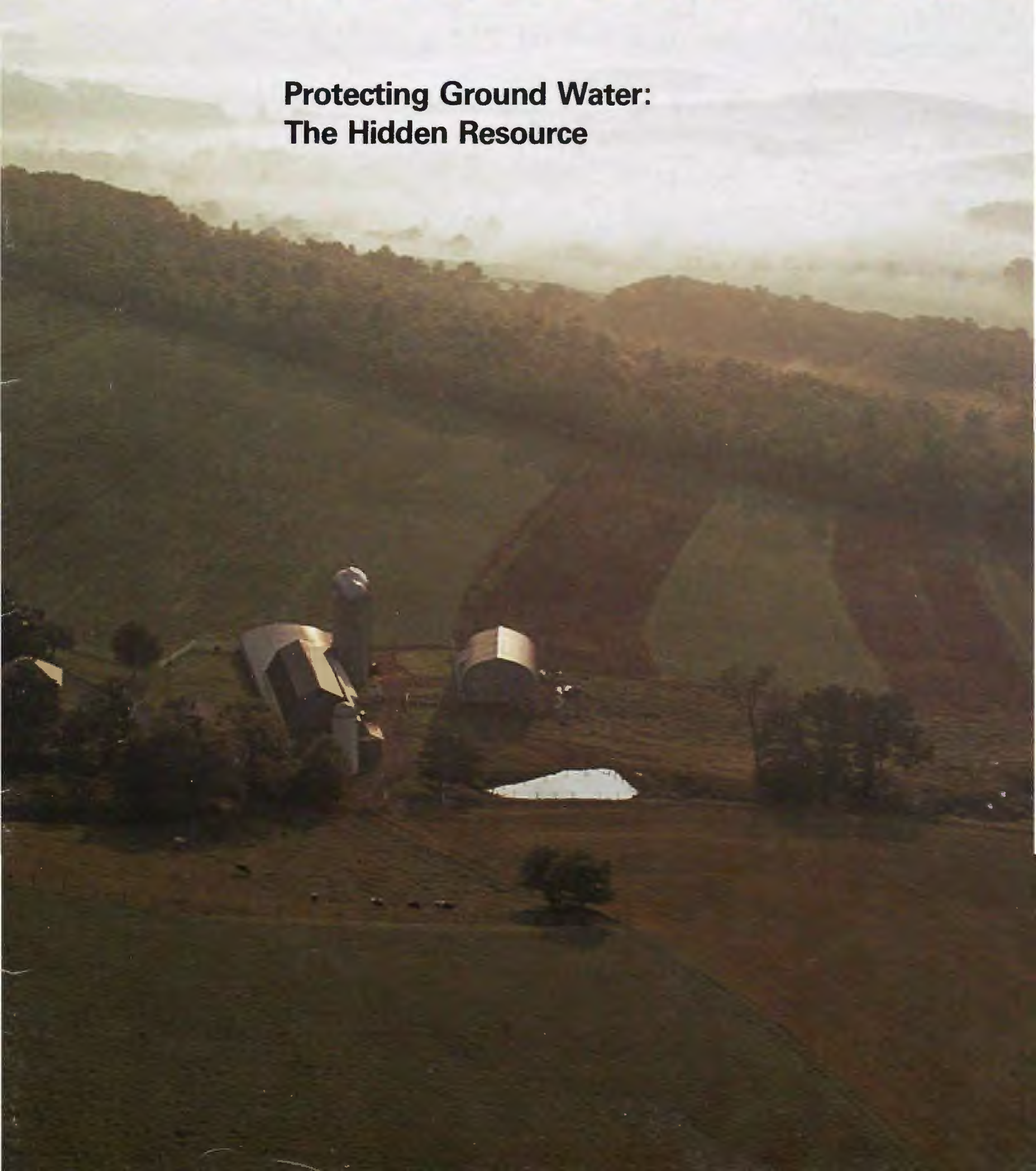
United States
Environmental Protection
Agency

Office of
Public Affairs (A-107)
Washington DC 20460

Volume 10
Number 6
July/August 1984

EPA JOURNAL



Protecting Ground Water: The Hidden Resource

Protecting Ground Water, The Hidden Resource

Bruin Lagoon, an abandoned hazardous waste site in Pennsylvania, next to a residential area. Wastes in the lagoon and storage tanks contaminated surface and ground water. The site is on EPA's National Priority List for Superfund action.

A few years ago ground-water pollution was an almost unknown problem. Today ground water is one of the major environmental concerns. This issue of *EPA Journal* explores why and describes what the states and EPA are doing about it.

Administrator William Ruckelshaus explains EPA's commitment to help protect this precious resource. Deputy Administrator Alvin Alm spells out the approach EPA has developed to help insure that the nation's ground-water resource is not going to be lost. The Assistant Administrator for Water, Jack Ravan, discusses federal-state relations in ground-water protection, an important factor because of the different responsibilities at state and federal levels regarding this resource.

In an interview, Marian Mlay discusses the ground-water problem and how the Office of Ground-Water Protection which she heads will help coordinate efforts to deal with it. The office was recently created within EPA by the Administrator, who named Ms. Mlay to direct it.

A view from the states regarding the best way to address the nation's ground-water problems is offered by Governor Bruce Babbitt of Arizona, Chairman of the Subcommittee on Water Management of the National Governors' Association. In addition, water quality officials in five states report on the particular ground-water problems they face and on the programs they have developed to deal with contamination. The states are Pennsylvania, Connecticut, New Mexico, Florida, and New Jersey.

Dangers to drinking water posed by ground-water contamination are described by John M. Gaston, a sanitary engineer with CH_2M Hill, an environmental consulting group. Sources of pollution are discussed in a piece by David W. Miller, a geologist and partner in Geraghty and Miller, Inc., a consulting firm specializing in ground water. Potential links between polluted ground water and public health are described in a piece by Dr. Robert A. Goyer, Deputy Director of the National Institute of Environmental Health Sciences.

A prognosis for the future of the nation's ground water is given in an article by Philip Cohen, chief hydrologist of the U.S. Geological Survey. EPA's efforts to develop more effective techniques to control hard-to-get-at pollution of ground water are described in an article by Bob Burke of the agency's Office of Public Affairs.

Concluding the issue's discussion of ground water, James T. B. Tripp, an attorney with the Environmental Defense Fund, writes about ground-water pollution in Nassau County, N.Y., and the national lessons it suggests, and Dr. Thomas M. Hellman, Chairman of the Chemical Manufacturers Association's Environmental Management Committee, gives his perspective on the ground-water problem.

Regarding the environment generally, the magazine includes excerpts from the June 19 speech by President Reagan to the National Geographic Society in Washington, D.C., outlining his views on the issue.

Special features include Appointments and Update, a summary of recent EPA developments. □

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EPA is charged by Congress to protect the Nation's land, air and water systems. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions which lead to a compatible balance between human activities and the ability of natural systems to support and nurture life.
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Front cover: Aerial view of a farm in western Maryland. Photo by Robert Madden of Folio.

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Design credits: Robert Flanagan; Ron Farrah

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The Nation's Need to Protect Ground Water

By William D. Ruckelshaus
Administrator, EPA

Upon my return to EPA in June of 1983, it was clear that the nature of the environmental threat facing our society had changed markedly in a decade. From its dominant focus on conventional air and water pollutants in the early 1970s, the agency has directed its attention to toxic and hazardous contaminants in all media. New legislation to control these contaminants has been enacted by Congress in the form of the Resource Conservation and Recovery Act, the Superfund law, the Toxic Substances Control Act, the pesticides act, and amendments to the Clean Air Act and the Clean Water Act. Our experience in implementing these statutes and evidence drawn from extensive monitoring and survey data suggest that the contamination of our ground-water resources constitutes a major problem the nation has too long neglected.

Shortly after I returned to EPA, I set up a task force of some of our best technical and professional experts to develop an agency strategy for ground-water protection. The dimensions of the challenge were clear:

- The consumption of ground water is increasing at twice the rate of surface sources of fresh water and it won't be long before most Americans will rely on ground-water resources for drinking water. Many regions and communities simply could not exist without clean and dependable ground water.

- Ground water is highly vulnerable to contamination. Abandoned hazardous waste dumps and thousands of poorly regulated hazardous waste facilities are the most prominent sources of contamination in the public's mind.

- Hundreds of thousands of landfills, ponds and lagoons used for storing wastes, and storage tanks containing gasoline and other liquids may also be polluting much of the nation's ground water. There are also literally hundreds of other major sources that range from 20 million private household septic systems to various pesticides and chemicals. A special problem exists in coastal areas where depleted ground-water aquifers are threatened by salt water intrusion. The list of sources of ground-water contamination keeps growing as new sources are identified and verified.

- Specific problems associated with ground-water contamination are among the most complex that EPA has ever had to deal with. Ground-water contamination is extremely difficult to detect and monitor, and it is not readily amenable to conventional cleanup measures. At present, we simply do not know how to clean up most ground-water pollution.

I directed the Ground Water Task Force to produce four key outputs:

- A program to build and enhance ground-water management institutions at the state level;

- A program to begin to deal with inadequately addressed sources of ground-water contamination—in particular, leaking storage tanks, surface impoundments, and landfills;

- A general framework for making EPA decisions affecting ground-water protection and cleanup; and

- A strategy for strengthening EPA's organization for ground-water management at the headquarters and regional levels.

Some of the Task Force recommendations have already been implemented and others are being actively pursued. The recommendations provide a basis for comprehensive and effective actions at all levels of government to protect and enhance our nation's valuable ground-water resources.

I have complete confidence in our nation's ability to provide protection for its ground-water resources. I have seen what federal, state, and local governments have collectively accomplished in the past when dealing with other environmental difficulties that seemed as challenging at the time as this one is now.

We will pull EPA's resources together to address the issues involved. We know that in most instances it is much easier to prevent ground-water contamination than to clean it up once it happens.

EPA is moving forward with vital research aimed at improving our capabilities to detect and clean up ground-water pollution. There's much we still don't know about these technically complex issues but we have made significant advances that were unimaginable only a short time ago.

We have every reason for optimism. The skills and dedication of federal, state, and local governments and the strong national commitment to environmental protection have served us well in the past. They are equal to the challenges of ground-water protection. □

EPA's Ground-Water Protection Strategy

By Alvin L. Alm
Deputy Administrator

National environmental attention has turned only recently to the problem of ground-water contamination. During the 1970s, the nation's concern focused mainly on natural resources and pollution we could see or smell. Federal and state programs were developed to address surface water and air quality, specific types of contaminants such as pesticides, and obvious sources of contamination such as uncontrolled hazardous waste sites. Few knew or really understood how seriously our ground-water resource was being compromised.

In a field hydrology class at Ohio's Wright State University, an instructor explains use of a rig to drill a ground-water monitoring well.

Public awareness of and concern about the problem grew as reports of contamination of drinking water wells and well closings increased. State, local and federal officials are responding to public demands for enhanced protection of ground water. These responses, however, are hampered by a lack of coordination between responsible agencies, limited information about the health effects of exposure to some contaminants, and a limited scientific foundation on which to base policy decisions.

Recognizing the need to protect ground-water quality as a national concern, EPA Administrator William D. Ruckelshaus asked me to create a Ground-Water Task Force. Comprised of senior representatives of EPA program and regional offices, the group was charged with developing a strategy for EPA's ground-water protection efforts. The Task Force began work in June 1983, using technical papers and proceedings from workshops and public hearings held over a period of several years as a foundation for their deliberations. Preliminary conclusions of the Task Force and a draft strategy were reviewed by and discussed with Congressional staff, state officials, and a wide range of industry and environmental organizations.

After extensive analysis of EPA statutory authorities as well as existing state ground-water programs, the Task Force concluded that the nature and variability of ground water makes its management the primary responsibility of the states. However, a number of significant federal authorities exist to support states in the effort. The group also found that since these federal laws were enacted at various times for separate purposes, some inconsistencies in regulations and decisions made under them have hindered a cohesive approach to ground-water protection. In addition to EPA's authorities, the Task Force found a variety of state and local authorities that can be used to protect ground water. Many states have already begun programs in this area, and fostering the continued development of state capability to protect ground water was deemed vital.

The effort to protect ground water will be enormous, and it will require sustained attention at all levels of government for a long period of time. Given the finite fiscal and human resources that are available, it is clear that we must direct our energies to minimize future contamination, even as we detect and manage contamination associated with past activities. If we are to focus our efforts where ground-water contamination would cause the greatest harm, this suggests that we should assign highest priority to those ground waters currently used as sources of drinking water or that feed and replenish unique ecosystems. In this context, EPA developed its Ground-Water Protection Strategy.

The strategy includes four major components that address critical needs. They are:

- Building and enhancing institutions at the state level;
- Addressing problems associated with inadequately controlled sources of contamination;
- Issuing guidelines for EPA decisions affecting ground-water protection and cleanup; and
- Strengthening EPA's organization for ground-water management.

With regard to building state programs, EPA plans to offer several types of assistance to states. EPA will make existing grant funds available to help states develop ground-water protection programs and strategies. EPA will also provide state agencies with technical assistance in solving ground-water problems, and will continue to support a strong research program in ground water more directed toward state needs.

The second component of the strategy is to begin addressing major sources of ground-water contamination not now regulated under federal law. Underground storage tanks, including those storing gasoline, are becoming recognized as a possibly serious and widespread source of ground-water contamination. EPA's Office of Toxic Substances has begun studying the nature, extent, and severity of the problem, and the agency is considering possible regulatory approaches to ensure proper design and operation of these tanks. In the meantime, the agency will issue chemical advisories to alert tank owners about the problem and will work with states and industry to develop voluntary steps to reduce contamination. Direct regulation of tanks storing hazardous waste is also being considered.

In addition, the agency is initiating efforts to determine whether land disposal facilities, including surface impoundments and landfills handling other than hazardous waste, require further state or federal regulation. Another recognized source of ground-water contamination is the use of pesticides; the agency is also stepping up efforts to assess the leaching potential of pesticides and to adopt and implement appropriate controls.

The strategy's third component recognizes the need for consistency in decisions affecting ground water that are made by EPA's regulatory programs. In thinking about building consistency in these requirements, we encountered two primary questions:

- How should we define the resource to be protected?
- To what extent should it be protected?

We have proposed guidelines which divide ground water into three classes, based on the use of the water and its vulnerability to contamination. Under the guidelines, each would receive a different level of protection.

The highest level of protection is reserved for "special ground waters." These special ground waters, characterized as Class I, are particularly vulnerable to contamination because of their hydrogeologic characteristics. To qualify as Class I, the ground water must also meet one of two other requirements. It must either be an irreplaceable source of drinking water for a substantial population, or it must provide water for a sensitive ecological system. To prevent contamination of Class I ground waters, EPA will initially discourage by guidance, and eventually ban by regulation, the siting of hazardous waste facilities over them. The agency will also place additional restrictions on existing land disposal facilities in those areas. Further, agency policy will be directed toward restricting or banning the use of those pesticides which are known to leach through soils and are a particular problem in ground water. EPA's policy for cleanup of contamination will be most stringent in these areas, generally requiring cleanup to background or drinking water levels.

Class II includes ground waters that are current or potential sources of drinking water or have other beneficial uses. These ground waters, which comprise the vast majority of ground water in the nation, will receive levels of protection consistent with levels now provided for under EPA's existing regulations. In addition, where ground waters are vulnerable to contamination and are used as a current source of drinking water, EPA will propose banning the siting of new hazardous waste facilities. EPA policy will require contaminating facilities in Class II areas to clean up to drinking water quality or background levels, but exemptions will be available to allow a less stringent cleanup level or plume management effort under certain circumstances when protection of human health and the environment can be demonstrated.

Class III — or ground waters that, because of natural or manmade contamination levels, are not considered potential sources of drinking water and which have limited beneficial use — will receive less protection than the other classes. However, technology standards for hazardous waste facilities would generally be the same. If such a facility should leak, it could be granted a waiver to clean up to a less stringent concentration limit for contaminants since the ground water would already be of limited value. However, such waivers would not be available to facilities which had caused the contamination that precluded future use of the ground water. EPA's Superfund program will not focus its activities on protecting or improving ground water that has no potential impact on human health or the environment.

To improve the consistency and effectiveness of EPA's current ground-water programs, the guidelines will be translated into specific requirements in each of the agency's relevant program areas. Many of these programs are delegated to the states, and for most programs states must demonstrate that their efforts are "no less stringent" than the federal program. However, in implementing these guidelines, EPA will provide as much flexibility as is possible under existing statutes.

The final component of the strategy is strengthening EPA's organization to focus on ground-water protection. We have formally established a new headquarters Office of Ground-Water Protection within the Office of Water. It will give the agency the kind of leadership and coordination it has long needed to make ground water a genuine priority. The Office will direct the development of EPA policies and guidelines for ground water, and coordinate the relevant activities of program offices. In addition, we are establishing ground- water staffs in each of our regional offices, whose function it will be to assist in ground-water policy development and implementation, and coordinate planning and technical support for states devising ground-water strategies of their own.

I consider EPA's Ground-Water Protection Strategy an extremely important step in enhancing protection of a vital resource and achieving consistency in regulatory requirements. The strategy does not propose simple solutions to the complex problem of protecting our nation's ground-water supplies. Rather, it provides a framework for a strengthened federal-state partnership that ensures the most effective use of our existing and future resources for protecting ground-water quality.

EPA's Ground-Water Protection Strategy gives us the tool for protecting this important resource and making sense out of our many programs that affect ground water. The strategy is now driving a number of our regulatory programs toward sensible goals. The strategy does not propose simple solutions to the complex problem of protecting our nation's ground-water supplies. But it does take us a long way toward rationalizing our programs, dealing with unaddressed ground-water problems, and creating the kind of state/federal partnership that is necessary for effective action. ☐

Coordinating Protection Efforts

An Interview with Marian Mlay

In the following interview, Marian Mlay, director of EPA's Office of Ground-Water Protection, discusses the ground-water problem and reviews EPA's efforts to help deal with it.

Marian Mlay

Q When did the country begin to realize it has a problem with ground water?

A The country has been aware for about the last five years, since some of the particular incidents of contamination in New England and New Jersey.

People in the environmental professions understood earlier that there were problems. It's just that ground water did not become a public issue until some particular instances of contamination became widely known, partly because of our new ability to measure ground-water contamination at much lower levels.

Traditional contaminants, such as microbiological contamination from septic tanks or outhouses, and certain natural contaminants have been known for a long time. But it's the new awareness of manmade chemicals that are toxic and getting into ground water that has really heightened public awareness of the problem.

Q What is the nature of the ground-water problem?

A We're finding ground water containing relatively high levels of manmade contaminants. They are affecting both public and private drinking water supplies, and drinking water is the most direct transmitter of pollution and contamination to people.

People are very concerned about surface water because they see it and smell it and have to be around it. By and large we expect to treat surface water when we use it for drinking water. But water from private wells and many smaller public water systems isn't treated. Now, with the more sophisticated methods of measurement, contaminants are being discovered in these sources. There is concern about the public health effects and about the cost to individuals and to the public water systems of treatment.

We have also become aware of more and more kinds of activities that will cause ground-water contamination. In addition to large hazardous waste facilities, there are gasoline storage tanks, several million of which are scattered around the country. There are pesticide and fertilizer applications, and highway de-salting. Ground water is being spoiled by many different incidents of contamination that come from relatively benign or innocent looking activities.

Q What would you say the major challenge is at this point—protecting clean ground water, or cleaning up contaminated ground water?

A Both. I don't know that we can really separate the two.

