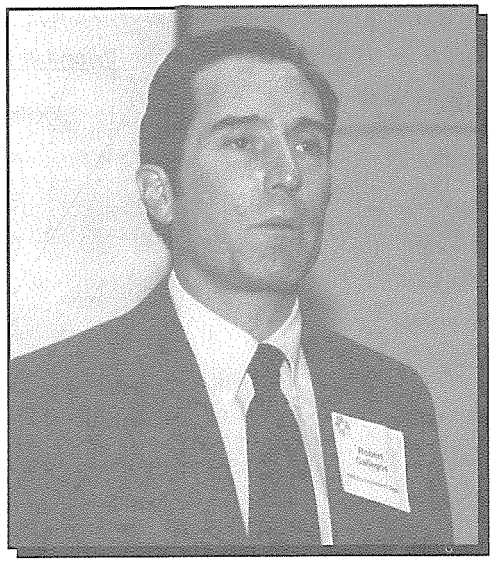
Robert Gallegos received an M.S. in Biology from NMSU in 1984. Since 1984, Robert has been employed by the New Mexico Environment Department, first as a Laboratory Scientist in the Biological Services Bureau, then as an Environmental Scientist in the Drinking Water Section, followed by a five-year tenure as Program Manager of the Drinking Water Section. He currently is the Bureau Chief of the Drinking Water Bureau.



SOURCE WATER PROTECTION THROUGH VULNERABILITY ASSESSMENTS

Robert M. Gallegos
Drinking Water Bureau
New Mexico Environment Department
PO Box 26110
Santa Fe, NM 87502

Today I will discuss the New Mexico Environment Department's Vulnerability Assessment Program. The Vulnerability Assessment Program is dependent on the water conservation fee that Hal Engle discussed; without the fee we would not be able to conduct the program.

Let me begin with a bit of background. The Safe Drinking Water Act amendments of 1986 required the U.S. Environmental Protection Agency (EPA) to set standards for 84 drinking water contaminants. Many contaminants listed in the chemical phases of the rules developed between 1986 and 1992 allowed states to make decisions about whether or not a system had to sample for those contaminants based on vulnerability. The Environment Department had long maintained that it would not institute such a program without any kind of federal funds or other additional funding because the monies EPA provides simply do not fund the program adequately. The water conservation fee which Hal spoke of was signed into law in 1993. It assessed a $0.03 per 1,000 gallons of water produced fee. The revenues generated by the fee are designed to do four things: collect chemical compliance samples, analyze those samples at a lab, perform vulnerability assessments, and provide training for public water supply operators.

The breakdown of the water conservation fee is presented in Table 1. The table depicts who pays the fee and how the fee is distributed. As you will note, the City of Albuquerque pays almost 36 percent of the total revenues generated by the fee. The fee is based on usage and water production.

TABLE 1. WATER CONSERVATION FEE SUMMARY

Population	Number of Systems	Percent of Population	Percent of Total Revenue	Estimated Total Revenues
< 100	287	1.2%	0.8%	$26,922
101-500	307	4.9%	3.2%	106,584
501-1,000	78	3.9%	3.0%	98,983
1,001-2,500	58	6.2%	5.3%	176,859
2,501-3,300	10	1.9%	1.9%	63,239
3,301-5,000	10	2.7%	2.3%	76,938
5,001-10,000	20	10.6%	10.1%	336,570
10,001-50,000	16	26.1%	28.6%	958,846
50,001-75,000	2	7.9%	7.9%	263,288
> 75,000	1	29.4%	35.7%	1,196,699
Non-Comm.	526	5.8%	1.3%	43,637
TOTALS	**1,315**	**100.0%**	**100.0%**	**$3,348,565**

Waivers may be granted by the Department to reduce or eliminate sampling when certain criteria are met. No waivers are available for nitrates or nitrites. We can eliminate monitoring for PCBs and pesticides, however, we only can reduce monitoring for volatile organics.

Our Vulnerability Assessment Program has four phases: Phase I consists of information research, Phase II is modeling analysis, Phase III is field inspection, and Phase IV is vulnerability analysis.

