Point Sources vs. Nonpoint Sources of Groundwater Contamination

By Richard S. Fawcett

Preventing contamination of wells by pesticides and nitrate requires an understanding of how contaminants reach the well, so that appropriate corrective actions can be taken. Misidentifying the cause or route of contamination can lead to the adoption of inappropriate and ineffective protection practices, costing money and causing hardships for farmers, without correcting the problem. Recent research and monitoring results have helped to improve our understanding of groundwater and well contamination and to direct efforts at effective solutions.

Nitrate in Groundwater

WHEN pesticides and nitrate are detected in wells, often the first source to be blamed is leaching of materials from treated farm fields. This type of nonpoint contamination can occur with nitrate and with certain pesticides under the right conditions. However, it is becoming increasingly clear that many cases of groundwater contamination by pesticides and nitrate are related to activities very near the well and may be due in part to construction of the well itself.

Determining the source of nitrate in wells can be difficult because nitrate occurs naturally and originates from many sources. Consistently high nitrate concentrations in shallow groundwater in some areas such as the Platte River Valley of Nebraska are apparently due primarily to nonpoint sources. However, in many cases, wells with nitrate concentrations exceeding the drinking water standard have been affected by their location near point sources of contamination such as livestock feedlots, septic systems or fertilizer handling sites. Evidence is increasing that well location and well construction can explain some high nitrate concentrations.

Pesticides in Groundwater

Pesticides vary tremendously in their physical and biological properties. Some pesticides break down quickly or are strongly bound by soil particles resulting in a very low risk of leaching to groundwater. Compounds which are more persistent and/or are weakly held by soil particles have a greater leaching potential. Certain products have specific label restrictions against use in highly permeable soils where the groundwater is shallow. Natural sinkholes in karst topographies or unplugged, abandoned wells permit direct entrance of any pesticide to groundwater, either attached to eroded soil particles or dissolved in runoff water.

Iowa. While nonpoint leaching of detectable amounts of certain pesticides is possible, recent studies have implicated point sources at pesticide storage, mixing and disposal sites as causes of many cases of well contamination.

In 1987, all public well systems in Iowa were tested for the presence of pesticides. Eight percent showed some pesticide content. All detects were of a few specific herbicides, except for one case of an insecticide. Levels detected were generally well below health standards, with the exception of three wells which exceeded a Lifetime Health Advisory or MCL (maximum contaminant level).

Many of the Iowa wells with pesticides had subpart per billion concentrations of atrazine, a herbicide found more frequently in groundwater due to its greater persistence and moderate mobility. Some

Dr. Fawcett is an Agricultural Consultant located at Route 1, Box 44, Huxley, IA 50124.

of these wells apparently contained atrazine from nonpoint sources, either small amounts leached from fields or more likely through surface runoff and erosion into rivers, followed by interaction of the surface water with shallow, alluvial aquifers. But for all other pesticides detected, a totally different pattern emerged. Over 80 percent of all public wells with pesticides other than atrazine had a pesticide mixing-loading site near the well, often a few hundred feet away.

Illinois. Illinois monitoring has traced all cases of public well detection of pesticides to point sources. These data led the Illinois EPA to conclude in a December 1989 report: "There is no indication from the sampling carried out to date that the field application of pesticides is affecting Illinois' community well systems."

Handling and Loading Sites

Soil will normally adsorb and degrade most pesticides and prevent measurable leaching. But if extreme concentrations are added to the soil, the system can be overloaded and leaching can occur. Unfortunately, there are many places where extreme concentrations of herbicides have been added to the soil. This occurs where herbicides have been mixed and sprayers rinsed over the years. Repeated small spills or occasional large spills contribute to soil overloading. Mixing and handling of large quantities of herbicides and fertilizer at sites close to a municipal well could lead to contamination.

Although farmers do not handle the quantities of chemicals processed by commercial chemical supply businesses, they have unfortunately often handled and loaded chemicals in the worst of possible places in the past—immediately adjacent to the farm well. Because of convenience and lack of an understanding that this kind of practice threatens well contamination, this activity has frequently gone on for many years. Handling chemicals near wells is especially risky if the well is shallow, is not properly constructed or maintained and if contaminated surface water can directly enter the well.

Confining all pesticide mixing activities to water-tight pads, where all spills and rinsate are contained for proper disposal, is one solution to this problem. In fact, states are beginning to require commercial pesticide storage and handling sites to install such secondary containment systems. This technique will work on farms as well, but simply moving the activity from the well site by conducting all mixing and rinsing activities in the field may be the most practical solution. That way, one site is not continually exposed to spills and the chemical ends up in the intended field. Moving pesticide activities away from the well also avoids any chance of backsiphoning when filling sprayers.

Results of a systematic survey of Iowa rural wells have thrown considerable light on the extent and causes of well contamination by nitrate and pesticides. Six-hundred-eighty-six rural wells were monitored. Eighteen percent of wells exceeded the nitrate drinking water standard, and one percent exceeded a standard for a herbicide. Thirteen percent of the wells showed some pesticide content, almost entirely comprised of a few herbicides. **The most striking result was the fact that 45 percent of the rural wells had unsafe levels of coliform bacteria. The presence of coliform bacteria is often evidence of contaminated surface water entering the well system due to well construction.** If bacteria can enter the system with surface water, herbicide molecules certainly can enter due to their much smaller size.

The fact that many rural wells are not properly sealed against surface contamination makes it all the more important that farmers change practices to move chemical handling from the well site. **But ultimately solving the bacterial and nitrate problems will often require improvements in the well itself.**

A recent study of rural wells in Kansas by Kansas State University illustrated the strong correlation of well site and construction to detection of nitrate and pesticides. Nitrate concentration averaged less when the well site was closer to production fields and farther from the

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