Clearly in our ground-water strategy we want to place more emphasis on protection, but it's easy to say, "Let's protect everything, let's protect all ground water, let's make sure that it's all pristine." We know that's extremely expensive and very difficult or impossible.

We can't stop all fertilizer use and we can't rip up all the gasoline stations in the country, so protection becomes a question of assessing the use of that ground water and protecting it for those uses while trying to divert potentially polluting activities where possible to areas where ground water will not be affected.

Q Is cleanup just as difficult?

A In ground-water cleanup we have a major technical challenge. We just don't know how to do it yet. I'm using the term cleanup in the context of turning an aquifer (an underground stratum containing water) back into its original, possibly pristine state.

The typical way of trying to restore ground water is to remove the source of contamination, even to the point of digging out contaminated soils. But you've got to put the spoiled material somewhere, and it will still have the potential to contaminate something else.

Once the source of the contamination has been eliminated, usually the water is pumped out, treated, and pumped back again. Even in what I'd call some simple cases involving a contaminant that's fairly easy to get out of water, like trichloroethylene (TCE), they've been pumping and treating for five years and they've still not gotten it all out. (TCE is a volatile organic chemical commonly used as an industrial solvent.)

So the problem of actually restoring aquifers is not solved technically. The techniques that exist are extremely expensive and can take forever.

There are other techniques for protecting public health from ground-water pollution: containment approaches. For example, you can put a well at the end of a plume of ground-water contamination spreading from a particular source and pump it out so that the plume doesn't move any farther. You can prevent the pollution from moving into a well system, for example.

There are other ways of protecting drinking water wells from contamination without cleaning up all the polluted ground water. Because of the expense of complete cleanup, we may have to consider them in many cases.

Some very interesting research is underway regarding ground-water cleanup, such as stimulating or injecting microbes underground to break down chemicals more rapidly, but we're probably five or ten years from being able to use it.

Q Do you believe that we've got a crisis on our hands with polluted ground water?

A No. I think we have a long-term problem, one that is not going to go away easily, but it can be dealt with and we need to do it. It will become a crisis only if we ignore it.

Q How did you get involved in the ground-water issue?

A Two days after I began work with the EPA Office of Drinking Water in late 1979 as Deputy Director, my boss, Victor Kimm, and I were called to the Administrator's office. The Administrator was very concerned about ground water. Those were the days when Superfund legislation was being considered. Various legislation had been proposed regarding aspects of ground-water pollution but no one was really thinking about the whole resource.

The Administrator saw the patchwork which was beginning to develop and wanted to prevent it. So he charged us with developing a ground-water strategy and, I must admit, I walked out of the office and looked at Victor Kimm and I said, "What's ground water?" I really had no background in it at all. So it was an educational process for me as well. I've become very much interested and have seen the issue through since then.

Q What is the significance of Administrator Ruckelshaus' action creating an Office of Ground-Water Protection?

A It's extremely significant. Of all the comments that we have been getting on the agency's ground-water strategy from people that we have asked about it — environmentalists, industries, state people — they're unanimous that setting up this office is extremely important for EPA. They see it as a focal point within the agency to heighten awareness of ground water as an important issue, to coordinate policy across the agency, to work with other federal agencies, and to work with the states.

Many people are interested in this issue and are grappling with it from their own perspective. They have been looking for leadership from EPA on the question, not so much in the form of regulations or guidelines, but as a resource to help them work through their problems. I think we have a wonderful opportunity to heighten awareness and work with experts throughout the country to help resolve the questions of how to protect this very complex resource.

Q What is the purpose of EPA's strategy for protecting ground water?

A It has several purposes. The basic one is to say that EPA is truly concerned about ground-water protection, about the resource itself. Even though the agency doesn't have direct authority as it has with surface water and air, it does administer statutes that affect ground water. We want to recognize more formally that responsibility.

The strategy is designed to clarify the relationship between EPA and the states on the issue of ground-water protection. In ground-water quality the question is, how can we work together within a framework that recognizes both the basic state responsibility for ground-water protection and the major federal program efforts to deal with specific kinds of contaminants like pesticides, hazardous waste facilities, underground injection wells, and so on? We're attempting to clarify these roles.

The strategy is also an attempt to express our concern about some sources of contaminants which aren't being addressed, and to define the extent of the problem and an appropriate federal response. Contamination from underground storage tanks is a good example. We're getting a lot of information that they are a major problem. Some states are doing some interesting work in that area, but the question we are addressing is, when does a problem like leaking tanks become of national import and require our action?

I think finally the strategy is an attempt to get our own act together within EPA. As we looked at the various EPA programs to deal with ground water, we found that they all deal with it differently. They define ground water differently; they protect it differently; the kinds and extent of regulations are different. The strategy is an attempt to state a general EPA policy on ground-water protection and then, over time, to make our own programs conform to that policy. In that way, both the regulated community and states will have a much more consistent set of requirements to deal with as they implement our programs.

Q Drafts of the strategy have been criticized as relying too heavily on the states to protect ground water. What is your reaction to that?

A We are dealing within the existing legal framework. The states have the major responsibility in ground-water protection. The federal government has some major responsibilities as well but it does not cover every potential source of contamination, and I'm not sure that it should. The critics may feel that the federal government can solve most problems. But in the case of ground water, many of the protective actions that would have to be taken do involve land use, which traditionally in our country has been under state and local prerogatives to control. I think that it's quite possible for us to forge a partnership with the states which respects those prerogatives and yet has an active and productive federal role.

Q How will your office coordinate the various parts of EPA in carrying out the ground-water strategy?

A That's a good question. It doesn't just involve EPA; other federal agencies have a major interest in this. The states are extremely interested and feel that they have to be a part of the action. Industry groups are obviously very interested; the environmentalists are very interested, and so I'm going to have a large number of group activities.

We've set up or are in the process of setting up several coordinating committees. It may sound bureaucratic but I think it's the only way we can do it.

One is an oversight committee of the four assistant administrators at EPA with ground-water programs. Jack Ravan is the chair and we have Lee Thomas, hazardous waste and emergency response; Bernard Goldstein, research and development; and John Moore, pesticides and toxic substances. The committee also includes two regional administrators, Michael Deland of Region 1 and John Welles of Region 8. This committee will provide policy direction to the Office of Ground-Water Protection. It will also give us an opportunity to deal directly with the principal operating assistant administrators in identifying their major concerns and in directing our work so that it's beneficial to them. Most of the things which we are attempting to do are designed to enhance their efforts in ground water. The Office of Ground-Water Protection is not going to be carrying out direct programs. It is a policy development and coordination office and it's going to be very small.

Regional administrators are also setting up small regional ground-water coordination offices in each region with a function comparable to ours.

We're setting up a steering committee which involves all the office directors at EPA: Office of Drinking Water, Superfund, etc.—all of the office directors who have substantial ground-water responsibility. They will be our day-to-day operating contacts, and we are even now working very closely with a number of them. We'll be setting up a group of state officials, a state-EPA liaison group, so that we can get their very direct involvement. They will represent the major state interests in ground-water protection.

We're setting up an interagency committee of the various federal agencies such as the U.S. Geological Survey and the Nuclear Regulatory Commission and the Departments of Interior, Defense and Agriculture. They see the strategy as having potentially substantial consequences for their programs. By and large we have gotten very enthusiastic support from this group.

We're also going to be having periodic briefings and meetings with environmental groups and industry people and we hope to coordinate with them in that way.

By working with these various groups on selected areas of concentration, we think we can affect what's happening. It will be a challenge. Obviously we can't coordinate with everything that goes on within the agency on ground water.

Q What difference do you think the ground-water strategy will make in the long run?

A Ground water will be a major resource for EPA's attention, just like surface water and air. I think that the states and others will be able to help us to use the strategy as a way of focusing our mutual concerns and giving as much attention to ground water as we do to those other resources. I think we can help build a public awareness and a foundation for cooperative action.

Q What kind of help will EPA be giving the states in ground-water protection? And how will this differ from the way it has been?

A EPA has done a fair amount in the past, particularly through the regional offices. It's a question of more and better.

Certainly, one of the kinds of help that we have given is grant support. Our strategy contemplates enhancing that through regions working with states on their ground-water problems and encouraging them to use our existing grant resources to focus on the problems that they see and to develop their own state plans and strategies.

Facts About Ground Water

What is ground water?

Ground water is that part of underground water that is below the water table. Ground water is in the zone of saturation within which all the pore spaces of rock materials are filled with water.

What is an aquifer?

An aquifer is a body of permeable, saturated rock material capable of conducting ground water and yielding economically significant quantities of water to wells and springs.

How much ground water does America have?

The United States has approximately 15 quadrillion gallons of water stored in its ground-water systems within one half mile of the surface.

How much ground water does America use?

Annual ground-water withdrawals in the United States are on the order of 90 billion gallons per day, which is only a fraction of the total estimated water in storage. This represents about a three-fold increase in American ground-water usage since 1950. Most of this is replenished through rainfall and offsets the hydraulic effects of pumpage, except in some heavily pumped, arid regions of the Southwest.

American ground-water use is expected to rise to about 95 billion gallons a day in 1985.

What are the major uses of ground water?

Public drinking water accounts for 14 percent of ground-water use in the U.S. Agricultural uses such as irrigation (67 percent) and water for rural households and livestock (6 percent) account for 73 percent of American ground-water usage. Self-supplied industrial water accounts for the remaining U.S. ground-water use.

What percentage of American drinking water comes from ground water?

Approximately 50 percent of all Americans obtain all or part of their drinking water from ground-water sources.

Where is America's ground water most heavily concentrated?

The richest reserves of American ground water are in the mid-Atlantic coastal region, the Gulf Coast states, the Great Plains, and the Great Valley of California.

What is the largest American aquifer?

The Ogallala aquifer, which extends from the southern edge of North Dakota southwestward to the Texas and New Mexico border, is the largest single American aquifer in terms of geographical area.

What are the most important American aquifers?

The most important American aquifer in agricultural terms is the large unconsolidated aquifer underlying the Great Valley of California. The most important ground-water sources of public drinking water are the aquifers of Long Island, N.Y., which have the highest per capita usage concentration in the U.S. (see story on page 30).

We're also interested in enhancing our existing research programs so that they are directed toward the kinds of problems which states see. We're going to try to coordinate our research planning efforts and state interests a lot more closely than we have in the past.

We're concerned about enhancing technical assistance to states. The states certainly are able to hire some expertise; they're able to buy it through consulting firms. But EPA has some very unique people. Some of our regional and program people have expertise which we hope to make available to the states when they have special problems.

I am thinking of one situation in which Maine was suddenly confronted with permitting a phosphate mine. They had never dealt with phosphate mining in that state. Some people from our Atlanta regional office who had permitted phosphate mines and some people from the state of Florida with similar experience hopped on a plane to Maine and spent several days providing technical assistance on that particular ground-water issue. That kind of help is extremely valuable. We will be trying to identify resource people within the agency who can provide that kind of consultation.

Q How does EPA plan to deal with sources of ground-water pollution which are not covered by federal law? One of the examples is underground storage tanks.

A Our primary emphasis is in helping the states develop the capacity to deal with ground-water problems themselves by encouraging them to do the necessary planning and providing useful information. We can also help insure that cleanup technology is transferred from state to state through shared experiences.

The second approach is to consider whether particular problems may require further federal activity. Underground storage tanks are one area we are looking at. We're trying to get a better fix on the extent of the problem through a fairly substantial survey which is now in the final phase of design by the Office of Toxic Substances. We're assessing the extent of current control measures. Should we conclude that the problem is big enough for federal action, then we are going to have to tackle it. We do have authority under the Toxic Substances Control Act and several other acts to take various steps, such as enforcement under the Safe Drinking Water Act and the Resource Conservation and Recovery Act.

Q What do you expect to accomplish during the next year?

A I would like to get the ground-water strategy out in public. I want to have set in place the Office of Ground-Water Protection and the regional ground-water offices so that they are well-functioning institutions. We're well on our way to that. I would like to see as a part of that a much closer working effort between our regions and states in enhancing state ground-water activities. We do have some state grant guidelines, but to help that along I hope to have ground-water strategy guidance in place, adopted by our various EPA programs within the next year. We're projecting to have draft guidelines within the next six to nine months.

I hope that within the next year we will be able to develop a ground-water monitoring strategy which will provide a better idea of what we and others, such as states and the U.S. Geological Survey, are doing to enhance knowledge of the extent of contamination and the nature of the resource.

Certainly, I'd like to see us have a very good handle on the storage tank problem. I don't think that all the studies we're planning will be completed by then, but we should have them well underway.

We are planning with the Office of Research and Development to establish an outside top level scientific review of our ground-water research. By the end of the year we should have a major report from this group on the directions we should be taking in ground-water research.

Q What process has been followed in developing the ground-water strategy?

A The strategy has been under development since late 1979. We had a pair of workshops in June 1980, with participants from states, industry, academia, environmental groups, and local government. That group of 80 people made the fundamental recommendations that we've been discussing. We had a public review of the draft strategy; we've had public hearings and gathered comments from hundreds of people that helped us put that early strategy together.

Since Bill Ruckelshaus came in June of last year, we've put together an internal task force to review the results of that earlier work; to review what's happened since, including the passage of Superfund; and to consider a number of implementing actions. We put together a report for the Deputy Administrator and went through several months of internal debate. We had several meetings with Deputy Administrator Al Alm and assistant administrators. Our task force went through the draft strategy in considerable detail and finally came up with a document that we all agreed on. We briefed industry, environmental groups, states, Congress and other federal agencies on our thinking.

We got some comments and ideas from those discussions, incorporated them back into the strategy, and came out with a document in January. We circulated it among key groups: trade associations interested in ground water, organizations representing states, and environmental groups. We sent copies to Congress, to other federal agencies. Our regional administrators sent copies to the governors and other key state officials and met with them to gather their comments.

Alm met with representative state officials here in Washington to get their comments. We had another series of meetings with other federal agencies. Now we have arrived at a final document which reflects all this input.

Q Is there any special comment that you would like to make?

A One of the questions that comes up so often is, why hasn't the job already been done, and why can't we do it fast? I recall the book, *In Search of Excellence*, in which the writer commented that really good national firms take about ten years to bring out a new product line. A ground-water strategy is at least as complex.

We need to think of ground-water protection as a long term effort which will evolve as our understanding of the resource and related technologies improves and as public understanding of the issues crystallizes. □

A State/EPA Partnership

by Jack E. Ravan
Assistant Administrator for Water

Contamination from land disposal: On Cape Cod, Massachusetts, ground water is pumped from a monitoring well into a bucket. Non-biodegradable detergents make the water foam. The detergents originated about a mile away at Otis Air Base, where they were disposed of on land between 1948 and 1964. They seeped into the ground water. Thirty years later, in 1978 when this photo was taken, they were still present in the ground water.

Over the past ten years, the states and EPA have worked together to bring about a remarkable reduction in pollution of rivers, streams, and lakes. In working to clean up surface waters, we forged a partnership based on mutual respect and an understanding of each other's capabilities. I have seen this partnership from both sides. I have served in a state office, an EPA regional office, and now at EPA headquarters, and I can testify to the importance of coordination. It produces results.

A new challenge—the protection of ground water—now confronts many environmental and other agencies at the state and federal level. If we are to be successful in controlling and preventing ground-water contamination, we must expand the state/EPA partnership which serves so well in controlling surface water pollution and in other program areas.

EPA's ground-water protection strategy is an important step toward building a state/EPA partnership for ground-water protection. In its early assessments of ground-water issues and programs, EPA found that states have the clearest, most direct authorities to protect ground-water and that many states are developing comprehensive ground-water programs. The EPA strategy recognizes clearly that states are responsible for comprehensive management and protection of ground-water resources. In developing these programs, states assess the nature and extent of ground-water contamination problems, develop appropriate pollution control programs, and implement control programs on an ongoing basis.

EPA's primary responsibility is to ensure that national environmental laws are implemented fully. Many of these laws — including the Safe Drinking Water Act, the Resource Conservation and Recovery Act, and the Superfund act — have substantial ground-water protection provisions. EPA is committed to providing states with the methods and means to carry out these federal programs and to assist states in developing the institutional capability to design and implement comprehensive ground-water protection programs, including protection from pollution sources which fall exclusively within state jurisdiction.

Over the next several years, EPA will provide states with technical and program development assistance, will assure that states have maximum flexibility in the use of grant funds to develop ground-water protection programs, and will direct research and development activities to specifically address state needs. Each of these activities is described briefly below.

Technical Assistance

EPA will provide states with assistance in addressing technical and program design issues encountered in development of ground-water protection programs. At the EPA headquarters level, we plan to support technology and information exchange between the regions and states. EPA regions will play an important and expanded role in assisting individual states with particular problems on a case-by-case basis. EPA regions will assist states in the following areas:

- analysis of technical or scientific problems,
- design of state ground-water protection programs,
- management of ground water-related data,
- seminars and conferences for state staffs, and
- consultation on issues concerning interstate aquifers.

EPA is just beginning to explore the range of mechanisms available to deliver technical and program development assistance to states. Ideas being considered include: exchanges of personnel under the Intergovernmental Personnel Act; designation of "national experts" in various aspects of ground-water protection; increased support of scholarships for study in critical ground-water fields; and regular state/EPA conferences or seminars on pressing ground-water issues or technical problems.

Grant Support

EPA is encouraging states to make full use of existing grant programs to develop ground-water protection strategies and programs. The work EPA will support is comparable to activities begun over the past several years by states that are already developing ground-water protection programs and will include:

- development of an overall state action plan or strategy to set ground-water protection goals and to coordinate ground-water programs in various institutions;
- identification of legal and institutional barriers to comprehensive ground-water protection programs;
- development of general ground-water programs and design of source or contaminant- specific ground-water protection programs; and
- creation of a data management system to increase the accessibility and quality of information needed to protect ground water.

Since a number of states have already completed some of these tasks, the agency will also support activities to assess the ground-water resource (e.g., mapping, selected monitoring), which are presented in a broad context indicating how they fit into an overall state ground-water strategy.

Funds from a range of existing grant programs are eligible to support ground-water program development activities, including grants under sections 205(j), 205(g), and 106 of the Clean Water Act, the Underground Injection Control program grant under section 1443(b) of the Safe Drinking Water Act, and the program grant under section 3011 of the Resource Conservation and Recovery Act, if RCRA program commitments are completed.

EPA regional administrators will work with governors to direct grant support to the state agency or program with the most complete authority and capability to undertake or continue statewide ground-water strategy and program development. Regional administrators will also work with governors in determining the most appropriate grants and levels of funding for ground-water programs in order to assure effective coordination among various state agencies involved in ground-water protection.

Research and Development

EPA conducts a research program to provide a broad range of data and information for use by decision-makers concerned with ground-water protection. The program is directed toward improving monitoring technology, prediction and assessment tools, and aquifer cleanup methods.

In the near future, EPA will establish a group of ground-water research experts under the Science Advisory Board to advise the agency of ground-water research needs. The research group will include state officials and one of the tasks of the group will be to direct research and development activities more specifically toward designing the tools and methods identified by states as needed to protect ground water.

Other research programs also contribute to the scientific bases on which decisions about ground-water protection are made. For instance, a significant portion of the research on the health effects and removal of drinking water contaminants is directed toward chemicals found in ground water. Research to develop and evaluate technology for control of sources (such as surface impoundments) and improvements in methodology for analyzing water samples for trace constitutents also contribute to our scientific capability. EPA will work to assure that findings of research efforts are made available to states in a useful and timely fashion.