We begin assessments with an information research to identify the area to be evaluated. We review the water system's history and its current situation and then try to find information from various offices such as the U.S. Geological Survey, Soil Conservation Service and State Engineer Office each contributing to the area's geology around the wells. We then determine where information is available on the well's construction. This part of the program is proving to be the most difficult. We are having a hard time locating information. There is no one office where you can go to get the information, no one-stop shopping. We eventually hope to be able to gather information about New Mexico's sources and supply and make it available to the public. This information would be provided to the public water suppliers to use in making decisions about locations of future water sources as well as to help us grant or deny waivers in cases where New Mexico public water supplies are susceptible to contamination.

Our review differs, of course, for surface water and groundwater basins. We try to include distribution systems of the systems involved, or in the case of surface water, the watershed area. Our guidelines come directly from the Federal Register regarding how EPA would like us to conduct ourselves in doing a vulnerability assessment. We consider prior results, analytical results, the environmental persistence, water protection measures in effect, and well head protection programs.

Incidently, through this program we prepared a Vulnerability Assessment Guidance Manual (New Mexico Environment Department Vulnerability Assessment Committee, NMED Drinking Water Bureau 1994, Vulnerability Assessment Guidance Manual Public Water Supply Protection) and we used some of our funding to hire six environmental specialists who are located throughout the state and who are responsible for getting data from libraries and conducting on-site evaluations of the various sources.

Phase II consists of modeling analysis. Again we look at both surface water and groundwater. We have developed an index internally within the department to measure surface water susceptibility to contamination. For groundwater systems, we are

using a model called DRASTIC (Table 2) which determines an overall susceptibility that a well may have to contamination. It is a simplified model; it is by no means a catch-all meant to answer all our questions. We are using it as a tool which contains the different types of information that we are trying to gather. The DRASTIC model gauges the potential for surface-water contamination and provides us a number, or index; the higher the index, the greater the potential for pollution. Our guidelines for waiver length stipulate that for an index less than 80, nine years is appropriate; for an index between 81-160, six years; and an index greater than 161 calls for three years, or we may not want to issue a waiver.

TABLE 2. DRASTIC (DEVELOPED BY THE NATIONAL WATER WELL ASSOCIATION - NOW RENAMED NATIONAL GROUND WATER ASSOCIATION)

DRASTIC	Characteristics
D	Depth to water
R	Recharge
A	Aquifer media
S	Soil type
T	Topography
I	Impact of vadose zone media
C	Hydraulic conductivity of the aquifer

Our groundwater modeling objective is to develop capture zones for wells. The capture zone of a well contains all water that will reach a well during a particular period of time. We use several methods to do this as described in Table 3.

TABLE 3. GROUNDWATER MODELING METHODS

Designated Fixed Radius Method
- Simple, quick, cheap
- An arbitrary radius is selected to form a circle around a public water supply well designed to protect the water supply for some particular length of time.
- In New Mexico the designated fixed radius has been chosen as 1,000 feet (the area of this circle is 72.12 acres). A disadvantage to this method is that it uses an arbitrary radius not based on any kind of conditions around the well.

Calculated Fixed Radius (several methods)
- Simple to apply
- Site specific
- Good ties to Time of Travel criterion
- Good relationship to well pumping characteristics and aquifer properties.

Currently, we are utilizing the Well Head Protection Analysis Delineation Code called WHPA. This is a modular semi-analytical groundwater flow model for delineation of well head protection areas. It is another simplified model consisting of four independent computational models used to determine a capture zone or an area of delineation around a well, and thereby determining the pollution sources within the delineated area. Figures 1 and 2 depict well maps in Roy and Maxwell, New Mexico generated by using the WHPA model. Three, six and nine-year capture zones are shown. We plan on generating maps of this type for every well in the state. We will try to inventory pollution sources up to the nine-year time of travel.

