The River Ran Red: A Blessing in Disguise?

by Muriel Morrisette
Photos by Larry Morrisette, Jr.

The river runs red under this little bridge where the dye trace begins. A very small tube under the bridge is the means of injection.

Society comments: Contamination of groundwater supplies is a growing concern across the United States. It is of particular concern in areas of rapid percolation of surface water into aquifers. One such area is southeastern Minnesota, where karst formations allow swift and direct passage of surface waters into underground streams. Community-wide cooperation and concern are making people aware of the fragile underground water system of the karst region, upon which they depend for freshwater supplies.

YOU ARE HIKING THROUGH the woods on a hot summer day. To cool off, you remove your shoes and wade along a sparkling stream. All of a sudden the stream disappears. What happened? Where are you? You have an Alice-in-Wonderland feeling and look around for a big white rabbit or at least a Cheshire cat. The reality of the situation is that you have stumbled across a phenomenon common to karst geology in southeastern Minnesota and large areas of at least 15 other states.

Speeding Surface Water Downward

Karst is a term used by geologists to describe a land area where the bedrock, usually limestone or dolomite, is very near the earth's surface. Since limestone and dolomite are water-soluble, surface water that finds its way into little cracks and crevices slowly eats away the bedrock, eventually forming channels and caves. Through these openings, surface water can flow very rapidly into the groundwater aquifer. The problem is that when the water travels so rapidly, it does not undergo the cleansing process provided by other soils.

Karst areas are usually characterized by sinkholes, disappearing streams, springs, caves and valleys that have no visible outlet. Karst areas have very little flowing surface water, because rainfall quickly disappears into the network of cracks and crevices and rapidly finds its way into the groundwater.

The significance, then, of the disappearing stream is that the surface water and any contaminants it may contain can, in a very short time, pass directly into the groundwater, contaminating springs and wells and threatening the water supplies of families, farms and industries.

Dr. E. Calvin Alexander, Jr., is an associate professor in the University of Minnesota's department of geology and geophysics. He has been studying the geology and hydrology of the karst region of southeastern Minnesota for several years. (Hydrology is the study of the movement and distribution of water.)

Alexander has found that the predictable principles of hydrology that apply to other geological areas simply do not apply to the karst region. Tried and true methods used for projects like siting landfills, draining feedlots and disposing of household wastes are not reliable. More knowledge is needed to help residents and regulatory agencies make future decisions about water resources. This information could also be applied to other karst regions that cover from 15 to 25 percent of the United States.

Motivation To Act

In 1980 a mishap involving toxic substances illegally deposited in a Fillmore County, Minnesota, landfill brought the potential for disastrous water quality effects to the attention of local residents and state agencies. People began to look with alarm at the mysteries of the karst region. Farmers, scientists, ecologists, pollution control specialists, parents, teachers, health officers, elected officials and others asked what could be done to protect the quality of their water.

According to Larry Landherr, Minnesota Pollution Control Agency (MPCA) regional director in southeastern Minnesota, the problem was this: Although the residents of the area are committed to the stewardship of their land and its resources, not enough good solid information is available. To protect water quality, it is necessary to know exactly what happens to water when it leaves the surface. Where does it go? What kind of soil does it pass through? How long does it take to go how far?

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One result of the landfill dispute was the formation of a citizens' organization, Citizens Concerned about Hazardous Wastes. Gary Peterson, one of the founders of the 500-member organization, describes the group as an "information-gathering" organization. "We wanted to find out as much as we could about the geology of our area and about water problems that we should look out for," Peterson said. That meant a lot of research, even a visit to Illinois to look at what was being done in a similar area. "I see the citizens' group as a sort of buffer between the various parties involved in studying and regulating water quality in our region," Peterson said.

One of those parties is Alexander and his research team at the University of Minnesota. Another is the MPCA and its regional office in Rochester, Minnesota. As so often happens when two groups pursue a common goal from different perspectives, the opportunity for friction was present.

A Common Goal Unites

On the one hand was the researcher, interested in scientifically demonstrable facts. On the other hand was the regulatory agency, obligated to deal with legal, economic and social factors of the immediate problem. The citizens' group, interested in both information and viable alternatives, stood in the middle, joining hands with both and thus creating an effective team.