EPA Organization

In addition to assistance directed to states, EPA is taking steps to improve coordination of its own programs. The ground-water protection strategy provides for developing guidelines to improve consistency among EPA programs related to ground water. Many states have chosen to implement EPA programs and have found that inconsistencies in procedural and substantive requirements have made coordination of EPA and existing state programs difficult.

States were also frustrated because many voices in EPA seemed to speak to ground-water issues. This problem should be alleviated by the recently established Office of Ground-Water Protection that will speak for the agency on overall ground-water issues and policies. The agency will also form a State Liaison Group to advise senior EPA officials on ground-water programs and issues. In addition, each EPA regional office will establish a point of coordination for ground-water programs, information, and activities. By setting a clear course for our own ground-water program, EPA is a more reliable partner for the states.

In my years of public service I have had the privilege of serving in both state and federal governments. I have seen agencies try to tackle a job alone and I have seen them set out to work cooperatively in the intergovernmental system. Almost invariably, a partnership among agencies brings the best result. While we may not always agree on a particular issue, it is important that we work together, share our views, and express our differences. The EPA ground-water protection strategy will offer states and EPA an opportunity to address a serious problem of mutual concern. I will make every effort to assure that states receive the support and cooperation they need to protect ground-water. □

From the States' Point of View

by Governor Bruce Babbitt
(D-Arizona)

An irrigation well in Arizona

Protecting the quality of our ground-water resources is one of the most difficult and complex environmental and public health issues of this decade. Since we don't fish or swim in ground water most traditional approaches to water pollution control do not apply, and we've assumed that it will continue to be available, in a pristine condition, for drinking and other purposes. Today, we know that ground-water quality has deteriorated in many areas, with 40 states already having documented instances of serious contamination.

The importance of protecting this resource cannot be overstated. Over 50 percent of us rely upon ground water as our source of drinking water. Ninety-five percent of all rural households depend on ground water. The withdrawal of ground water has tripled since 1950 and now accounts for a quarter of all fresh water used. These uses include irrigation, drinking water, and industrial applications.

At the same time, the desirability of preventing contamination, rather than relying on corrective measures, is clear. Arizona, in developing its ground-water quality program, compared annual preventative and mitigation costs for selected industrial impoundments, surface mining activities, wastewater treatment plant removal processes, and landfills. That study showed that in every case the annual costs of prevention were from six to ten times less than the cost of cleaning up the contamination. The preventative approach is economically justified, even without considering the less easily quantifiable and more insidious public health effects arising from contamination of ground water.

While the value and vulnerability of ground water and the state of technology make it clear that protection of the resource and mitigation of existing contamination are in our best interest, a number of factors makes protection a difficult task.

(Governor Babbitt is the Chairman of the National Governors' Association Subcommittee on Water Management. The subcommittee is developing recommendations for state ground-water protection.)

The Difficulty of Protection

Undoubtedly the most important factor which makes ground-water quality protection difficult is the variability of the resource itself. In some states, ground water is ubiquitous — plentiful supplies occurring in large shallow aquifers encouraging development. In other areas, and not necessarily distant locales, ground water may occur in small quantities or at depths which preclude economic use. Aquifers may be confined, or may flow into each other in complex hydrologic systems. Subsurface conditions may be highly permeable, or may effectively prevent recharge. The rate of movement of ground water also varies from inches to miles per year.

Like any other resource, ground water changes with use. A vast range of human activities affects ground-water quality. While the number of sources of contamination makes it difficult to achieve comprehensive controls, each source will have a potentially different impact on the ground-water resource, depending on hydrologic and geologic conditions at the site, as well as the rate and nature of the discharge, and the facility design. Contaminants may move quickly to ground water, or may take years to reach the aquifer. Once in contact with ground water, similar variations in transport rate occur.

Finally, the art and science of ground-water management are relatively young. Historic involvement in the development and protection of surface waters has produced relatively plentiful expertise and considerable data. Unfortunately, this is not the case when considering ground water. No common monitoring system exists, and, while a number of states have mapped their aquifers and have sufficient data to determine the location and quality of their ground-water resources, most states do not have a comprehensive understanding of ground-water occurrence and conditions.

In spite of these difficulties, states are progressing in their efforts to address ground-water quality. Like the resource itself, protection systems and goals vary.

State Efforts

Whether aggressively pursuing comprehensive programs or beginning to examine the need for new regulatory efforts, states are focusing on ground-water quality protection. Activities focus on several broad approaches that are not mutually exclusive:

- Classification of aquifers by quality, vulnerability, or use;
- Control of contamination sources on either a site-specific basis, or by discharger class;
- Development of numeric or narrative standards for ground-water quality; and
- Controls on land use, with emphasis on facility siting or protecting of sensitive recharge areas.

While these broad approaches form the basis for protection programs, other factors bear heavily upon ground-water program development. Soils and geology, water yield, and linkages between surface and ground water all must be considered in planning for protection of this resource.

In considering these factors and combining them into regulatory or management strategies, states must make numerous judgments about current and future users, the relationship between statutory systems for allocation and quality protection, the willingness of an informed public to assume risks, and the wisdom of depending upon the development of new technologies for mitigation of resource damage. Population density, levels and types of industrial activities, and overall dependence on the resource exert major influences over the design of protection systems.

A quick review of existing systems reveals that states have addressed these considerations in formulating protection strategies. Maine and New Hampshire have, across-the-board, designated their aquifers as drinking water sources. The New Jersey system combines classification standards and source controls. Wisconsin has instituted a non-degradation policy, while Connecticut, North Carolina, and Wyoming have intricate classification systems.

Arizona's ground-water quality protection system takes a site-specific approach to protection of current and future uses of ground water. Broad narrative standards which focus on use protection will be applied through a system of permits on specific sources. General permits, to guide classes of activities which are of concern in their cumulative effects, as well as area permits which would cover a number of similar discharges in a specific location, are also proposed.

The general belief that states possess the legal authority to control ground-water quality requires careful review. While the police powers of states would presumably suffice in combination with general water quality statutes, attempts to implement aggressive protection strategies have triggered successful legal challenges. A thorough examination of the extent of state jurisdiction and subsequent legislative action are essential to the pursuit of comprehensive state protection.

Putting aside the question of legal authority, it is clear that states have a basic responsibility for protection of ground-water resources. Less obvious, but as important, is the role which local governments can play in the development and execution of state programs. Both the New Jersey Pine Barrens and Long Island, N.Y., are models of local land use approaches to ground-water quality protection. Bills in the last two sessions of Congress offered the opportunity to enact, nationwide, a voluntary state/local planning and source control process relying on the use of zoning and designation of sensitive areas. Local and regional governments, depending on their interest, resources and expertise, cannot be ignored as potentially valuable components of protection programs.

The federal government also plays a significant role in ground-water protection. Federal activities directly influence states and the condition of the ground-water resource.

Federal Efforts

The influence of federal agencies on ground-water quality arises from a variety of existing regulatory programs, the collection and interpretation of data on specific ground-water resources and related research and development, as well as in the operation of federal facilities.

The federal regulatory picture is a patchwork of controls on sources and quality-related uses of the resource. The Resource Conservation and Recovery Act is the most important federal statute which seeks to minimize ground-water contamination. The Act confers broad authority to EPA (and through EPA to the states) for hazardous waste management and solid waste controls, including a variety of permit standards as well as authority to "restrain imminent hazards." The Clean Water Act offers a regulatory framework which can protect ground water as that resource is related to surface water. The Toxic Substances Control Act and the Underground Injection Control portion of the Safe Drinking Water Act also regulate specific sources of contamination. Other portions of the Safe Drinking Water Act, in regulating quality of water at the tap, can be used to drive ground-water protection. And finally, the Superfund program is already addressing the mitigation of ground-water resource damage.

EPA, in the preparation of its ground-water strategy, has already acknowledged that statutory authority could be more effective if it were better focused and less hampered by inconsistencies in terms and application. The process for achieving that goal will be difficult, and the agency should be commended for embarking on those efforts. The involvement of states in the process is crucial if changes in the operation and scope of programs are to be accomplished.

Federal research, data gathering, and technical and financial assistance are all crucial to the development of effective state protection programs. Immediate needs include:

- Expedited EPA development of drinking water standards for nationally significant ground-water contaminants and, in the interim, the provision by EPA of guidelines to assure consistency among states in health protection and enforcement actions;
- Development of additional methods to assess contamination with emphasis on both detection at the source and on the quality of drinking water;
- Development of health and environmental effects data for various levels of contaminants in ground water;

• Elaboration of risk assessment and risk management methodologies for ground-water contaminants; and

• Assistance in aquifer mapping, and development of ground-water modeling capabilities.

Accelerated remedial action at known sources of contamination will also assist in driving the development of new treatment and restoration technologies.

Finally, the federal government, in operating federal facilities including military bases, must move aggressively both to eliminate ground-water contamination sources and undertake cleanup activities. This area is ripe for acceleration.

Left begging at this point is the question of the need for overarching federal criteria or goals for ground-water quality protection. It is on this question that the most interesting public policy debate affecting ground-water quality will turn.

The nature of the ground-water resource and the large variations in emphasis and structure among existing state ground-water programs tend to argue against the promulgation of a national ground-water program. States, with their inherent responsibility for water allocation and protection activities, jealously guard the right to control this resource. But admittedly the pattern of state activities is uneven. Citizens of two different locales should not suffer as a result of different levels of health protection.

Yet the ability of national guidelines and criteria to produce accelerated ground-water protection is also questionable. Inaction cannot be attributed only to insensitivity. Limited resources and the complexity of existing environmental programs inhibit the development of new protection programs.

While the jury is still out on the need for a federal program, much can be done to apply existing authorities and resources throughout government more effectively. We must work with the tools which are currently available, and resist any attempts to retreat from protecting this most valuable resource. □

Protecting Ground-Water: Five States Report

What particular ground-water problems do various states face? How do they handle them? EPA Journal *asked these questions of ground-water officials in five states. Here are their reports:*

Robert E. Moore

Assistant Deputy Commissioner
Connecticut Department of Environmental Protection

Providing safe drinking water to Connecticut citizens is the primary goal of the state's ground-water management program. Approximately one-third of our 3,100,000 people rely on ground water for their water supply source. Twenty percent rely on individual household wells for drinking water without any benefit of routine water monitoring to assure potability.

By March 1, 1984, the Department of Environmental Protection had investigated 493 well contamination problems. Of those, 380 were private domestic wells; 56, public water supply wells; and 57, commercial wells. Most problems were due to contamination by solvents, followed by pesticides, spills of gasoline or oil, landfill leachate, and finally road salt. Most of the problems have or are being resolved by development of a new source of supply, treatment, use of bottled water, and removal of the contamination source.

Clearly prevention of contamination must be the main element of any ground-water management program, as it is in Connecticut's, but other key elements must include enforcement and pollution abatement processes, control of water withdrawal, monitoring, and research.

In 1980 the Department adopted ground-water quality standards along with its surface water quality standards. These standards set all goals and policies for ground-water use and protection. Four use standards or classes were adopted: two (GAA & GA) suitable for drinking water use without treatment with no sources of pollution allowed; one (GB) may not be suitable for drinking without treatment due to past land uses or disposal practices and no need exists to restore these waters to potable quality; and one (GC) defining areas which may be most suitable for certain waste disposal activities such as landfills and hazardous waste facilities due to the hydrogeologic characteristics of the site. The entire state has been classified and mapped into these classifications. Over 90 percent of the land area falls into the GAA or GA class, and less than 0.3 percent into the GC classification.

In the work required to develop this system, the mapping of hydrogeologic characteristics, pollution sources, land uses, etc., it became clear that our management program lacked several key tools which were needed to meet the goals being set. The first was the control of water withdrawal from the ground. In 1982 the Department prepared and submitted to the General Assembly a bill requiring a permit for the diversion of surface or ground water over 50,000 gallons per day. This bill was adopted as Connecticut's Water Diversion Policy Act of 1982 and provides to the Department the authority to allocate the state's water resources.

Several other additions to our statutory authority for enforcement and regulation beyond the present authorities requiring permits for wastewater and leachate discharges were needed and subsequently pursued and adopted in 1982. They include:

1. The authority to ban by regulation the use of toxic substances or priority pollutants in septic system additives and cleaners. Regulations requiring product labeling and prohibitions have been adopted.

2. The authority to set standards by regulation for the design, installation,

testing and removal of underground fuel and chemical storage tanks (over 5,000 gallons). Regulations have been through the administrative process and are awaiting final adoption.

3. The authority to require persons or municipalities who have polluted a water supply well to provide potable water to the affected persons. This law is a very important and powerful tool designed to get safe drinking water to the people as soon as possible while the months or years of cleanup activities go on. The Act provides a municipality a grant to cover 50 percent of the capital costs of providing potable water from funds derived from a state hazardous waste generators tax where there is no obvious source of contamination or where the responsible party has no assets.

4. The authority to delegate Department authority to local municipal agents or agencies. This allows development of local ground-water protection programs with a strong statutory basis. Delegation of programs to towns will include: administration of underground fuel storage regulations, additional review and permit of large septic systems (only single residential and small commercial are now delegated), expanded rights of investigation and monitoring, and control over many commercial activities.

Connecticut's ground-water program direction for the future is towards prevention through control of land uses by state ground-water standards and classifications and by development of comprehensive local aquifer protection programs. Our development efforts today are aimed at providing education, training, and assistance to towns in establishing needed land use controls and establishing locally enforceable performance standards for small commercial and industrial establishments (gas stations, laundromats, dry cleaners, etc., and home industries such as photo developing, printing, etc.).

We now feel we have the tools to carry out an effective, comprehensive ground-water management program at the state, and soon, the local level. While enforcement tools are capable of solving today's problems, the lack of national drinking water standards for pesticides and other toxic, hazardous and carcinogenic substances hinders and in some cases halts problem resolution and stifles anticipation and prevention of future problems. National standards for maximum contaminant levels and understandable risk factors must be promulgated as soon as possible to define safe drinking water and to allay public confusion and fear.

Dr. Rodney S. DeHan

Administrator
Ground-Water Section
Florida Department of Environmental Regulation

Florida is not known as a highly industrialized state; yet it has its share of potential point and nonpoint sources of pollution. Examples of these are:

- Some 6,000 largely unlined surface impoundments containing wastewater that percolates into the ground water;
- Some 7,000 drainage wells directly discharging water or wastewater of lower quality than the receiving aquifers;
- Some 40,000 underground storage tanks that are either leaking or will potentially leak contaminants into the ground water within the next two decades;
- Large agricultural lands that receive fertilizers and pesticides, some of which find their way into the ground water;
- Large stretches of coastal aquifers that have been intruded with salt water;
- Hundreds of potentially uncontrolled hazardous waste sites and;
- Hundreds of thousands of septic tanks, some of which are constructed in the water table aquifers or are periodically subject to submergence due to water table fluctuation.

The current large scale contamination of ground water by the pesticide ethylene dibromide (EDB) is but one manifestation of the potential problems facing the resource.

The Florida Department of Environmental Regulation (DER) has developed Ground Water Rules which classify ground water into four classes according to water quality as measured by Total Dissolved Solids (TDS). These are:

Class G-I: "Single Source Aquifers" for potable water use and having a TDS of 3000 mg/l (milligrams per liter) or less. Aquifers in this category receive the highest protection.

Class G-II: Potable water use having a TDS of 10,000 mg l or less. This class constitutes the majority of Florida's aquifers.

Class G-III: Nonpotable water use having a TDS of over 10,000 mg l in *unconfined* aquifers.

Class G-IV: Nonpotable water use having a TDS of over 10,000 mg l in *confined* aquifers. G-IV aquifers receive the lowest degree of protection.

The rules define the water quality standards used in determining ground-water pollution, monitoring, and cleanup of polluted aquifers. The standards include the Primary and Secondary Drinking Water Standards, as well as the narrative "Minimum Criteria" standard. The latter includes any chemical agent that is judged toxic, carcinogenic, teratogenic or mutagenic.

Until numerical values are developed for these standards, the DER will attempt to prohibit the presence of such chemicals in the ground water. In April 1984 Maximum Contaminant Levels (MCL) for eight such chemicals were added to Florida's drinking and ground-water standards. Compliance with the new MCLs will be in effect by June 1985 for community water systems which serve 1,000 or more people, and by January 1987 for those serving fewer than 1,000 people.

The DER has been delegated Primary Enforcement Responsibility "Primacy" for the Underground Injection Control (UIC) Program. The Department has developed a UIC rule that is more stringent in certain aspects than the federal guidelines.

In 1983 the Florida legislature enacted the Water Quality Assurance Act, considered the most important environmental legislation in decades. Ground-water protection was addressed in the act through fifteen steps, including data collection, a monitoring network, protection of public water supplies and establishment of a Pesticide Review Council. Other steps were a hazardous waste management program, promotion of public awareness and inspection of package sewage treatment plants, thought to be a potential ground-water pollution source. Also, state funds were provided to replace, match or augment federal funds designated for building sewage treatment facilities, cleanup of contaminated sites, emergency cleanup of spills, and other cases.

The above programs and activities are directed entirely towards the protection of ground-water quality. Water quantity issues such as availability and consumptive use permits are the responsibility of five agencies known as the Water Management Districts (WMDs). Considerable effort is underway to achieve maximum interaction between DER and the WMDs so that ground-water quality issues are better coordinated.

As our population continues to grow so will our dependence on the ground-water supply. One major issue facing Florida in the 1980s is accommodating the expected population growth without destroying the environment that instigated such growth in the first place. Ground water is a critical factor in this highly complicated equation.

John W. Gaston, Jr.

Director
Division of Water Resources
New Jersey Department of Environmental Protection

Ground-water contamination in the State of New Jersey has of necessity received rigorous regulatory attention. The reasons are many. Approximately 50 percent of New Jersey's population and 80 percent of its area is dependent upon ground water. Population density is high and the state's geology is complex and highly variable, ranging from fractured shale and crystallines to cavernous limestone and coastal plain sediments. Compounding these conditions is an economy heavily dependent upon chemical and refining industries. The Department of Environmental Protection has estimated that between 10,000 and 15,000 firms in New Jersey are engaged in the production of chemical and petrochemical products. New Jersey also generates about eight percent of the nation's hazardous waste, the highest of any state. As an inevitable consequence, aquifer contamination has occurred in many locations through poor industrial housekeeping, spills and accidents of all types, deliberate dumping, illegal discharges, leaks from subsurface storage landfills, and so on.

Avenues for the release of contaminants are all too numerous. Contamination has had, moreover, decades of opportunity to reach the state's unconsolidated and bedrock aquifers. Contrary to public belief, most of the pollution sources are at facilities which had some type of permit to operate. However, these earlier permits did not consider ground water an integral regulatory factor.

Ironically, state and federal laws passed in the 1970s inadvertently increased the quantity of pollutants discharged to the state's aquifers as federal laws concentrated on "fishable and swimmable" goals for surface waters. To quote a predecessor of mine, "Waste will migrate to the area of least regulation." This certainly proved to be true in New Jersey as many surface discharges were replaced by percolation and evaporation lagoons, spray irrigation, and landfills which accepted chemical wastes. The growth of New Jersey's ground-water pollution control program has paralleled a rising public awareness of ground water and its possible contamination by toxic substances.

The first organized effort to investigate ground-water pollution in New Jersey began in 1974 with four geologists. Currently, there are 12 hydrogeologists and geophysicists dedicated to ground-water contamination investigations.