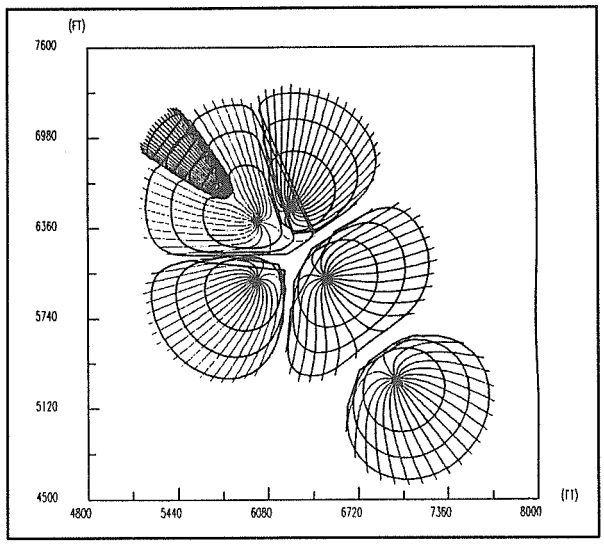


Figure 1. WHPA sample of well map in Roy, New Mexico with 3, 6 and 9-year capture zones.

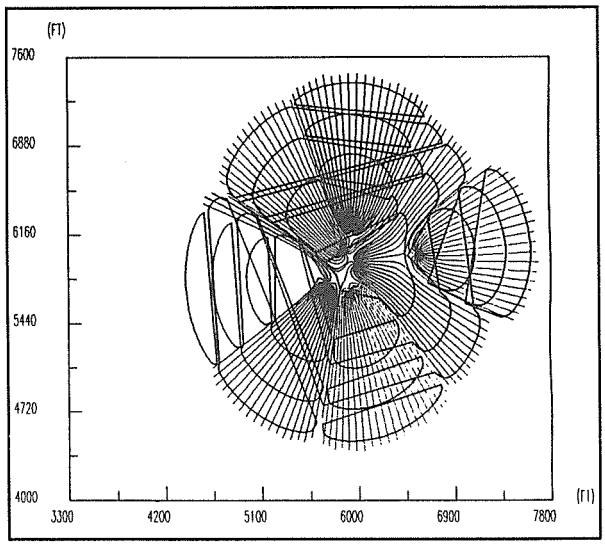


Figure 2. WHPA sample of well map in Maxwell, New Mexico with 3, 6 and 9-year capture zones.

EPA, the developer of the WHPA model, is refining it, and because it is in the development phase, EPA refers to it as the Well Head Analytical Element Model (WHAEM). This model is a bit more complicated and more technical and requires more information. We are aware that there are other more sophisticated models available to delineate areas susceptible to pollution, but based on our budget and available resources, we feel we need to start simple.

Other modeling methods include:

- saturated flow models
- unsaturated flow models
- hydrogeochemical models
- saturated transport models
- unsaturated transport models
- parameter estimation models
- statistical analysis models

Phase III is the field inspection in which we investigate actual and potential sources of contamination within designated areas of delineation, verify water system layout and characteristics, and enter contamination and system layout data into our department's GIS system.

Phase IV is the vulnerability analysis where the actual decisions are made about issuing waivers. The system is evaluated as to its vulnerability to a particular type of contaminant based on a range of criteria that we have established in our Vulnerability Assessment Guidance Manual. The manual is available and anyone interested in receiving it can contact me for a copy. The manual is an open document; if anybody has comments on how we conduct our assessments, we would certainly like to hear from you.

Finally, what are we going to do with all this information? EPA has funded 106 well head protection grants in the state. We would like to take newly gathered information back to local governments and communities and encourage them to look at their vulnerability, look at the aquifer characteristics, and decide for themselves whether or not they want to develop a well head protection program. Certainly, it would be voluntary.

We have programs in the state now; Bluewater Lake for example, has placed signs around their wells indicating a designated well head area. It is a voluntary tool which heightens people's awareness of where their drinking water comes from. On the other side of the coin, the City of Santa Fe is working on a very comprehensive well head protection program that would restrict many kinds of activities within their designated areas. Santa Fe has chosen a 1,000-point fixed radius.