The landfill crisis — chemical solvents leaching from barrels and finding their way into private wells — has been resolved. The Wisconsin company responsible for dumping the offending barrels has removed them. The landfill operators have closed the facility. The MPCA Board has revoked the landfill permit and ordered the operators to cover the site with soil and to install a groundwater monitoring system. Contaminated water is being pumped from wells into a holding pond where the solvents can dissipate. Several problems, however, are pending: hearings, regulatory planning efforts and the problem of what to do with the water in the holding pond.

It Takes a Crisis . . .

According to Alexander, the landfill situation may have been a blessing in disguise. It served to focus the attention of a lot of people on the potential for disastrous effects on the fragile water system of the karst region. "Our group has been working in the area for several years. The local residents were polite; they put up with us. Now they aren't just tolerating us; they're involved," Alexander said.

Another result of the landfill crisis was that Alexander recognized a need to increase the body of knowledge of the karst region's hydrology. To accomplish this, he proposed to execute a dye trace of the south fork of the Root River, one of those magical disappearing streams: the one, in fact, that flows past the landfill and the one into which the contents of the holding pond would be dumped if studies proved that it was safe to do so.

By pouring rhodamine WT, a harmless red dye developed especially for this purpose, into the river, the direction and rate of flow could be traced. If the dye were detected in wells and springs, it would show that river water, along with the many contaminants it contains, was entering the groundwater. It would also show exactly where and how fast that was occurring.

Such dye traces cost money. Alexander approached the Freshwater Foundation for financial assistance. After studying Alexander's proposal, the Foundation agreed to finance the project on the condition that Alexander's efforts be coordinated with those of the MPCA. A plan for water monitoring and sharing was worked out. When intensely interested

parties disagree, it is necessary to find those areas where different goals have common ground; such areas do exist. In the karst region, that common ground is the protection of water quality.

Cooperative Effort Begins

So the effort began — cooperative, coordinated and parallel. For its part, the Freshwater Foundation facilitated Alexander's research with support and a financial grant. The MPCA continued its monitoring program, testing 12 wells along and downstream of the river.

Steve Lee, of the MPCA Hazardous Waste Division, explained that the agency has been monitoring as many as 45 wells in the area. "We are looking for traces of chemicals that may have leached out of the landfill," Lee said. He reports that, to date, chemical levels are very low in all but one of the wells. Lee added that other contaminants, of agricultural and household origin, have been found in the water. He emphasized that the dye trace was needed to prove that anything that gets into the river will eventually find its way into the drinking water and that it usually doesn't take very long.

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The citizens' group and Alexander worked as a team. Their roles were so interdependent that the work of one could not be recorded without that of the other. Months of preparation preceded the actual dye trace and water sampling. Alexander met with the citizens' group several times to explain what jobs had to be done, why they had to be done and who would do them.

One week before the test began, Alexander met with those residents who wished to participate in the study by sampling their private wells. By doing so, they could detect any connection between the river and the groundwater that supplies their wells. Alexander also explained how and when water samples were to be taken and how they should be labeled and stored. All residents in the testing area were invited to participate. For one week before the dye trace, each well was sampled once a day at approximately the same hour. These tests provided background water analysis before the dye was added to the river.

The Day the River Ran Red

The dye trace took place on August 7, 1982, resulting in a great deal of activity on the Ken Hadland homestead near Spring Valley, Minnesota. Hadland's house served as headquarters for everyone involved in the dye trace. Other local residents helped by providing sleeping accommodations and food for the workers.

At 10 a.m., Alexander began injecting dye into the river. This procedure was repeated throughout the day. At strategic points along the river and at eight

This rocky outcrop above a spring reveals the characteristic cracks and crevices of karst topography. Water erodes these "joints," creating passages through which surface water flows rapidly to underground aquifers.

springs, water samples were taken at regular time intervals for three days and nights.

Residents who sampled private wells stepped up their schedules to four times a day for the week following the dye trace. They then tested once a day for another week to establish how long it took their well water to return to its pretest condition.

Results and Ramifications

Early results indicated that the underground water moves in a different direction when rainfall has been high than when it has been low. When all water analyses have been completed and all the data interpreted, Alexander will present a report on his findings to area residents and the MPCA. He will also discuss the implications and ramifications of those findings.