Today as we discuss ground-water problems and the potential for future problem sites, I think it is critical to understand that the State of New Jersey has the most sophisticated and comprehensive ground-water permit program in the United States. Unlike federal law, New Jersey law requires that *any* discharge of waste into the ground, including non-hazardous waste, must have a permit and comply with water quality standards. This requirement protects the future use of the resource and controls discharge.

This is illustrative of the type of commitment New Jersey has made to implementing an aggressive ground-water protection program. In this respect, New Jersey is years ahead of most other states.

Maxine S. Goad

Program Manager
Ground Water Section
New Mexico Environmental Improvement Division

Maxine S. Goad

In New Mexico, much of which is arid, water has historically been recognized as a resource which is limited, critical, and basic. Ground water is particularly important in this state because: 95 percent of the water supplied by public systems is from ground-water sources; three-fourths of the state's population is supplied drinking water by these systems; one-half of the total water annually withdrawn for all uses in New Mexico is ground water; and the only source of water in many areas of the state is ground water.

Potential sources of ground-water contamination in the state include mining and milling, oil and gas production, refinement and distribution, public and private domestic sewage disposal, dairies, power plants, and other industrial discharges.

In the 1970s, concern in New Mexico about ground-water quality led to the development of a comprehensive statewide regulatory program to protect that quality. The program has two basic aspects: (1) setting ground water standards (as of 1984, 35 numerical standards plus a generic "toxic pollutant" provision have been adopted); and (2) requiring by regulation that a discharger demonstrate he will not cause those standards to be violated at any place of present or foreseeable future use.

This combination results in a detailed enforceable permit. The stated purpose is to protect all ground water which has an existing concentration of 10,000 mg l (milligrams per liter) or less total dissolved solids. The regulations apply to all discharges of effluent or leachate onto or below the surface of the ground, including well injection, seepage from surface impoundments or leach fields, land application of wastes, and any other discharges which may impact ground water, except those specifically exempted. Oil and gas production activities, for example, were exempted from these regulations because they were covered by other state regulations already in effect.

Development of the standards and regulations began in 1974; they were adopted by the New Mexico Water Quality Control Commission in 1977 after extensive public hearings and have been upheld by the New Mexico Supreme Court. Based on seven years experience in administering them, the following general observations can be made:

(1) These regulations have proven extremely effective in preventing ground-water pollution from new and newly modified discharges; improving pollution controls at facilities already operating before the 1977 implementation of the regulations is more difficult and progress has been slow though steady.

(2) Numerical standards define clearly for all parties what is allowed, but cannot be adopted for all possible pollutants; therefore a generic provision for toxic pollutants is also necessary.

(3) Having standards that apply in ground water, rather than detailed design and operation requirements, allows consideration of site-specific conditions, an important advantage in New Mexico where hydrologic and geologic conditions vary greatly.

(4) A substantial commitment of expert staff is required for site-specific evaluations.

New Mexico's regulatory program for the protection of ground-water quality is well established, workable and effective. However, new industries and other new facilities continue to enter the state and new knowledge is being acquired about existing conditions, resulting in newly identified problems. It is necessary that development of the regulatory program be a continuing process to cope with these newly identified problems, to incorporate new knowledge, and to keep the program at a high level of effectiveness.

Louis W. Bercheni

Director
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Louis W Bercheni

The Pennsylvania Department of Environmental Resources has been aggressively involved in ground-water quality protection since the early 1960s. Our programs rely heavily on the development and implementation of regulations and permits to prevent and abate pollution from all major sources where disposal, treatment, and storage of waste materials occur. We are also committed to the inclusion of ground-water quality considerations in environmental planning. Our ground-water quality staff initially consisted of a single unit composed of five hydrogeologists. This has subsequently grown to more than 50 hydrogeologists, distributed over three bureaus in the Department.

Much of our recent program growth has been stimulated by federal expansion into the areas of solid waste, hazardous waste and mining regulation as well as state program development. Rapid changes in internal Departmental structure and adjustments to these regulatory demands have resulted in extensive diversification in our program requirements and approaches to problem solving.

Though all of our programs protect ground-water quality for water supply use, no legally specified ground-water quality standards exist. Only a small portion of our potential pollution sites are monitored. Differences in monitoring design, sampling frequencies, chemical parameters analyzed, ground-water isolation characteristics, and data management make it difficult to conduct comparative evaluations, hinder program uniformity, and result in inconsistent levels of protection. In addition, although ground water in the Commonwealth is generally of excellent quality, no effective mechanism exists to give a true measure of existing regional water quality, and subsequently, to evaluate the overall success of our program efforts.

We are currently developing recommended program modifications to solve these problems. Our first step would be to define ground-water uses that are to be protected. The statewide uses "water supply" and "surface water maintenance" would be protected at the EPA drinking water standards and surface water quality standards, respectively, for all ground water having a total dissolved solids (TDS) concentration of 10,000 mg/l (milligrams per liter) or less. Specific siting criteria would define special waters requiring nondegradation.

The only ground waters with a natural TDS concentration of more than 10,000 mg/l are deep, water-bearing formations containing brines. These are unsuitable for use and would remain unprotected. Design and monitoring standards included in injection permits would insure containment and protect overlying ground water. The formal delineation of mixing and buffer zones would be required for all major land treatment/disposal systems.

Microcomputers and ground-water models are being used to check the credibility and identify technical inconsistencies in permit proposals. A Departmental task force has been established to review and implement recommendations designed to improve program uniformity.

Data management and a viable assessment mechanism are critical to the success of our ground-water quality management efforts. To improve this program area, 478 ground-water basins of approximately 100 square miles each were delineated and prioritized by evaluating quality, uses, pollution sources, and pollution dispersion potential. Basin boundaries were computerized by EPA's Environmental Photographic Interpretation Center and placed in EPA's system for storage of water quality data (STORET).

A fixed station network consisting of 25 stations in each higher priority basin is being proposed to supplement ongoing data gathering efforts and chronological controls for data evaluation. Surveys will be relied on to supply additional information in areas where major data gaps or significant pollution exist. Data generated is to be used for quality trend analyses, program evaluations, permitting, facility site evaluations, and to fulfill systematic reporting requirements such as Section 305(b) obligations under the federal Clean Water Act. All monitoring data are being placed on STORET. Unique data will be stored on microcomputer discs until such time as evaluations are required, whereupon they will be placed on STORET with other ground-water sources being systematically monitored.

In anticipating the public presentation of our recommended program modifications within the next few months, the Department held a seminar for policy level decision makers in Pennsylvania. It was conducted by Geraghty and Miller, Inc., a ground-water consulting firm, for representatives of all Departmental environmental advisory groups and upper management level staff on the fundamentals of ground water. The intent of the seminar was to develop a basic understanding and knowledge about the complex nature of ground water. This should enhance the public's participation and input on recommended program modifications which are critical to our future success. □

Sources of Ground-Water Pollution

by David W. Miller

(David Miller is a geologist and a partner in Geraghty & Miller, Inc., a ground-water consulting firm in Syosset, New York.)

To the general public, the subject of ground-water contamination conjures up pictures of people dressed in space suits examining abandoned drums of hazardous wastes. Although there are hundreds of such sites across the nation that obviously represent a health threat to community water supply wells, hazardous waste sites are only a very small piece of a very complex picture when it comes to describing potential sources of ground-water quality degradation. In fact, less than one third of all sources of ground-water contamination may be caused by regulated waste discharges such as landfills and injection wells. Although existing federal and state regulations focus on waste discharges and hazardous waste facilities, a majority of water supply contamination incidents appear to be caused by nonpoint sources such as accidental chemical spills, disposal of toxic consumer products, leaks from underground storage tanks, and run-off from urban and agricultural land.

The sources of ground-water contamination are essentially the same as those for any other form of water contamination. They include practically every type of facility or structure installed by man and are present in millions of places across the face of the land. Some sources or causes of ground-water contamination involve discharges of contaminants that are wastes or wastewaters. Others involve discharges of contaminants that are not wastes at all but are represented by stockpiles of raw materials or the application of fertilizers and pesticides. Still others are not even discharges but can be due to the infiltration into the ground of polluted river water or the intrusion of salt water into a well because of heavy ground-water pumpage in a coastal area.

Some Major Sources of Ground-Water Contamination

Surface impoundments: Industrial wastewater impoundments are a source of serious ground- water contamination because of their large number and their potential for leaking hazardous substances that are relatively mobile in the ground-water environment. In some heavily industrialized sections, for example, the areal extent and the toxic nature of the contaminants have ruled out the use of ground water from shallow aquifers. The contaminants cover the full range of inorganic chemicals and organic chemicals normally contained in industrial wastewaters. Those documented as having degraded ground-water quality include solvents, phenols, acids, heavy metals, and cyanide.

Surface impoundments are used by industry to store wastewater as part of the treatment process, and they are often unlined. Pits, ponds, and lagoons are also used in municipal waste treatment processes and for storing agricultural and mining wastes. They can range in size from a swimming pool to hundreds of acres. They number in the hundreds of thousands across the United States.

Application of pesticides, one of many potential sources of ground-water contamination.

Landfills: Land disposal sites for solid waste can be sources of ground-water contamination because of the generation of leachate caused by water percolating through the refuse and waste materials. Precipitation falling on a site either runs off, returns to the atmosphere via evaporation and transpiration, or infiltrates the landfill. Contamination problems are more likely to occur in humid areas, where the available moisture exceeds the ability of the waste pile to absorb water.

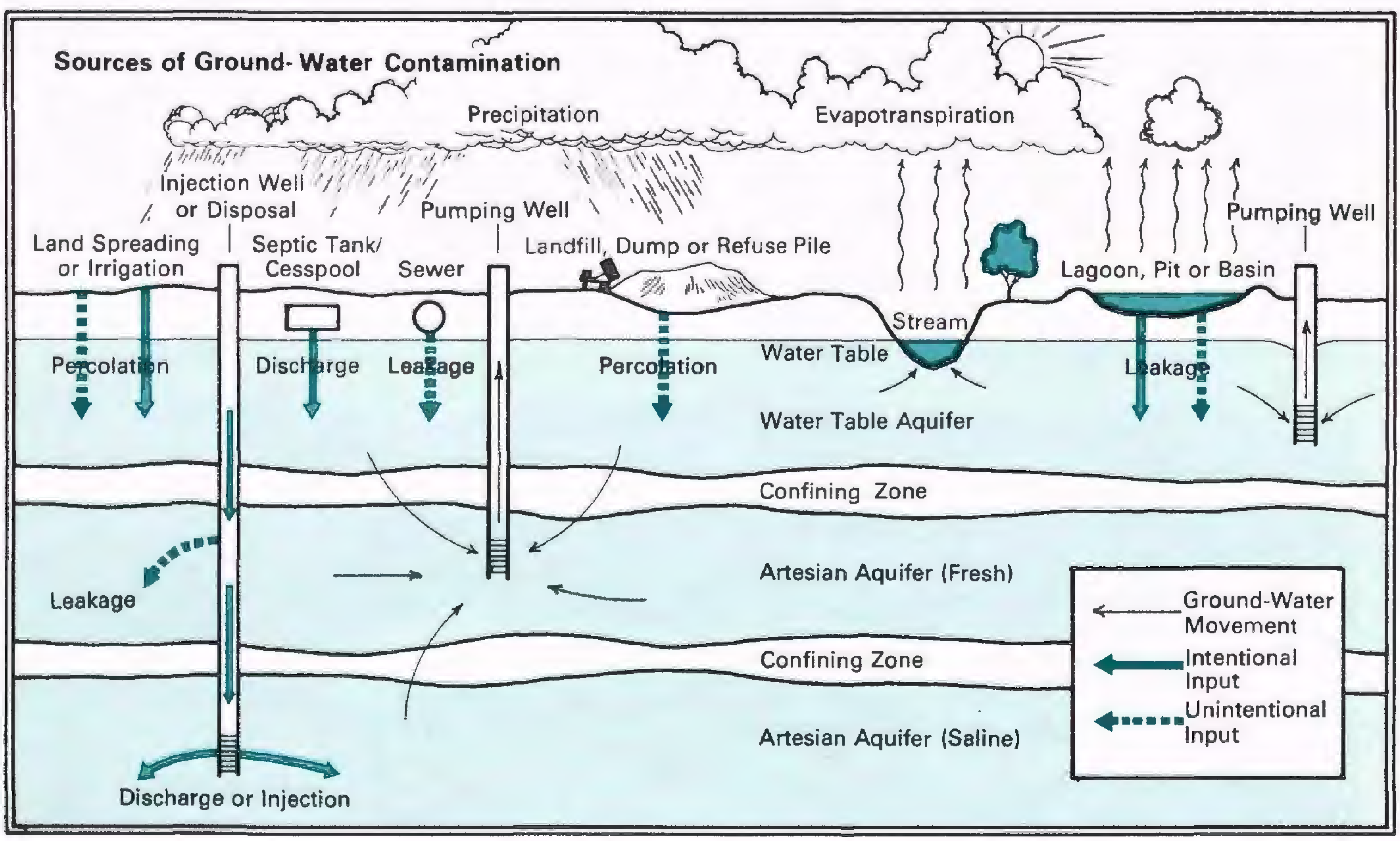
Leachate from such sites is a highly mineralized fluid with such constituents as chloride, iron, lead, copper, sodium, nitrate, and a variety of organic chemicals. Where manufacturing wastes are included, hazardous constituents are often present in the leachate (e.g. cyanide, cadmium, chromium, and chlorinated hydrocarbons). The particular makeup of the leachate is dependent upon the industry using the landfill or dump.

There are about 20,000 land disposal sites that accept municipal wastes. Most are open dumps or poorly sited and operated landfills, and most receive some industrial wastes. There is no national inventory available on privately owned industrial land disposal sites. However, it is estimated that 90 percent of industrial wastes that are considered hazardous end up in landfills mainly because it is the cheapest of all waste-management options.

Septic tanks and cesspools: Septic tanks and cesspools rank highest in total volume of wastewater discharged directly to ground water and are the most frequently reported sources of ground-water contamination. Most of the reported problems are related to individual homesites or subdivisions where recycling of septic fluids through aquifers has affected private wells used for drinking water. Except in situations where the recycling is so quick that pathogenic organisms can survive, the overall health hazard from on-site domestic waste disposal is only moderate, with relatively high concentrations of nitrate representing the principal concern.

Twenty-nine percent of the population, residing in about 19.5 million single-housing units, disposes of domestic waste through individual on-site systems. Regional ground- water quality problems have been recognized only in those areas of the greatest density of such systems, primarily in the northeast states and in southern California. Across the U.S., there are four counties (Nassau and Suffolk, N.Y.; Dade, Fla.; and Los Angeles, Calif.), each with more than 100,000 housing units served by septic tanks and cesspools, and there are 23 other counties with more than 50,000 such units. Data on discharge to industrial septic tanks are not available.

Collection, treatment, and disposal of municipal wastewater: Municipal wastewater follows one of three direct routes to reach ground water: (1) leakage from collecting sewers, (2) leakage from a treatment plant during processing, and (3) land disposal of the treatment plant effluent. In addition, there are two indirect routes: (1) effluent disposal to surface water bodies that recharge aquifers, and (2) land disposal of sludge that is subject to leaching. Although the volume of wastewater entering the ground-water system from these various sources may be substantial, there have been few documented cases of hazardous levels of constituents of sewage affecting well-water supplies,



largely because the subject has not been studied in detail.

Mine spoil piles and tailings: All forms of mining can produce products or conditions that contribute to ground-water contamination. Although every mine is a potential contamination hazard, few studies of the effects of mining on ground-water quality have been carried out.

With both surface and underground mining, refuse piles and slurry lagoons are probably the major potential sources of ground-water contamination. Where aquifers underlie these sources, water with a high acidity (except in arid regions) and an elevated level of total dissolved solids can percolate to ground water.

Waste disposal wells: Industrial waste, sewage effluent, spent cooling water, storm water and oil field brines are discharged through wells into fresh- and saline-water aquifers in many parts of the U.S. In the literature the greatest attention has been given to deep disposal of industrial and municipal wastes through wells normally drilled 300 metres or more into saline aquifers. About 300 such wells have been constructed in 25 states, 20 of which are presently operating. They pose a comparatively small contamination threat compared with the many shallow wells injecting contaminants into freshwater aquifers or the tens of thousands of wells reinjecting oil field brines into deep geologic units.

Accidental spills: Percolation of liquids spilled at the land surface can be another serious threat if the ground is permeable and allows downward percolation. For example, many petroleum spills penetrate into the ground, travel downward, and come to rest on top of the water table. Underground storage of chemicals, chemical wastes, or petroleum products in steel or concrete tanks presents a potential hazard because metal corrosion or concrete deterioration may ultimately permit seepage of contaminants into an aquifer.

The leaching of soluble solids stored on the land surface is another practice that can be responsible for the contamination of ground water. These situations occur, for example, where rainwater dissolves soluble materials from piles of highway de-icing salt or where industrial raw materials have been allowed to spill at railroad or truck loading areas.

Types of Contaminants

Most things that contaminate ground water may be placed in one of three broad groups: biological organisms, inorganic chemicals, and organic chemicals.

Biological organisms: Biological contamination of ground water occurs when human or animal wastes enter an aquifer. Microorganisms present in the wastes may be carried by ground water into nearby wells used for drinking water. The first time an illness was traced to a well contaminated with sewage was during a cholera epidemic in London in 1854.

The travel of bacterial pollutants through the ground has been studied by collecting samples from test wells. Indications are that the bacteria seldom travel more than 100 feet from a source. Exceptions are where the aquifer is fractured or cavernous, allowing bacteria to travel rapidly for great distances. Studies also have shown that bacteria are largely removed by filtration. Although most microorganisms die out rapidly in ground water, bacterial pollution may occur locally:

- In heavily populated suburban areas where numerous septic tanks discharge large quantities of waste into an aquifer.
- Near leaking wastewater lines.
- From leaks in storm sewers, storm sewer overflows, or flows directly from city streets into the ground.
- Near improperly operating sewage treatment lagoons and ponds.
- From poorly designed land-spreading and wastewater recharge operations.

Inorganic chemicals: Inorganic chemicals are substances of mineral origin. Inorganic chemical contamination differs from biological contamination in a couple of important ways: the persistence of the pollutants, and the difficulty of their removal from water.

EPA has set standards for the maximum permissible concentrations of certain substances in drinking water. For example, the standards require that concentrations greater than 0.05 milligrams per liter of toxic elements such as arsenic and chromium will jeopardize a ground-water source for drinking purposes. Levels of cadmium greater than only 0.01 milligrams per liter will also threaten supply wells. Excessive concentrations of arsenic, cadmium, and chromium in ground water are often found where electroplating wastes have been discharged into the ground. Lead can get into the ground water where gasoline has entered the aquifer through leaking pipelines and service station tanks.

Organic chemicals: Organic chemicals are substances containing predominantly carbon, hydrogen, and oxygen. There are many different kinds of organic chemical contaminants associated with industrial wastes. They represent a complex group of byproducts and compounds produced with major industrial products. Organic chemical contamination is most often caused by:

- Solvents used for degreasing septic tanks.
- Spills and leaks.
- Industrial, municipal, and other wastes disposed on land.

The Future

Today considerable effort is being expended toward investigating and cleaning up some of our past mistakes, especially those involving hazardous wastes, that have led to the contamination of ground-water supplies. These activities, however, must be matched in the future by the equally important effort of preventing ground-water pollution in the first place. Because of the diverse nature of sources of contamination and their widespread occurrence, much of the responsibility for protecting ground-water resources must be left to state and local agencies. This is especially true because programs to protect ground-water quality will not be successful unless they reflect the close relationship of the land, ground water and surface water. Long-term ground-water quality depends on what we do with the land.

