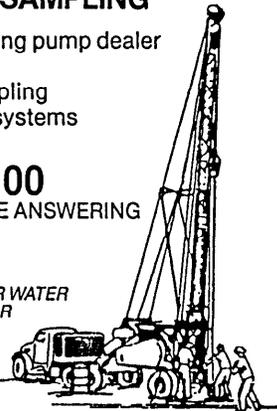
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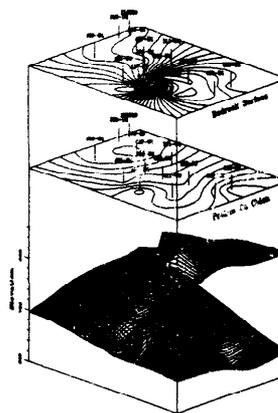
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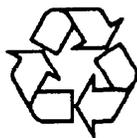
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