The results will be directly used to help decide what to do with the contents of the landfill holding pond. Indirectly, the results will guide future decisions which must be made by residents and government regarding waste disposal in the area.

"Basically," Alexander said, "I'm an educator. At a very fundamental level, this was an educational exercise." He explained that, from the beginning, he and the citizens' group learned from each other. "As a scientist," Alexander said, "I had a lot to learn about sociology. I learned about those citizens: their needs, their priorities, their economics and the effectiveness of a concerned, informed, community effort."

The effectiveness of that community effort was described by Larry Landherr of the MPCA. "Interest in water quality in this area has been gaining momentum and popular appeal," he said. "Alexander has gotten folks interested. By blowing a horn and beating a drum, he has gotten them marching to the courthouse door. Elected officials have had to listen."

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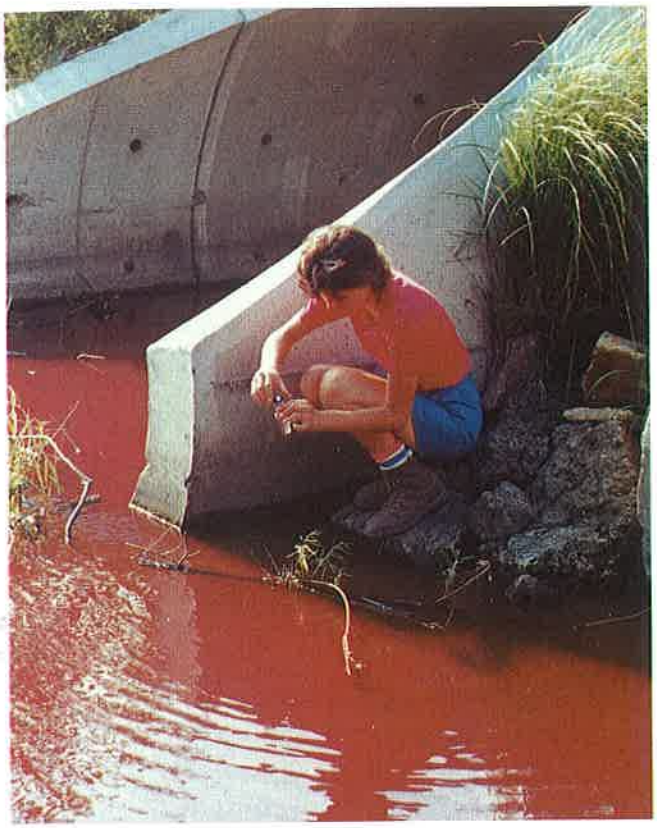
One result is the Four County (Houston, Winona, Fillmore and Mower) Solid Waste Task Force, which has pledged to use its joint powers to address groundwater protection. Behind the scenes, others are working to guide the enthusiasm into something constructive. The Water Planning Board, the Southern Minnesota River Basins Board, the Department of Health and the Agricultural Extension Service are all studying ways to standardize the reporting of lab test results and to disseminate information in an understandable form. According to Landherr, "We may not have all the answers, but the people are learning."



Geologist Jodi Milske collects water samples for later testing.

What did the citizens' group learn besides some basic testing techniques and scientific jargon? They learned a great deal about the region in which they live and about the water upon which they depend. They learned that water quality is something that must be considered every day when planning for household facilities and farming practices. They learned that they could effectively influence the system and that, by working with it, they could make the system work. They learned that whatever occurs is their concern, because they are the ones ultimately affected. They learned that, in the end, the quality of their water is their own responsibility.

About the author: Muriel Morrisette is a Twin Cities freelance writer. As former editor and planner for the MPCA, she coordinated a citizen participation program and produced a booklet entitled "A Citizens' Guide to Water Quality Management Planning."

RECOMMENDED FURTHER READING

"Curse of the Karst", by Lucy Cook. **Journal of Freshwater**, Navarre, Minnesota, 1981.

Groundwater Pollution Prevention in Southeast Minnesota's Karst Region, Extension Bulletin 465, Agricultural Extension Service, University of Minnesota, St. Paul, Minnesota, 1982.

The Citizen and Environmental Policy, by Sheldon Kinsel. National Wildlife Federation, Washington, D.C., 1977. Single copies free; additional copies 10 cents each.