We are still learning more and more each year about the impact that various sources of contamination can have on ground water. In fact, as we have become more knowledgeable, our emphasis on which source to concentrate our regulatory efforts has changed drastically over the decades. Thus, there is a critical need to give ground-water resource protection the high national priority that it deserves and to encourage federal, state and local agencies to develop the required strategies and programs to carry out this priority.

Contamination of Drinking Water

by John M. Gaston

Prior to 1979 the common theme, at least in California, was to abandon marginal drinking water sources obtained from surface streams (creeks, springs, lakes, etc.) and develop new ground-water sources (wells). The public health philosophy as preached by the state and local agencies stressed the hazards that might contaminate surface sources—waste discharges, livestock, illegal dumping, etc.—and praised the pure, pristine ground water.

To be sure, there are many benefits to be seen by developing a ground-water source for drinking water. These benefits include, especially for the small community or individual, a lesser degree of maintenance, fewer treatment chemicals, a relatively trouble-free operation and, as it was thought at that time, the ultimate protection afforded by the depth of the well.

In contrast to this, public health officials felt that many surface sources were disasters waiting for a time to explode. The threat of mine drainage, livestock waste contamination, illegal spills and countless other hazards awaited the hapless water system operator with the misfortune of having to deal with a surface water source. Those hazards in surface sources still exist and the benefits of most ground-water systems still exist, but the water supply "community" or "industry" has learned quite a lesson since the late 1970s.

- The myth of the protected, pristine ground-water source has been shattered.
- Public confidence in the water utility industry and the public health community has been shaken.
- The professional water supply community — engineers, scientists, etc. — has been taken aback by recent ground-water problems and, to state the case politely, is "re-grouping".
- The laboratories and techniques employed in water analysis are much more sophisticated than in the recent past and are able to detect compounds at very low (part per trillion) levels.

How did we get in this fix and what have we learned in the process?

The discovery of contaminated drinking water wells in California in the late 1970s was not unusual. It was unusual, however, if the contaminant was anything other than nitrate or bacteria. Common knowledge held that improperly constructed wells could allow surface water containing either land drainage or other waste into the well and thereby contaminate the source.

The nitrate contamination problem seemed to be prevalent in agricultural areas and therefore was thought to be directly related to fertilizer or animal wastes. Indeed a direct cause and effect was established in a number of wells located in feed lot and poultry areas. Bacteriological problems also occurred in these areas and seemed to be directly related to poorly constructed wells.

Other ground-water problems — arsenic, fluoride, selenium, iron, manganese — were thought to be naturally occurring, rather than related to "outside" contamination. These problems were relatively scarce and could either be treated (iron and manganese) or new sources could be developed to eliminate the problem.

Most community water system operators frequently test the water for a variety of compounds and constituents—bacteria, inorganic and organic chemicals. The testing procedures and compounds are established by state and federal law and specific Maximum Contaminant Levels (MCLs) are set for each constituent. No wells, at least in California, had shown any sign of contamination by the "regulated" organic chemicals contained in either the state or federal listing.

Honest Disbelief

As a result of this long history of negative results from ground-water samples there was some honest disbelief when "unheard-of" organic compounds were discovered in the late 1970s. The reaction by the regulatory agencies was confused. Many of the contaminated wells were on or near industrial sites, and the obvious connection between the site and the contamination was made. This happened in specific cases involving two industrial sites in California. Initially the fear was that the "protected" ground-water theory was wrong. This quickly changed to the position that these were "special" cases involving massive contamination and that ground water as a sacred resource was still safe.

Advances in analytical techniques in the laboratory about this time caused some consternation. When a group of "clean" ground-water samples was being analyzed for one of the "special" case constituents, a low but consistent level of the contaminant was detected in all of the samples. This caused the regulatory people—laboratory and engineers—to develop and advance the "laboratory error" theory that was then to be used to explain the unbelievable. It was as though one day the sun came up in the east, proceeded to the *north*, and then set in the west. We were all confused until we discovered that we had moved to South America.

Eventually a series of events led the regulatory agencies to conclude that organic contamination of ground water was a fact. These events included:

- The installation and operation of new, sophisticated analytical laboratory instruments provided by EPA grant funds;
- The realization that there could only be a limited number of "laboratory errors";
- The independent confirmation of contamination by different laboratories;
- The development and verification of the theory that various organic chemicals

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could move downward through the soil and into the ground water.

To quote an old bromide, the rest is history. As more samples were taken, more contamination was found. Similar reports from other states confirmed the phenomenon, and the "pre-1979 syndrome" of pure, pristine ground water was dead. The regulatory agencies began to move ahead in several areas but, to the dismay of the consumer and public interest groups, more discoveries and questions were being raised without any hope for answers or solutions.

It was (and is) a classic regulatory dilemma. If one problem is found, should all resources be bent to finding a solution to that problem, or should other problems be investigated at the same time? If resources don't exist (and they don't) at the state or federal level to fix all these problems now, should we provide token support for each problem or should we concentrate only on the biggest problems and let the others slide until we have the resources?

Patterns Emerge

Following a period of chaos, patterns have emerged to assist the regulatory agencies and the public:

- It appears that many ground-water contamination sites can be located by looking at land use patterns, industrial grouping and other related factors. This will save valuable laboratory resources and allow the states to limit their sampling to areas where problems are more likely to be found.

- If contamination is found the levels are likely to be fairly low—part per billion range—and the lifetime risk from ingestion low. Rarely have situations involving acute hazards been found. This is not to imply that organic contamination is good or even acceptable, but it does buy some time for the various agencies to fix the problem.

- Intermediate solutions have been developed to either treat contaminated sources or to provide alternate drinking water sources to the impacted population.

- Advice from toxicologists indicates that a widespread epidemic is not forthcoming or even probable. No incidents of acute poisoning were demonstrated and most of these compounds have very long-term, if any, effects.

- New laws at the state and federal level have been promulgated to assist in the discovery and cleanup of many of the problem sites.

As more sites are found, and everyone hopes that the frequency decreases soon, several questions still exist in the mind of the public and all other parties. For example, if these problems were first found in the late 1970s, how long before that date did the contamination occur? If ground water is contaminated and a "responsible party" cannot be found, who pays for the cleanup and treatment?

The water supply industry has traditionally been very low key and has generally kept in the background. Now the industry has been pushed into the front row. Both the public and the industry may feel deceived at some point because everything was going smoothly and steadily until the organics and ground-water problem came along. Several predictions might be made in light of what we've seen in the recent past:

- More contamination *will* be found and those states that are not ready with laboratory facilities and contingency plans may suffer.

- Water rates will increase to cover the costs of monitoring and treatment of all supplies.

- Analytical techniques will continue to improve and some areas once thought to be "clean" will turn out to be contaminated.

- Water utilities will look more closely at their existing physical facilities and may choose to improve surface sources rather than develop new ground-water capacity.

In light of all this the public must be terribly confused. It is faced with a continuing barrage of bad news about water supply. The water utility industry must enlist the support of the public and regain its confidence. The public, on the other hand, must take the time to become informed and be willing to play a role in the decision making process. If the average citizen only knows what he reads in the newspaper, the story may not be complete and the decision making may be very one-sided. □

Potential Health Effects from Ground-Water Pollution

by Dr. Robert A. Goyer

There is a growing awareness of the potential toxicologic effects of synthetic organic chemicals that have contaminated ground-water sources of drinking water. This awareness is the result to some extent of monitoring chemicals in fresh water supplies, as well as the realization of the potential for contamination from human activity. Particular culprits are the thousands of improperly located toxic chemical waste dumps now found throughout the country.

The problem has received the attention of a number of government and state health agencies; the best known reports are from the Council on Environmental Quality, New York State Department of Health, and a four-volume National Academy of Sciences report on drinking water and health. The problem is further highlighted in a recent editorial in *Science* magazine.

The topic has immense public health significance since it is estimated that roughly 50 percent of Americans receive their drinking water from wells fed by ground water. More than 700 specific synthetic organic chemicals have been identified in various drinking water supplies. Nationally, 20 percent of public water systems contain trace but measurable amounts of volatile organic contaminants; 28 percent of public water systems serving communities with populations over 10,000 contain volatile organic contaminants.

Among these chemicals are pesticides, organic solvents, and a long list of halogenated compounds. Many are known carcinogens; many have other known toxicologic effects. But the concentration of any one chemical is likely to be very low. The public health question, therefore, concerns what possibilities there are, if any, that a particular chemical contaminant or, in fact, the mixture of chemicals in drinking water is likely to cause disease among people in the general population.

The response to this question is enormously complex and not completely answerable at the present time. There are now a number of studies designed to investigate associations between the drinking of chlorinated surface waters and cancer. These studies do suggest increased risks of gastrointestinal and urinary tract cancer, but comparable studies on populations consuming only well water are not available. However, there is only minor overlap between chemicals found in disinfectant-treated surface waters and in ground water.

Health problems stemming from surface drinking water are thought to be related to byproducts of chlorination, particularly the four trihalomethanes (chloroform, bromoform, bromodichloromethane, and dibromochloromethane). There are a number of possible approaches within the regulatory context for the control of these substances, such as substitution of other types of disinfectants, treatment to reduce precursor concentrations, or even removal after their formation.

Synthetic organic chemicals in ground water present a less predictable and less controllable problem in spite of nature's filtration and cleansing processes. For instance, trichloroethylene (TCE), probably the most commonly occurring organic chemical contaminant in well water, has been found in 13 percent of community water supply wells in Nassau County, N.Y., with maximum concentration of 300 ppb (parts per billion).In 1979, the Pennsylvania Department of Environmental Resources found widespread contamination of drinking water supplies in Montgomery and Bucks counties, with a maximum concentration of 1,400 ppb. Human exposure was confirmed by detection of metabolites of TCE in urine.

The most direct way of establishing a link between such exposure and effect on health is by epidemiologic study, particularly case control studies which relate exposures in persons with and without disease. Although such studies are useful in appropriate circumstances, they are retrospective and often depend on information from death certificates for diagnoses. Occupational, dietary, and smoking histories are often incomplete or unobtainable.

In an effort to assess the influence on health from TCE in Montgomery and Bucks counties, physicians from the Centers for Disease Control (CDC) reviewed the number of deaths attributable to liver cancer over the 19-year period, 1960-1978, and found no difference with the incidence of this tumor in the rest of Pennsylvania. Weaknesses of this approach are that the population studied may not be large enough to show small increases in tumors or the period of residency in the region of investigation and, hence, exposure to TCE may be too short to allow a sufficient latency period for the tumor to develop.

Another problem common to studies of persons in the general population is that it is often difficult to find control cases without exposures to the chemical(s) in question. In an effort to establish exposure to synthetic organic chemicals among residents of Love Canal, blood samples were analyzed for synthetic organic chemicals. A small group of young volunteers, intended to serve as unexposed controls, did indeed have measurable blood levels of many of the chemicals in question.

Furthermore, corrective action based on evidence of human disease is not ideal public health action. Rather, methods that are predictive and not dependent on detection of illness seem

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more desirable. Such approaches are dependent on adequate toxicologic data for the chemicals in question and appropriate methodology for extrapolation of the data to man. For many of the organic chemicals found in ground water, toxicologic evaluations have been performed, particularly in terms of characterization of carcinogenic potential, but quantitative estimates of human risk from such data require additional refinements. A review of current methodologies suggests that it is possible to make crude estimates of carcinogenic risk from animal data for drinking water that contains synthetic organic chemicals.

Toxicologic data for prediction of disease from synthetic chemicals for end points other than cancer are also available in terms of characterizing the effect, but useful quantitative data of this type are not common. Although there is some evidence that TCE may be a carcinogen, there is also evidence that TCE and other structurally similar halogenated hydrocarbons are nephrotoxins (toxic to the kidney). Experimental studies have shown that chronic exposure to these compounds may produce glomerular lesions sometimes leading to the nephrotoxic syndrome and renal failure.

Although cancer, as a toxicologic end point, receives the major focus of concern, chronic renal failure is also a major human disease entity. The incidence for end-stage renal disease may be as high as 15.6/100,000 people per year, and the Social Security Administration indicates that its cost for the end-stage renal disease program was $286 million in 1974 and is rising each year. Costs in 1984 are projected to be more than $3 billion.

There is also evidence that the nephrotoxicity of TCE is made more potent by simultaneous exposure to polychlorinated biphenyls and polybrominated biphenyls. This serves as a reminder that ground water contaminated with synthetic organic compounds is always a complex mixture of chemicals, each with its individual potential for carcinogenicity and other toxicities.

Consideration of risk is almost always calculated on the basis of toxicologic data on single chemicals. But what about synergistic or suppressive interactions that may occur with exposure to chemically-contaminated ground water? Without direct experimental study of each complex mixture in the proportions present in nature, it seems virtually impossible to be predictive with the present state of understanding.

Considerable thought has been given to this problem. A report of a National Research Council Committee outlined a number of basic principles underlying the behavior and toxicity of mixtures, such as chemical-chemical interactions, interactions with macromolecules, and alterations in cellular responsiveness or reactivity because of the actions on one or more members of a mixture. These principles, however, have not been assembled into any quantitative measure of the toxicity of specific complex mixtures.

In the absence of a more definitive approach, a World Health Organization criteria document on methods in toxicity testing describes an additive model but restricts the application of the model to mixtures of chemicals that act at the same site producing the same type of acute toxic effect and having similar dose-effect relationships. Even so, such a model, when tested experimentally, may determine an effective dose that is greater or lesser than the predicted dose.

And finally, factors of individual susceptibility further complicate the task of predicting the toxicologic effects of complex mixtures of even single chemicals in ground water. Such factors may subtly or dramatically alter the predictability of a biologic or toxicologic reaction. These include stress conditions of the host, nutrition and dietary factors, personal habits, and pre-existent disease states.

It has been shown that animals exposed to hepatotoxins, such as carbon tetrachloride, benefit from a diet that is high in carbohydrates and low in fat, whereas low caloric diets enhance the hepatoxicity of carbon tetrachloride. Protein-deficient diets reduce the activity of hepatic microsomal enzymes and the level of cytochrome P450, resulting in decreased ability to metabolize xenobiotics, and diseases of the kidney reduce the ability to excrete chemicals.

From these considerations, it becomes apparent that the science of predictive toxicology requires considerable additional research. The potential problems posed by synthetic organic chemicals in ground water add to the urgency for the further development of this science and suggest a number of specific research needs. [

EPA Researchers Seek Answers to Ground-Water Contamination

by Bob Burke

Many Superfund On-Scene Coordinators will be able to identify with the scenario that follows. EPA has directed the removal of tons of contaminated materials from a hazardous waste dump close to a residential area. In a public meeting, the On-Scene Coordinator reports that all immediate health threats have been removed, but notes the continued presence of ground-water pollution beneath the site area. Neighbors begin pressing demands that the ground water be restored to pristine conditions as promptly as possible. The On-Scene Coordinator realizes the obstacles involved in cleaning up ground water at this particular site, but it is difficult to articulate them clearly or to make on-the-spot commitments. Months of hard and often dangerous work seem almost obscured at that moment as a very wide gap emerges between public expectations and technical possibilities.

Superfund officials aren't the only ones who are often confounded by ground water-related issues. Ground-water protection is a highly complex and often frustrating issue that affects a host of federal and state environmental responsibilities. This story describes the major challenges of ground-water protection and some of the fascinating and innovative areas of research and field work that EPA is involved in to solve these problems.

Ground-water pollution poses challenges to research scientists and environmental managers that defy conventional measures for detecting, monitoring, and cleaning up surface water pollution. EPA research laboratories at Ada, Okla., and Las Vegas, Nev., are working on these problems, which fall into three broad but interrelated areas.

Ground-water pollution is elusive. Ground water is extremely vulnerable to pollution. Once a pollutant enters ground water, it follows the flow of the hydraulic gradient and forms an irregular, sometimes finger-shaped form of contaminated water called a plume. A plume usually occupies a relatively small part of an aquifer that can range from a few feet to more than 2,000 feet beneath the earth's surface. The plumes then travel to points of ground-water discharge which can be wells or surface waters.

Looking for a polluted plume or locating its pathway into and through an aquifer without knowing its point of origin is akin to the proverbial search for the needle in a haystack. It is often difficult and expensive to determine where a plume originated, what pollutants it contains, its precise location and configuration, and what private or public water supply it may ultimately pollute.

Ground-water pollution is latent. Ground water generally moves slowly at velocities that can average from a few feet per day to a few feet per year. The contamination of ground water by any source may go on for months or even years before it is finally detected when it reaches a public water supply or an ecologically vital body of surface water.

Ground-water pollution is difficult to clean up. Natural transformation or degradation of pollutants is often a slow process and may not occur at all because of the nature of the subsurface environment and the kinds of pollutants involved. Restoration of polluted ground water, even under the most favorable of conditions, is time consuming, extremely expensive, and technically challenging.

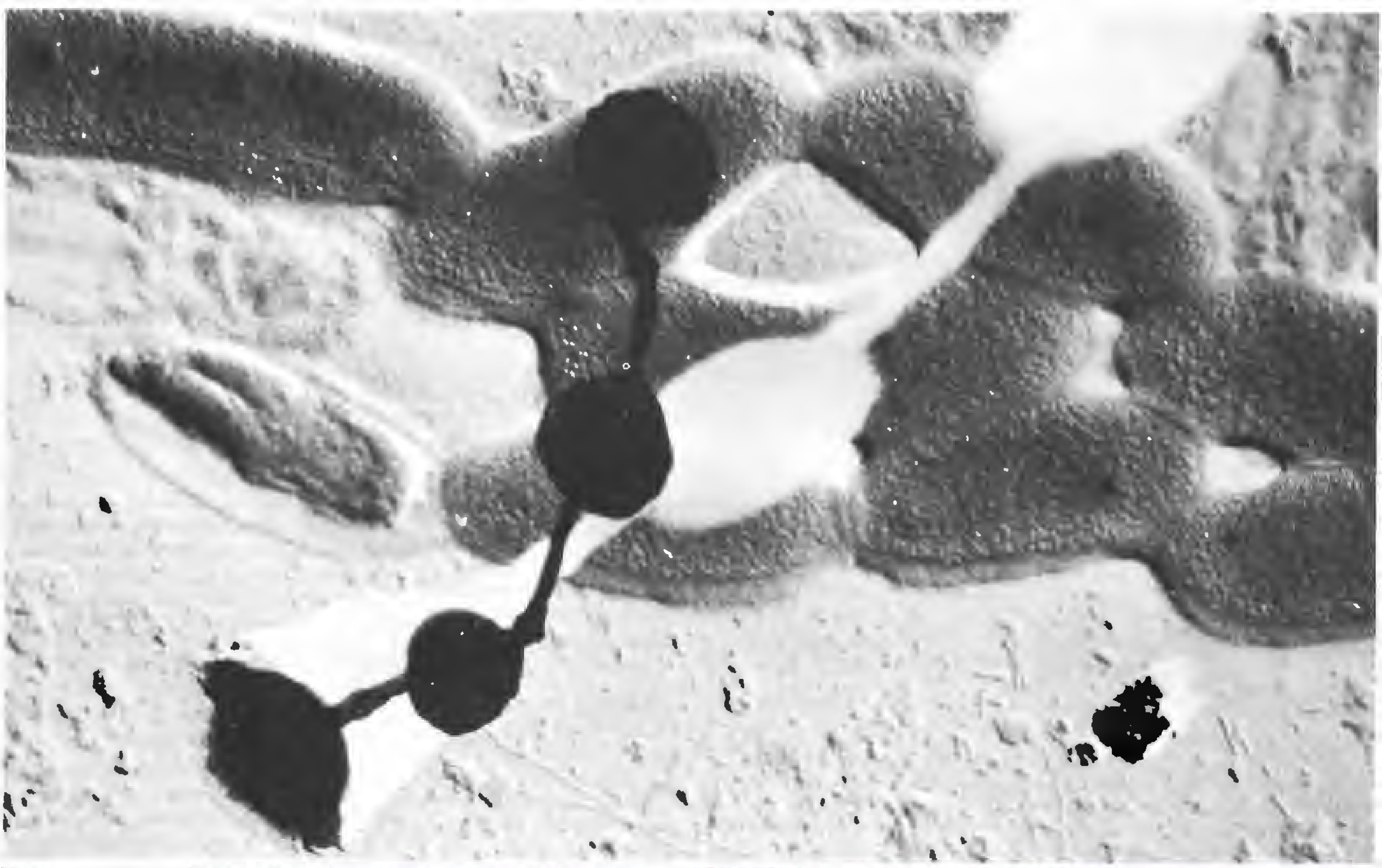
Ground-Water Prediction: The Waterloo Field Study

Two major problems with detecting and monitoring underground pollutants are accessibility to the ground-water environment and the heterogeneity of the subsurface. Subsurface conditions generally differ significantly over short distances. Monitoring wells are expensive and sample only a small segment of the aquifers but are practically the only way to access the ground water. It is extremely difficult to observe the inception of pollutants from various manmade sources and activities, and their penetration of the earth's surface on their way to a ground-water supply. This missing picture of the inception of ground-water pollution may hold an important key to predicting the various ways that pollutants will behave in ground water.

Now researchers are working to unravel as much of this puzzle as possible in a unique field investigation funded by EPA, and carried out by Stanford University and the University of Waterloo in Ontario, Canada.

In 1982, a research team from the two universities injected pollutants into a shallow, relatively homogeneous, uncontaminated portion of an aquifer in Ontario, parts of which had been polluted by an existing landfill. They used several synthetic organic compounds (major sources of ground-water contamination) at different concentrations, and monitored the ground water in order to determine the behavior of each contaminant.

As expected, the pollutants formed plumes which are being monitored by the team using a dense three-dimensional network of sampling wells. By September 1983, over 9,000 samples had been taken using specially designed devices to ensure sample



New extraction techniques have revealed many previously unknown microorganisms. The dense black spheres supported by a braided shaft in this photo are a new discovery. EPA researchers are trying to determine how well these "ground-water bugs" degrade pollutants.

integrity. Most samples were taken in ten 2-3 day sessions distributed over the year to obtain three-dimensional snapshots of how the pollutants were being distributed throughout the aquifer.

There have already been some important observations in the ongoing Ontario field investigation. The size, shape, location, and movement of polluted plumes vary depending on the kind, quantity, and concentration of pollutants they contain. Estimates of concentration, location of the center of the plume, and other pertinent information for each pollutant have also been observed. The study is leading to a better understanding of how specific pollutants may behave and move in the pathway from the earth's surface to the aquifer, and how these factors influence subsequent movement and behavior within the aquifer.

Various contaminants move through the subsurface at vastly different rates once they are in ground water. This may have special significance for eventually predicting how long various contaminants are likely to pose health hazards and if and how they disperse in ground water.

For example, at an observation point downgrade from the injection point, the study showed that chloride became highly concentrated very shortly after it entered into the ground water but was almost totally undetectable after 50 days in the aquifer. Dichlorobenzene, conversely, showed no concentration at all until it had been in ground water for a month, but then it showed low levels that remained relatively constant for at least several months. The concentration of several other pollutants also showed sharp differences. These discoveries are important, although further verification is needed under different conditions from those experienced in this study.

Biodegradation Research: Working with Ground-Water Microorganisms

There was a time, not so long ago, when most experts considered ground water devoid of life. Now, it appears that ground water is often teeming with microbes, some of which may be potential allies in cleaning up certain forms of ground-water contamination. In fact, the total biomass of bacteria in the subsurface may be greater than the biomass of bacteria in rivers and surface soils.

Research into these microbes is being carried out by EPA's Robert S. Kerr Environmental Research Laboratory in Ada, Oklahoma, described in a recent *Smithsonian* magazine as the "premier" facility for ground-water research in the United States. Using carefully controlled procedures, researchers from this laboratory have been learning more about "ground-water bugs" and their ability to degrade various pollutants.

The Ada laboratory's field team examined subsurface organisms in samples taken from a ground-water aquifer near Lula, Oklahoma. Their results clearly showed that certain subsurface organisms degrade some of the organic pollutants that may enter their environment. Positive results have been obtained for the chemical toluene, as well as for styrene and bromodichloromethane. But problems have been observed as well. There is preliminary evidence, for example, that trichloroethylene (TCE) occasionally undergoes biotransformation which results in an extremely undesirable product called vinyl chloride.

The precise environmental conditions required for these various transformations are, as yet, not

Work carried out at the EPA lab in Ada, Oklahoma is part of the agency's ground-water research program. Here a scientist determines biodegradation by passing water containing organic chemicals through columns of authentic, uncontaminated aquifer materials.

understood and research to characterize the microorganisms in ground water is still under way.

The possibility of employing microbes to degrade wastes and restore aquifers is fascinating even if the production of contaminants such as vinyl chloride demonstrates the possibility of some risks. Can certain microbes be introduced into contaminated ground water to degrade specific pollutants? Can genetic engineering eventually produce "superbugs" capable of degrading ground-water pollutants with which existing microbes seem unable to deal? At present, answers to such inquiries remain in the realm of hopeful speculation.

Other Research

EPA laboratories in Ada and Las Vegas are engaged in other areas of research aimed at meeting the complex challenges of ground-water protection. Some of these include:

- **Early warning monitoring systems** are being examined intensively by EPA's Las Vegas laboratory with a view to detecting the movement of pollutants before they reach ground water. These systems rely on tracking pollutant percolation in the zone above the water table known technically as the "unsaturated subsurface." This early warning monitoring program involves soil testing methods and the extraction of fluid samples with suction devices. It is being developed and tested for practical use in hazardous waste land treatment operations.

- The use of **fiber optics** for detecting and monitoring the movement of contaminated plumes in ground water. Fiber optic technology won't serve to make detection and monitoring programs significantly more accurate, but it will considerably reduce the costs associated with locating and charting the movement of small plumes in relatively large underground aquifers.

- **Geophysical methods** are aimed at reducing the number of expensive wells required for taking samples from contaminated ground water. The present system depends on drilling a large number of wells in a given aquifer. Improved site selection may be able to ascertain needed information from a smaller number of wells which can provide more representative samples. Geophysical methods are also being developed at the Las Vegas lab to map salt water contamination deep in the subsurface of oil fields where the salt water is a major pollution problem to fresh ground water.

- Under the **Underground Injection Control Program**, research is being carried out to develop methods for locating abandoned wells and assuring that injection wells maintain mechanical integrity so that ground water is isolated from sources of contamination.

- The development of various **simulation models** which allow the prediction of contaminant behavior according to the type of ground-water system under investigation.

Significant progress is being made in areas of ground-water research such as locating pollution plumes and monitoring the ensuing changes in ground-water quality. There are even some breakthroughs occurring in the very difficult area of rehabilitating polluted aquifers. These achievements are important first steps in a long and difficult journey toward the solution of the nation's ground-water problems. In other areas, however, we are still in our infancy in dealing with many of the problems involved. We must expand our knowledge of pollutant behavior in the subsurface environment so that we can better select sites for waste disposal and treatment. We must evaluate the extent of contamination at existing sites, carry out remedial actions in a cost-effective way, and deal with new chemicals in an environmentally acceptable manner.

Ground-water research may not be a good line of work for those who are impatient and those who always expect quick and tangible results from their technical and professional efforts. Instead, these efforts require perseverance, discipline, and the ability to accept the realization that months and years of extensive research may yield incomplete results. The complexity of ground-water issues makes EPA's regulatory and research mission both challenging and frustrating. □

The Future of the Ground-Water Resource

Philip Cohen
Chief Hydrologist
U.S. Geological Survey

The nation's ground-water resource, including both the liquid and the rocks that house it, is an important share of the national stock of water. Rising appreciation of its economic and environmental significance is attracting unprecedented protective and managerial attention. A remarkably efficient crystal ball would be required to forecast the enlarging role for ground water in our society, and associated impacts on its quantity and quality. Until such an instrument is perfected, estimates of future demands on ground water, and of the physical and chemical fate lying ahead for it, must rely on conventional predictive methods. Principal among these are:

- Accumulating knowledge of ground water, including its geological, hydrological, and chemical characteristics;
- Lessons learned from past water and waste management practices;
- Application of the hydrologist's growing ability to predict and to estimate quantitatively the responses of ground-water systems to imposed hydraulic, chemical, and structural stresses; and
- Employment of demographic, economic, and technologic projections to anticipate future demands on the resource.

Based generally on these approaches, this article is an effort to characterize factors that shape the future for the nation's ground water.

Enlarging role for ground water

It is reasonable to conclude that the pattern of increasing ground- water usage defined in past years, as illustrated graphically in the chart on page 29, will continue into the near future. Ground-water withdrawals in 1985 probably will amount to about 95 billion gallons a day, continuing to be about one-fifth of the total freshwater usage in the nation. To meet rising demand, well fields will be enlarged, new well fields constructed, and the number of individual wells increased to supply single homes and other small uses. Augmentation of inadequate surface-water supply systems may be one principal avenue of growth. Rapid expansion of metropolitan areas, particularly in the water-short Southwest, accounts for a sizable increase in public supply ground-water pumpage during the past half-century, and that growing demand is likely to continue as long as the Sunbelt attracts new residents.

The nation has also experienced country-wide and regional droughts with the ground-water resource being the focus of attention. Development of water supplies capable of weathering long periods of drought is an attractive goal that increases in appeal with each passing drought event. Although the ground-water resource is not immune to drought, its sheltered environment and the large volumes of ground water in storage lend the resource to supplementary water service during times when streamflow and surface storage are deficient.

The "drought resistant" characteristic of ground water is already utilized on an unplanned basis over much of the country. For example, the extensive drought of 1977 caused failure of surface water supplies in California's Central Valley. However, increased pumping from active irrigation wells, reactivation of idle wells, and drilling of thousands of new wells successfully maintained the flow of irrigation water and minimized the impact of the drought on food production. Institution of organized plans for supplementary irrigation pumpage during drought throughout the nation would result in a sizable increase in ground-water usage.

Irrigation, an established agricultural practice in the West, is now being adopted in humid areas of the country as well. It is the largest usage of ground water, amounting to slightly more than 60 billion gallons a day in 1980, when pumpage exceeded one billion gallons a day in eight western states and two eastern states.

In Nebraska, irrigation pumpage amounted to 6.7 billion gallons a day in 1980. The development of center-pivot equipment, whereby a moving sprinkler pipe rotates around a central supply well to irrigate a large circular area, has led to a manifold increase in irrigated acreage and enlarged dependence on ground water as a source of irrigation supply. With the aid of center-pivot irrigation and other newly developed equipment, irrigation usage of ground water in Georgia rose 1,000 percent between 1975 and 1980.

Large amounts of water will be required for new energy-producing industries, particularly for the generation of power. Wherever surface sources of water are insufficient or already fully committed, ground water is likely to be targeted for additional water supply. The Madison Aquifer, for example, an extensive and largely unutilized water source lying beneath the Great Plains states, is the subject of intensive investigation as a potential source of water for mining operations, coal-slurry pipelines, and power generation.

Finally, because of the decreasing availability of surface sites suitable for large water reservoirs and the environmental objections they often precipitate, ground water is becoming a substitute source of supply for many of the needs presently fulfilled by surface reservoirs.

Consequences of expanding usage

Continued increases in extracting ground water have unavoidable impacts. From a hydraulic point of view, pumpage from an aquifer or ground-water basin must result in lowering ground-water levels. Deepening water levels, though necessary to progressive development, impose both a loss of well yield and the expense and power consumption of increased pumping lift. The lower water levels may also reduce flows of hydraulically connected streams by decreasing natural discharge of ground water to them. With continued pumping and still further declines in water levels, water from streams may be induced to flow into ground-water systems. Inflowing stream water of inferior quality will degrade the quality of ground water.

Similarly, saline ground water bordering the edges of the continent may be induced to flow toward coastal well fields, threatening freshwater supplies. Upward movement of saline water underlying fresh ground water throughout most inland areas is likewise stimulated by pumpage of fresh ground water, and may rise to contaminate fresh supplies.

Extracted ground water may be returned to the ground-water system after use by artifical recharge and irrigation field seepage. Recycling of ground water in these ways extends the supply but progressively reduces the quality of the water. In a somewhat similar manner, subsurface disposal of liquid wastes adds to the volume of ground water in storage but jeopardizes its quality.

Land subsidence caused by the extraction of ground water is less well known than problems of supply and quality, but this costly structural phenomenon is becoming more prevalent with increasing development of the nation's ground water. Subsidence is associated with pumping from artesian and semi-artesian aquifers containing fine-grained sediments susceptible to compaction in response to the lowering of water levels. Subsidence has been identified in California, Arizona, Texas, Louisiana, South Carolina, Virginia, and several other states.

In certain areas of the country, ground-water quantity as well as quality can be a serious problem. Markers on this pole in California's San Joaquin Valley indicate a dramatic drop in the land surface — a loss of 29 feet between 1925 and 1977. The subsidence was caused by ground-water withdrawal, primarily for irrigation.

The most serious cases are in the Santa Clara and Central Valleys of California and the Houston-Galveston area where damaging land-surface declines ranging from about 3 to 30 feet have been measured. The textural structure of the sediments is altered permanently by compaction, with consequent permanent loss of water storage capacity. A long list of other economically significant harmful effects include structural damage to buildings, levees, roads, and bridges; inundated coastal areas; and changes in grade of canal systems and irrigated land slope.

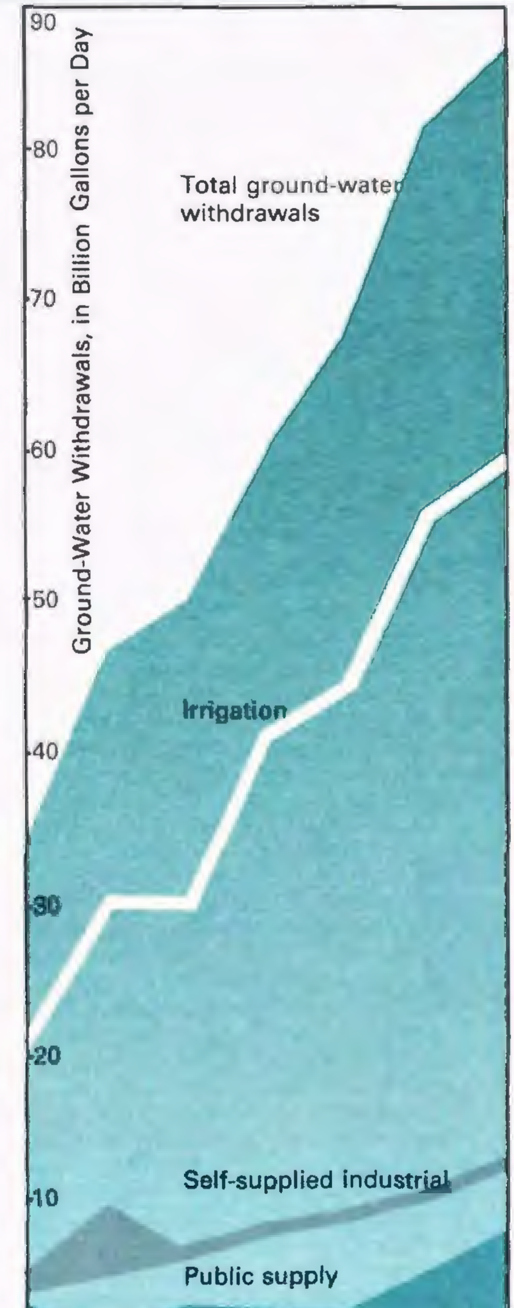
Deterioration of ground-water chemical quality reduces its usefulness. During the past decade a great deal of information was published on the actual and threatened degradation of the nation's ground-water resource as the result of intentional and incidental introduction of waste liquids to the subsurface. Other articles in this issue of *EPA Journal* describe the geographic extent and severity of contamination of the resource, and measures being implemented to cope with the situation.

Although some degradation is inevitable in our industrial society, chemical deterioration of ground water to the point of erasing its utility constitutes virtually the same loss of resource incurred by volumetric depletion, and usually without having put the "lost" water to a useful purpose. From a purely hydrologic standpoint, a case can be made for utilization of subsurface pore space for controlled storage of waste liquids in judiciously selected hydrologic settings. However, much of the ground-water contamination identified at this time originated under circumstances devoid of effective control measures and with limited understanding of, or indifference to, the receiving hydrologic system.

The future

The slow rate of movement of ground water — only a few feet to several hundred feet a year in most cases — imparts "slow motion" to the dynamic changes taking place as the water migrates from areas of influx to areas of discharge. These gradual hydraulic and chemical changes distinguish the resource from stream systems in which flow rates and quality changes are relatively rapid. Accordingly, the characteristics of hydrologic problems and of management requirements commonly differ for the two environments. A particle of water or waste might enter and leave a stream network in a few days. Ground-water problems are not "flushed away" so easily.

Thus, ground-water conditions identified today are a legacy of past events, natural and man-engineered, and left to natural hydrologic processes will change only slowly. Hydraulic, chemical, and structural ground-water problems confronted today will remain problems—hopefully with some gradual lessening of seriousness—tomorrow. A ground-water reservoir depleted by pumpage over a period of decades may require a similarly long (or longer) period of rest to recover, unless artificially replenished. A contaminated ground-water reservoir will flush out its degrading chemicals naturally only over a long period of time. In the time frame of practical planning, the chemical health



Trends in ground-water withdrawals in the U.S., 1950-1980.

of the reservoir may never be restored unless effective measures are instituted to accelerate the process. Unfortunately, economic and practicable reclamation technology for ground water is in its infancy.

Presently, withdrawals of ground water are on the order of only 10 percent of the estimated natural flow through the nation's ground-water systems. From a national perspective, therefore, the resource is far from overdeveloped, even though locally the situation varies widely. Except for large parts of the Southwest and certain smaller areas elsewhere, increased ground-water pumpage remains a viable option in water resources management. Contamination, too, has affected only a relatively small percentage of the resource, although local cases of contamination are widely prevalent. An improved future for the nation's ground-water resource, then, would appear to rest on curtailment of damaging practices; the introduction of well-informed, judicious management; and patience while nature acts. With regard to further development of the resource and its protection from deteriorating actions, good management can make a big difference. Clearly, effective control of the influx of contaminants would be a good beginning. No insurmountable technical or scientific barriers lie in the path of improved management practices. Institutional barriers, however, as always will present major challenges. ☐

The Ground-Water Issue: Two Viewpoints

How serious is the nation's ground-water problem? What should be done about it? EPA Journal *asked two experts looking at the problem from different vantage points for their views. James T. B. Tripp, an attorney handling ground-water cases for the Environmental Defense Fund, describes the ground-water situation in Nassau County, New York, and the lessons he believes it offers nationwide. Dr. Thomas M. Hellman, Chairman of the Chemical Manufacturers Association's Environmental Management Committee, analyzes the ground-water issue from a more general perspective. Their articles follow:*

Ground-Water Lessons From Nassau County, N.Y.

by James T. B. Tripp

Some three million people live in Nassau and Suffolk Counties, Long Island, New York. They all depend on the Island's ground water as the sole source of water supply. The Island's ground water is also the predominant source of fresh water for the area's fresh water wetlands, rivers and bays. Thus, the quantity and quality of ground water are critical concerns to Long Island's residents, economy, and environment.

In part for these reasons, Long Island's ground-water hydrology and quality are perhaps the most studied of any such system in the country. The U.S. Geological Survey, the New York State Legislative Commission on Water Resources Needs of Long Island, the Long Island Regional Planning Commission, the State of New York Department of Conservation, the County Health Departments, and Cornell University have all undertaken extensive studies of Long Island's aquifers. Nassau County may rank as the first county in the United States to have discovered measurable quantities of toxic organic compounds in some of its public water supply wells. Those wells had to be closed, almost ten years ago. Long Island therefore often serves as a laboratory for the nation in its effort to improve ground-water protection and management.

Starting with the preparation of the Long Island Section 208 Water Quality Management Plan in 1975, Nassau and Suffolk Counties identified their critical recharge watershed areas where precipitation flows deep into the water table Glacial Aquifer and the deeper Magothy Aquifer. In Long Island, these critical watersheds, with sandy soils underlying them, are generally located in the middle third of the Island and extend out the Island's South Fork. Much of their original vegetation was oak brush and pine barrens. Of this vegetation, only remnants remain in central Nassau and western Suffolk Counties. Eastern Suffolk is better off in this regard.

About 110,000 acres of largely undeveloped pine barrens remain in central eastern Suffolk County and the South Fork. The Long Island Regional Planning Commission 208 Plan of 1978 designated most, but not all, of these eastern Suffolk Pine Barrens as a special hydrogeological zone which should be subject to special land use controls.

Halt Development?

Since the ground water recharged through these pine barrens is of remarkably high quality, and the sandy soils would allow for easy percolation of contaminants, a group from the New York State Legislative Commission on the Water Resource Needs of Long Island, Group for the South Fork, Museum of Long Island Natural Sciences, Friends of the Earth, the Sierra Club, and the Environmental Defense Fund published a report entitled *Watershed Planning for the Protection of Long Island's Groundwater* (September 1982) in which we recommended a virtual halt to development in the remaining Pine Barrens to retain it as a vast undergraded watershed, with growth redirected to the periphery of this vital recharge zone. Two of the eastern Suffolk County townships, Southampton and East Hampton, have undertaken major rezonings of this watershed within their boundaries.

Due to its size and development status, Suffolk County can probably retain a large enough reservoir of high quality ground water through adoption of aggressive watershed protection programs. Nassau County's situation is much more problematic. Its population is comparable to that of Suffolk County, but its land size is only about one-third as large. Further, much of its central recharge area has experienced intensive industrial, transportation, and residential development. Thus, the major landfills and industrial waste sites of Nassau County are situated in this central recharge zone away from the county's coastal areas. Organic and other chemical contaminants from these sources are moving deep into Nassau County's two major aquifers. Clearly, this development pattern occurred in Nassau County at a time when the critical recharge zone concept was unknown or its soils were deemed to be effective traps for contaminants.

With a population of about 1.68 million, daily withdrawal of about 180 million gallons, and total estimated budget area recharge of some 200 million gallons per day, Nassau County does not, under the best of circumstances, have much room to maneuver to retain water supply self-sufficiency. Already, on a regional basis within the county, ground water is being mined. Further, as organic and nitrate contaminants extend deeper and laterally, quality considerations will impose additional constraints on supply availability.

Time is therefore running out for Nassau County. While it may consider other supply options, such as imports from New York's system or from Suffolk County, use of alternative supplemental sources of supply faces economic and political obstacles. What, then, should Nassau County do to maintain self-sufficiency in water supply in a cost-effective and environmentally satisfactory manner?

Some of us active in the preparation of *Watershed Planning for the Protection of Long Island's Groundwater,* joined by

Open spaces in Nassau County. In East Meadow, Long Island, a golfer tees off at Eisenhower Park, one of the county's most well used recreational areas and a part of its watersheds

others from New York Community Action Network and the Natural Resources Defense Council, have once again joined forces to address this issue. What is apparent is that policy debates should not continue forever; in Nassau County, the time for action is now.

Six Components

A ground-water action program for Nassau County must have six major components to meet this objective.

First, while much of the Nassau County central watershed is heavily developed, some 10,000 acres of it, in northern Nassau straddling and north of the ground-water divide, are not intensely developed. Local governments and the county, with support from the state, should designate these lands as a special protection area and use their zoning powers to limit future development with a view to preventing degradation of this ground water. While Nassau County does not have the extensive undeveloped watersheds of Suffolk County, it still has watershed lands which it should protect. Just because so much of Nassau County's central recharge area is intensely developed, designation and protection through stringent land use controls of its remaining watershed is critical.

Second, EPA, the state, the county and its townships must proceed expeditiously to implement a program for cleaning up, containing, and isolating the industrial waste sites and landfills (some eligible for Superfund support) in the central recharge zone. Since the toxic contaminants from these sources have penetrated deep into the ground-water system, remedial action to clean up the polluted ground water is probably hopelessly expensive. However, through removal and treatment of wastes on the land surface, capping, and other techniques, it should be possible to abate introduction of more contaminants from these sources into the ground water. Sooner rather than later, the responsible agencies must move beyond assessment and monitoring and take action in the field to contain, remove, and/or treat these wastes.

Third, private and public open spaces used for golf courses and parks are located throughout both the intensely developed and less developed parts of the central watershed. Fertilizers and pesticides used on these lands are a major source of contamination. The state, county and towns should adopt limits on uses of these chemicals to avoid further contamination. They must recognize the watershed, as well as recreational, function of these lands.

Fourth, because of the extent of the penetration of the ground-water system by organic contaminants, some of the county's water suppliers will have to install appropriate treatment technologies to remove toxic pollutants, at least on an interim basis. Use of such technologies should not serve as an excuse for failing to take other urgent action. It is far better to have programs in place which prevent contaminants from entering the ground water in the first place. But Nassau County does not have the luxury of relying solely on preventive strategies. Ideally, over time, supply treatment will become less necessary as preventive and control actions protect and restore the ground water.

Fifth, the county should pursue vigorously wastewater reclamation and recharge. Presently, much of the county is sewered, and treated wastewaters are discharged into coastal waters. Both in terms of maintaining water supplies and ground water-dependent ecosystems, scientifically controlled reclamation and recharge makes sense. The county, with state and EPA support, has sponsored a 5 million-gallon-a-day reclamation recharge demonstration project. It should pursue and expand this project, not discontinue it, as has happened.

Sixth, water supply conservation is a necessity. Both carrots and sticks should be used. The state has water well regulations which in theory could limit withdrawals to achieve a conservation management objective, although they have not been so used. Water pricing strategies tied to watershed protection and cleanup programs could also serve to dampen demand. In addition, required use of water recycling systems and water-conserving devices would further conservation. Compared to other alternatives, we expect that an aggressive conservation program, designed to reduce per capita demand by 15 to 20 percent, would be cost-effective. What is needed are the institutional reforms to implement such a program.

Crises create opportunities. Nassau County should face the reality of its ground-water quantity and quality crises and act aggressively. If it does so, it will have established an action program from which the many communities in the country that face ground-water quantity and related quality problems could benefit.

Second view next page

Ground Water: A Major Concern

by Dr. Thomas M. Hellman

Ground water has become a major national issue that will continue to be debated throughout the 1980s. The ground-water issue is complex and the political and economic stakes are enormous.

Ground water is an important resource that contributes significantly to the economic well-being of the nation. As a society we have historically used ground water for a wide variety of purposes and we will continue to do so in the future. Increasing use of ground water and rapidly improving monitoring and analytical capabilities increase national attention to the issues of quality and quantity.

There has been an approximate 200 percent increase in this nation's population in the past 80 years, but the consumption of water on a per capita basis has increased 500-800 percent. This is about 2,000 gallons of water used per day for each man, women and child in the U.S., and three times the per capita water use by the Japanese. There is growing concern that the supply of our nation's ground water is being used at a rate greater than the resource is being replenished. Many experts compare today's water problems to the energy crisis of the 70s. Water, they predict, will be the resource crisis of the 80s.

Many states are facing the growing reality that the crisis over water will not abate in the near future. Southern California and Arizona have battled one another for the right to water from the Colorado River. Arizona won that legal fight.

Southern California is also trying to gain access to the abundant water supply of northern California. New Mexico, Texas, and Colorado are locked in a dispute over rights to both surface and ground water. The eastern half of Colorado wants more water from west of the Continental Divide. Native Americans in the West have filed lawsuits claiming rights to enormous amounts of water based on terms of peace treaties signed during the 1800s. The list goes on, and includes the eastern half of the country as well as the western.

The concern about this resource is genuine for several reasons. First, the supply is unevenly distributed. Most of it is concentrated in the eastern half of the United States and in the Pacific Northwest, while in the more arid western regions of the country farmers are competing with urban residents and industry for the available ground water.

Another concern is the management of this resource. Historically, we have had an abundant supply of ground water for all uses. But today we are becoming more aware of the limitations of this valuable resource. In order for everyone to have the continued access that we have enjoyed in the past, we must begin to protect and manage the nation's ground water in a sound and rational fashion. Safeguarding water quality and quantity requires comprehensive ground-water management on a federal, state, and local level.

In looking at modern man's achievements in ground-water management, we see extraordinary knowledge and skill in hydrology. On the other hand we have ground-water shortages caused by overpumping, scattered chemical and biological contamination, saline and contaminated river water intrusion into fresh water aquifers, and serious subsidence problems.

We are fortunate that the supplies of ground water in this country are vast. If we act now to apply our knowledge and skills in protecting this resource, we can assure the development of a sound ground-water management system resulting in a supply of water for all uses. Comprehensive ground- water management is necessary to protect public health and the environment while responsibly maintaining multiple uses of the resource. This type of an approach is needed to insure that we do not misuse our ground-water resource.

Ground water is one of the nation's most valuable, but least understood, natural resources. Out of sight, ground water is all too often out of mind. However, new awareness and knowledge of the effects of human activity on the subsurface environment force us to recognize that this resource — once thought to be protected from pollution by layers of soil and rock — is indeed vulnerable.

One viable method of protecting ground water is through the development of a comprehensive use-based classification system. The concept of ground-water classification is practical and technically feasible. A ground water use-based classification system provides a basis for planning and action. Such a system combines a goal, a management approach, a technical approach and a state/federal relationship.

A use-based classification system maintains multiple uses of the resource while protecting human health and the environment. This is done by: a) recognizing existing ground-water uses, b) protecting future ground-water uses,

stalling a sampling ice in a monitoring ell.

c) accounting for the occurrence, availability and chemical and biological quality of ground water, and d) ensuring that different uses of the same ground water are compatible.

The flexibility of this type of water management system allows it to be successfully applied on a micro- and a macro-geographic basis. The concept of classification is not a solution in itself but a useful tool in a comprehensive ground-water management plan.

Congress has already taken several important steps toward protecting our ground-water resources. Major environmental legislation has been enacted to control potential discharges to aquifers. The requirements of existing statutes such as the Clean Water Act and the Comprehensive Environmental Response, Compensation and Liability Act (Superfund) are reducing and controlling industrial, commercial, and municipal facility discharges that contribute to ground-water contamination.

Several states presently have water pollution control statutes that extend to ground water. Many states have specific statutory authority to develop ground-water management systems. Most of the western states have implemented general permit systems for allocating the quantity of ground water. A few eastern states have followed suit, although quantity is generally not a priority because of an abundant water supply.

The question of who has the ultimate authority over the management of ground water is an important one. We believe the states should have the primary responsibility for developing their own ground-water management plan and implementing ground-water policy. The federal role should be one of adviser, funder, and supplier of technical assistance and scientific information.

Congress and EPA both have determined that ground water protection will be one of their primary activities during the next few years. Congress is currently addressing the reauthorization of the Safe Drinking Water Act with proposed bills in the House and Senate, and EPA has recently completed a ground-water protection strategy. It is important that we manage our ground water so we can maintain multiple uses and assure that there is a safe and sufficient supply of water for all uses in the years ahead. ☐

ir , th Carr

President Reagan Addresses the Environmental Issue

In a speech at the National Geographic Society in Washington, D.C. June 19, President Ronald Reagan discussed the nation's environmental problems and the Administration's programs to help deal with them. Here are excerpts from his remarks:

"Now, I know as we near the end of this amazing and troubled century that you, as all of us, are looking to the future. And I know that one of your great interests and concerns is the environment — conservation and ecology. You are worried about what man has done and is doing to this magical planet that God gave us. And I share your concern.

"What is a conservative after all but one who conserves, one who is committed to protecting and holding close the things by which we live? Modern conservatives in America want to protect and preserve the values and traditions by which the nation has flourished for more than two centuries.

"We want to protect and conserve the idea that is at the heart of our national experience, an idea that can be reduced to one word: freedom. And we want to protect and conserve the land on which we live — our countryside, our rivers and mountains, our plains and meadows and forests. This is our patrimony. This is what we leave to our children. And our great moral responsibility is to leave it to them either as we found it, or better than we found it.

"But we also know that we must do this with a fine balance. We want, as men on earth, to use our resources for the reason God gave them to us — for the betterment of man. And our challenge is how to use the environment without abusing it, how to take from it riches, and yet leave it rich.

"But I think the whole idea of conservation has often been obscured these past 20 years by some who have attempted to seize it as an issue, politicize it, and claim it as their own. I think there have been some who use the conservation movement as an excuse for blind and ignorant attacks on the entrepreneurs who help the economy grow — the farmers who make our food, the businesses that give us heat in winter and coolness in the summer. This kind of antagonism to all things that speak of business has tended to confuse the issue, blur responsibility, and overshadow sincere concern.

"As I said in my last State of the Union message: 'Preservation of our environment is not a liberal or conservative challenge — it's common sense.'

"Our nation has taken great strides in the decades since an old conservative named Teddy Roosevelt led the charge to create the national park system. From that great beginning step, we have steadily expanded efforts to protect our heritage of land and water. We've been proud to pick up the mantle and move forward in a number of important areas.

"We've spent $737 million since 1981 as part of a billion dollar plan to repair and replace national park facilities...Even as we grapple with getting federal spending under control, the 1985 budget request proposed that almost $160 million be made available to acquire new lands for our national park and wildlife refuge systems.

"We're keeping a close watch on endangered species. With the leadership of Secretary Clark, the Interior Department has listed 23 species so far this fiscal year, including the Wood Stork and the Woodland Caribou.

"Together, the federal government and Ducks Unlimited have created a new program to ensure the protection of American waterfowl nesting areas. This, by the way, reflects our attempts to work closely with the private sector. The non-profit Ducks Unlimited will work with the Fish and Wildlife Service and fund the protection of the waterfowl areas.

"Just this past April, the Prudential Insurance Company donated more than 100,000 acres of wetland and forest areas to the National Wildlife Refuge System. That's a $50 million gift. And we rely on private volunteers in our national parks. Last fiscal year, we had the help of more than 22,000 volunteers who in all donated more than a million hours of their own time. And that was a taxpayer savings of about $7 million.

"Creating parks and wildlife refuges is only a part of protecting our environment, of course. I'm proud to report that the most recent studies of the Environmental Protection Agency show that we've made great progress in cleaning up the air and water. Many lakes and streams have been declared open for fishing and swimming, after being closed to a whole generation. EPA tells us that after a national expenditure of $150 billion on air pollution controls, concentrations of all the major pollutants are on a downward trend.

"We are moving forward in responding to new challenges as well. In just three years, we have tripled funding for the cleanup of abandoned hazardous waste dumps from $210 million in 1983 to $640 million proposed for 1985. We have doubled funding for acid rain research in each of the past two years. We're trying to get a clear, scientific understanding of its causes and effects.

"And what we're aiming at is a policy of common sense.

"We have, all of us, over the past 20 years, reached consensus on the need to conserve our environment. Now, we must come to agreement on how to do it. And in coming together on that, we must keep in mind the word *balance,* a balance between the desire to conserve and protect and the desire to grow and develop, a balance between concern for the good earth and concern for the honest impulse to wrest from the earth the resources that benefit mankind, a balance between the overall demands of society and the individual demands of the free citizen.

"If we rid our minds of cant, of empty rhetoric, of mere politics, we'll strike that balance naturally and together.

"This is my great hope and in this you have my complete commitment." □

Update

A review of recent major EPA activities and developments in the pollution control areas.

AIR

"Bubble Concept" Approved

The Supreme Court affirmed the authority of EPA and state air pollution control agencies to let facilities use a "bubble concept" to meet Clean Air Act requirements more quickly and inexpensively where they add new industrial processes or modify existing ones.

The court reversed a lower court's decision, holding that such "modifications" need not be subject to the Act's most stringent, time-consuming requirements for "new emissions sources" anywhere in the country, if plant-wide emissions do not increase by significant amounts. Capping developments that began in 1979, the court went on to note that EPA and the 32 states that had adopted this "bubble approach" properly balanced the Act's twin goals of economic growth and environmental progress.

The "bubble concept" generally allows factories, refineries, and other sources of air pollution to treat all their stacks and vents as though they are enclosed by a giant bubble, getting more pollution control on stacks that are easy to control in exchange for reduced controls on those that are expensive to control, so long as overall emissions are reduced by the same amount.

General Motors Recall

The General Motors Corporation was recently ordered by EPA to recall approximately 550,000 1980 model year vehicles that are exceeding the federal emission standards for oxides of nitrogen. EPA's investigation revealed that these vehicles exceeded the 1980 oxides of nitrogen standard because the Exhaust Gas Recirculation systems were defective.

GM has begun to voluntarily recall these vehicles but has indicated that it would limit free repair to those vehicles which are under five years old and have mileage under 50,000 miles when brought into the dealership. While this limitation reflects GM's interpretation of its responsibility under the Act, GM and EPA are in litigation over this issue. EPA believes the Act requires GM to recall and repair all of the cars at no cost to the owner. This order reflects EPA's view that all vehicles must be repaired, regardless of age or mileage when presented for repair.

Proposed Funding Sanctions

A cutoff of federal highway construction money for the Detroit area of Michigan was recently proposed by the EPA because of the state's failure to adopt an auto emissions inspection program required by the Clean Air Act.

The proposed restrictions would withhold federal highway funds and air quality planning grants from the state for use in Wayne, Oakland, and Macomb Counties.

Under the Act, areas of the country which could not meet federal ozone and or carbon monoxide standards by 1982 were required to implement a tailpipe emissions inspection program as a condition to receiving a five-year extension of the deadline. The Detroit metropolitan area received an extension after agreeing to such a program but failed to start the inspection program, as required, by Dec. 31, 1982.

HAZARDOUS WASTE

Superfund Contract

A four-year $168 million Superfund contract—the largest awarded in EPA's history—has been granted to the Boston firm of Camp Dresser & McKee.

The contract will provide technical assistance and resources to supplement the agency's hazardous waste site cleanup program, which is authorized under the Superfund law (the Comprehensive Environmental Response, Compensation, and Liability Act).

Under the new contract, Camp Dresser & McKee (CDM) will be involved in long-term cleanup actions for uncontrolled hazardous waste sites. The new contract will supplement current long-term cleanup capacity available under two contracts awarded by EPA in 1982. The firm will undertake site investigations and feasibility studies, cleanup designs, initial long-term cleanup measures at sites, general technical support, and oversight of some enforcement activities.

Illinois Consent Decree

EPA and the U.S. Department of Justice announced a proposed consent decree which would require four companies which disposed of hazardous waste at a site in Greenup, Ill., to conduct a surface cleanup of the 3.8 acre site, which at one time contained four waste lagoons and 13 tanks containing wastes.

The proposed consent decree, lodged in the U.S. District Court in East St. Louis, Ill., would take effect if approved by the court after a 30-day public comment period.

The companies involved are the Aluminum Company of America; CAM-OR, Inc.; Northern Petrochemical Co.; and Petrolite Corp. Also agreeing to the consent decree, in addition to the Justice Department and EPA, were the State of Illinois; Cumberland County, Ill.; and the Village of Greenup.

INTERNATIONAL

US-USSR Environmental Agreement

President Reagan has asked William D. Ruckelshaus, Administrator of EPA, to assume the role of co-chairman of the U.S.-U.S.S.R. Joint Committee on Cooperation in the Field of Environmental Protection. Yuriy A. Izrael, chairman of the U.S.S.R. State Committee for Hydrometeorology and Control of the Natural Environment, is the Soviet co-chairman.

The agreement — originally signed in May 1972 and renewed in May 1982 — provides for cooperative activity and information exchanges on 42 specific projects in the areas of air, water, and marine pollution, urban and agricultural pollution, nature conservation, biological/genetic effects, climatic effects, earthquake prediction, arctic/subarctic ecosystems, and legal/administrative measures.

More than 2,000 American and Soviet specialists have participated in exchange visits, with information exchanged on flora and fauna conservation, climate change, earthquake prediction, and pollution processes and effects.

Administrator in Europe

EPA Administrator William D. Ruckelshaus met with top environmental officials in Sweden, France, The Federal Republic of Germany, and Great Britain on matters of mutual concern over a two-week period beginning June 17.

Ruckelshaus arrived in Stockholm on the first leg of his trip on June 17. The next day he devoted to meetings with the Swedish Ministry of Agriculture and the National Environment Protection Board.

His next stop was Paris on June 20, where he chaired a June 21 session of the Organization of Economic Cooperation and Development (OECD). The 24-member OECD discussed directions environmental policies are expected to take in the next decade and beyond.

While in Paris, Ruckelshaus signed a U.S.-French Memorandum of Understandinr with Mrs. Huguette Brouchardeau, French Secretary of State for the Environment and the Quality of Life, to maintain and enhance bilateral cooperation between the two countries in environmental affairs.

From Paris, Ruckelshaus went to Munich to attend the Multilateral Conference on the Prevention of Damage to Forests and Waters by Air Pollution in Europe. This conference on acid rain was held from June 24 through the 27th. The conference considered a joint resolution for controlling acid rain in Europe.

The Administrator concluded his European trip in London, where he met with the Minister of the Department of the Environment on June 28.

PESTICIDES

Wood Preservative Rules

EPA recently imposed restrictions on three pesticides used to preserve wood: creosote, pentachlorophenol, and inorganic arsenicals.

The agency's final action restricts the sale and use of the wood preservatives to certified applicators. Until now, anyone could purchase and use these preservatives around homes and farms. These pesticides account for over 97 percent of the wood preservatives used in this country and for one third of all agricultural and industrial pesticides (2.7 billion pounds) produced in the U.S.

In addition, the commercial wood pressure treatment industry will be required to participate in a consumer awareness program to inform users of pressure-treated wood or treated wood products.

EPA will require appropriate protective clothing, such as gloves and coveralls impervious to the chemicals, in certain applications of the wood preservatives and in handling freshly treated wood. Respirators will be required in certain high exposure situations.

The registrants of pentachlorophenol will also be required to limit immediately the dioxin contamination (hexachlorodibenzop-dioxin or HxCCD) in pentachlorophenol to 15 parts per million (ppm) and to reduce that level to one ppm within 18 months. The more potent 2,3,7,8, tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) has not been found nor will it be permitted in pentachlorophenol. EPA said that without these restrictions, the risk to public health from using these pesticides would outweigh the benefits.

Larvadex Decision Deferred

EPA has announced that it is deferring a final decision on whether or not to conditionally register the pesticide Larvadex until after it receives additional test data.

Larvadex (chemical name, cyromazine) was proposed to be used as a feed-through insecticide to control the larvae of flies found in manure of caged layer hens.

As part of the registration requirements for a new pesticide, EPA requires the manufacturer to submit teratology (birth defects) studies conducted with two different animal species.

These studies are required to determine if a pesticide presents a risk of birth defects or other harm to developing fetuses.

Until the additional data are received, the agency will not issue any additional emergency exemptions for the use of Larvadex or other cyromazine-containing pesticides and will terminate any outstanding exemptions. Presently, the agency has granted emergency use of Larvadex in selected counties of four states to combat the avian flue that threatens poultry operations.

Monsanto Ruling

The U.S. Supreme Court held that the 1978 statute authorizing EPA to make public the health and safety data on pesticides is constitutional. The court vacated a 1982 lower court judgment which had enjoined EPA from making public the results of tests on pesticides concerning toxicity, environmental fate, and wildlife effects. The statute had been attacked by Monsanto Company, a major pesticide producer, as an unconstitutional taking of property rights granted under state laws concerning trade secrecy.

Monsanto had claimed that the 1978 statute violated the Fifth Amendment of the U.S. Constitution, which prevents the government from taking private property for public use without providing just compensation. The court's opinion said that there was sufficient basis for compensation available under the law for any loss suffered by Monsanto.

The court said that although Monsanto may have property rights in pesticide data, Congress was free to provide by statute that EPA might make the data public. The court also upheld a companion provision in the pesticide statute allowing other businesses to obtain registration by relying on data previously submitted by firms such as Monsanto, if they offered to compensate the original data submitter.

With regard to data submitted to EPA between 1972 and 1978 (when the pesticide statute prohibited disclosure of the data or unconsented use by other businesses), the court said that if EPA now discloses it to the public or allows other businesses to rely on it without Monsanto's consent, Monsanto may be entitled to recover damages in the United States Claims Court. Data submitted before 1972 or after 1978 cannot give rise to a claim against EPA for "taking" damages.

TOXICS

School Asbestos Meetings

Three public meetings were held by EPA in June as part of the agency's effort to improve its asbestos in schools program. The meetings were held June 14 in San Francisco; June 20 in Chicago; and June 28 in Boston.

On Nov. 16, 1983, the Service Employees International Union (SEIU) petitioned EPA, under Section 21 of the Toxic Substances Control Act, to initiate rulemaking to require the abatement of friable asbestos-containing materials in public and private elementary and secondary schools. In addition, the petition requested rulemaking concerning the inspection and abatement of friable asbestos-containing materials in public and commercial buildings.

On April 17, 1984, EPA agreed to consider the SEIU's requests and seek public comments on how EPA should modify its program. EPA sought written public comment, and held a public meeting in Washington, D.C. on May 7.

New PCB Standards

EPA announced a series of separate actions on the chemicals called polychlorinated biphenyls (PCBs), including a final rule affecting those industries that inadvertently generate PCBs as byproducts and impurities.

The allowable PCB levels in this rule are built on the framework of a joint recommendation of industry and environmental groups (the Chemical Manufacturers Association, the Environmental Defense Fund, and the Natural Resources Defense Council) submitted to EPA on April 13, 1983. EPA believes, based on a regulatory impact analysis and assessments of risk for carcinogenicity and environmental effects, that these concentrations do not pose an unreasonable risk to health or the environment.

WATER

Municipal Sludge Policy

Under a new management policy EPA will actively promote practices which provide for the beneficial uses of sludge in producing energy, and as a nutrient and soil conditioner. The policy also indicates EPA's intent to tighten state program requirements and to strengthen technical requirements on sludge disposal and use.

Prepared by a special EPA Sludge Task Force, the policy establishes the framework for future regulations and guidance in managing sludge.

In July 1984, draft regulations governing the establishment of state sludge programs to implement both existing and future controls were expected to be released for public comment. Work on technical regulations will be completed over the next two years.

In August 1984, issuance of general guidelines was planned to describe the capabilities of technologies, the current federal requirements that govern them, and successful management practices.

Maximum Contaminant Levels

Recommended maximum contaminant levels (RMCLs) are being proposed by EPA for a group of nine chemical compounds that might cause health problems if they are found in drinking water supplies at significant levels.

Chemical compounds covered by the proposal are benzene, carbon tetrachloride, 1,4-dichlorobenzene, 1,2-dichloroethane, 1,1-dichloroethylene, tetrachloro-ethylene, 1,1,1-trichloroethane, trichloroethylene and vinyl chloride. Members of a chemical group known as volatile synthetic organic chemicals (VOCs), they are found in industrial solvents, degreasing agents, and dry-cleaning fluids.

The recommended maximum contaminant levels are nonenforceable goals. Under the Safe Drinking Water Act this is the first step in setting standards.

Final standards would come later in the process with the setting of maximum contaminant levels (MCLs) if EPA decides they are needed.

EPA/Interior Agreement

EPA and the Department of the Interior announced joint approval of a Memorandum of Understanding concerning coordination of environmental permits for oil and gas drilling activities on the Outer Continental Shelf.

The agreement provides for the two agencies to coordinate studies and related regulated responsibilities aimed at allowing EPA to issue National Pollutant Discharge Elimination System (NPDES) discharge permits at the same time Interior publishes a final notice that it is offering offshore leases. The measure is designed to make the process more responsive to environmental concerns and eliminate needless delay. □

Appointments at EPA

Alexandra B. Smith

Sanford W. Harvey, Jr.

Walter W. Kovalick, Jr.

Administrator William Ruckelshaus has appointed eight EPA employees to new positions in the agency. The appointments include a new Judicial Officer, a Deputy Regional Administrator, and a Special Assistant to the Assistant Administrator of EPA's Office of Water.

The Office of Emergency and Remedial Response and the Science Advisory Board have new Deputy Directors, while new Directors have been named for the State Programs Division in the Office of Drinking Water, and for the Facilities Requirements Division and the Municipal Construction Division of the Office of Water Program Operations.

Louise Jacobs will serve as EPA's second Judicial Officer, with initial specialized responsibilities for civil rights and labor standards decisions. Jacobs will be delegated exclusive authority to issue final EPA decisions in internal equal employment opportunity and Contract Work Hours and Safety Standard Act cases. She will also decide assigned cases arising under the agency's environmental statutes.

Ruckelshaus said, "We are fortunate to have recruited someone of Ms. Jacobs' background and professional reputation to act as the agency's second Judicial Officer. Her assignment to initial concentration on civil rights cases is an indicator of the importance I attach to just resolution of civil rights concerns."

Jacobs joined EPA in 1979 as Director of the Enforcement Division in the Kansas City regional office. In 1982 she came to agency headquarters to serve as Associate Enforcement Counsel, first for the Air Division and later for the Water Division.

Prior to her EPA service, Jacobs was Senior Staff Attorney for the U.S. Court of Appeals for the Third Circuit in Philadelphia. She has held several positions with the Administrative Office of New Jersey Courts, including Staff Attorney and Court Administrator. She has also been engaged in the private practice of law.

Jacobs holds a bachelor's degree from Seton Hill College and a doctor of jurisprudence degree from Seton Hall University School of Law, where she served as a Notes Editor of the *Law Review* and was named a Centennial Scholar. She is listed in *Who's Who Among American Women* and *Who's Who in American Colleges and Universities.*

Alexandra B. Smith has been named Deputy Regional Administrator for EPA's Region 8 in Denver. Since 1980 she has headed the Air and Waste Management Division of Region 10 in Seattle.

Between 1977 and 1980 Smith was Chief of the Environmental Evaluation Branch in Region 10. In 1976 and 1977, she was Director of EPA's Office of Federal Affairs in Seattle.

Smith began her government career in 1972 at the Department of Housing and Urban Development, where she was an employee development specialist. She also worked briefly for the National Park Service in Harpers Ferry, W. VA.

Before joining government service, Smith worked for private companies in Colorado and New York and for television stations in New York and Seattle.

In 1980 Smith received EPA's Gold Medal for meritorious service, and in 1982 EPA's Bronze Medal.

Smith received her B.A. in government in 1967 from St. Lawrence University in Canton, N.Y., where she held a New York State Regents Scholarship. In 1968 she received her M.A. from Syracuse University and, in 1982, her M.B.A. from the University of Washington.

Sanford W. Harvey, Jr., has been named Special Assistant to Jack E. Ravan, Assistant Adminstrator of EPA's Office of Water. Harvey comes to this position from the Office of Enforcement and Compliance Monitoring where he has been Associate Enforcement Counsel for Special Litigation since April.

Harvey came to EPA headquarters from Region 4 in 1980, to serve as Deputy Assistant Administrator for Mobile Source, Noise and Radiation Enforcement. In July 1981, he became Director of the Office of Pesticides and Toxic Substances Enforcement. The following January, Harvey was appointed Associate Enforcement Counsel in the Office of Legal and Enforcement Counsel.

Harvey joined EPA in Atlanta in August 1978, as Regional Counsel for Region 4. In April 1979, he was appointed Director of the Enforcement Division in Region 4.

Between 1975 and 1978, Harvey worked for the U.S. Army Corps of Engineers as an Attorney-Advisor and as an Administrative Judge on the Corps' Board of Contract Appeals. From 1971 until 1975, he served in the U.S. Army Judge Advocate General's Corps where he was a Military Judge.

Prior to military service, Harvey was a manpower analyst for ABT Associates, a multi-disciplinary consulting firm in Cambridge, Massachusetts.

L to R, EPA Administrator William Ruckelshaus, Louise Jacobs, and EPA Civil Rights Director Nathaniel Scurry. Ms. Jacobs was appointed as the agency's second Judicial Officer, with initial responsibility for civil rights and labor standards decisions.

In 1967 Harvey graduated with highest honors from Norwich University. He received his J.D. from Harvard Law School in 1970 and has been admitted to the Massachusetts and District of Columbia Bars.

Harvey received EPA's Bronze Medal in 1980. While in the Army, he was awarded the U.S. Army Commendation Medal and the U.S. Army Meritorious Service Medal. He is listed in *Who's Who in American Universities and Colleges.*

Walter W. Kovalick, Jr., has been named Deputy Director of the Office of Emergency and Remedial Response (OERR) in EPA's Office of Solid Waste and Emergency Response. OERR administers EPA's Superfund program.

Kovalick has been with EPA and its predecessor agencies for over fifteen years. Since October 1978, he has been Director of the Chemical Coordination Staff of the Office of Pesticides and Toxic Substances. Between 1974 and 1978, he served as Chief of the Guidelines Branch in the Hazardous Waste Management Division of the Office of Solid Waste and Emergency Response.

After working two years at the Department of Health, Education and Welfare, Kovalick began his EPA career in February 1970 as a program advisor in the Air Pollution Control Division at Region 5 in Chicago. Between 1972 and 1974, he served as technical advisor and consultant to the Region 5 Administrator and Deputy Administrator in various program areas.

From 1979 through 1981, Kovalick chaired the regulatory development work group of the Interagency Regulatory Liaison Group. For the past 16 months he has been co-chairman of the Interagency Toxic Substances Data Committee. In addition, Kovalick has represented EPA in environmental programs of multinational organizations such as the North Atlantic Treaty Organization and the Organization for Economic Cooperation and Development. Kovalick also has served as consultant to the federal government of West Germany.

Kovalick received his B.S. in industrial engineering from Northwestern University in June 1967. In 1966 he was elected to Alpha Pi Mu, the Industrial Engineering Honor Society. In 1967 Kovalick won the American Institute of Industrial Engineers' Award for Student Excellence and the Hamilton Watch Award bestowed by Northwestern's Technological Institute. In 1972, after studying on a National Honorary Fellowship and an EPA Traineeship, Kovalick earned a master's degree in business administration from Harvard University.

Continued to next page

Kathleen Conway

Paul M. Baltay

Robert J. Blanco

James A. Hanlon

Kathleen Conway has been named Deputy Director of EPA's Science Advisory Board. She comes to the Board from EPA's Office of Health Research where she has worked as an environmental health scientist since 1977.

In 1981-82 Conway served as Acting Director for both divisions in the Office of Health Research. She took a one-year leave of absence from EPA in 1982-83 to serve as program administrator for health and safety at IBM as part of the President's Executive Exchange Program.

Conway joined EPA's Region 1 in Boston in 1974 and worked there until 1977 as a sanitary engineer. Prior to joining EPA, Conway was a junior sanitary engineer at the Central District Health Office of the Massachusetts Department of Public Health. She also worked as a technical writer for Project MISOE in Winchester, Mass., and as a feature writer for the *Hartford Courant.*

Conway received a B.S. in biology from Tufts University in 1970. In 1977 she completed her M.S. in sanitary engineering and public health, also at Tufts University.

Paul M. Baltay will fill the position of Director, State Programs Division, Office of Drinking Water, at EPA headquarters. Since 1982 Baltay has been acting Director of the State Programs Division. For four years prior to 1982, he worked as its Deputy Director.

Baltay joined EPA in 1974 as Assistant Director for Operations in the Program Evaluation Division. In 1975 he received a group citation EPA Silver Medal for his work on several of EPA's Construction Grants Task Forces.

Baltay began his government career in 1967 at the Bureau of the Budget, which later became the Office of Management and Budget. Among other assignments, he served as staff assistant to the Director in 1969 and as a budget examiner from 1970 to 1974.

Baltay received his B.A. in political science from Union College in 1962. At Union he was a Merit Scholar and a New York State Regents Scholar. Baltay did graduate work at Albany Graduate School and the Maxwell School of Syracuse University.

Robert J. Blanco has been appointed Director of the Facilities Requirements Division in the Office of Water Program Operations at EPA headquarters. For the past three years, Blanco has been Chief of the Water Supply Branch at EPA's Region 3 in Philadelphia.

Blanco joined EPA in 1971 as Chief of the Environmental Impact Branch in Region 3. He held that position until 1975 when he became Chief of the Water Planning Branch in Region 3. In 1978 Blanco was honored with EPA's Bronze Medal and appointed Chief of EPA's Virginia/West Virginia Branch. He held that position until 1980 when he served briefly as acting Chief of the Air Programs Branch in Region 3.

Blanco studied engineering at New York University, where he received his B.S. in Civil Engineering in 1968 and his M.S. in 1969. While at NYU, he received the University's Trowbridge Award.

James A. Hanlon has been named Director of the Municipal Construction Division at EPA's Office of Water Program Operations in Washington. Hanlon comes to EPA headquarters from Region 5 in Chicago, where he has worked since 1972.

Hanlon began his EPA career as a civil engineer in the Construction Grants Branch of the Region 5 Water Division. He worked in the Construction Grants Branch from 1972 until 1978 when he became State Management Assistance Program Manager in the Region 5 Water Division. For his work in this position, Hanlon received EPA's Bronze Medal in May 1980.

Most recently he served as Section Chief of the Program Management Section in the Municipal Facilities Branch of the Region 5 Water Division.

Hanlon studied civil and environmental engineering at the University of Illinois, where he received his B.S. with high honors in 1972. In 1977 Hanlon received an M.B.A. from the University of Chicago. ☐

A resident of Vinton County, Ohio, stands behind the 18-foot-deep well that he planned and constructed himself.

Back cover: Young green-backed heron near Ocean Springs, Mississippi

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