

# Pesticides in Groundwater

Commercial pesticide applicators, farmers, and homeowners apply about 1 billion pounds of pesticides annually to agricultural land, non-crop land, and urban areas throughout the United States. The use of pesticides has helped to make the United States the largest producer of food in the world and has provided other benefits, but has also been accompanied by concerns about their potential adverse effects on the environment and human health.

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## Pesticides in Groundwater

If you ask your grandparents what life was like when they were kids, the answer will probably be that things were simpler, slower, less automated, and that people did not move around the country so often. But since your grandparents' time two major



*Crop dusting is one technique used to spread pesticides on agricultural lands, as in the Albemarle Sound region of North Carolina.*

*Credit: Michelle Moorman, U.S. Fish and Wildlife Service*

Status -  
Completed

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<https://answers.usgs.g>

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things have happened: (1) the population of the United States has increased greatly, and (2) technology and scientific innovations have come to play a major role in our lives.

Pesticide use has grown because not only must our exploding population be supplied with food, but crops and food are grown for export to other countries. The United States has become the largest producer of food products in the world, partly owing to our use of modern chemicals (pesticides) to control the insects, weeds, and other organisms that attack food crops. But, as with many things in life, there's a hidden cost to the benefit we get from pesticides. We've learned that pesticides can potentially harm the environment and our own health. Water plays an important role here because it is one of the main ways that pesticides are transported from the areas where they are applied to other locations, where they may cause health problems.

## Pesticides can contaminate groundwater

Pesticide **contamination of groundwater** is a subject of national importance because **groundwater** is used for drinking water by about 50 percent of the Nation's population. This especially concerns people living in the agricultural areas where pesticides are most often used, as about 95 percent of that population relies upon groundwater for drinking water. Before the mid-1970s, it was thought that soil acted as a protective filter that stopped pesticides from reaching groundwater. Studies have now shown that this is not the case. Pesticides can reach water-bearing aquifers below ground from applications onto crop fields, seepage of contaminated **surface water**, accidental spills and leaks, improper disposal, and even through injection waste material into **wells**.

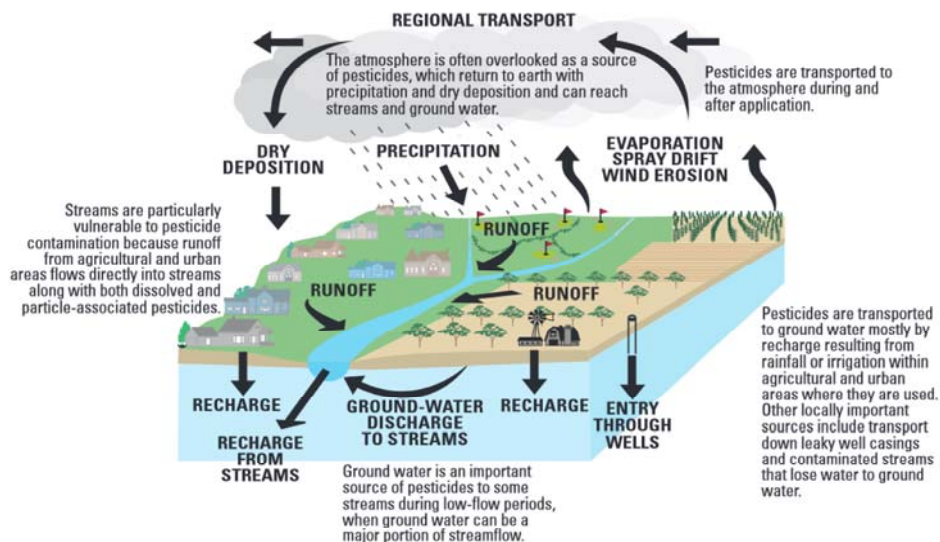


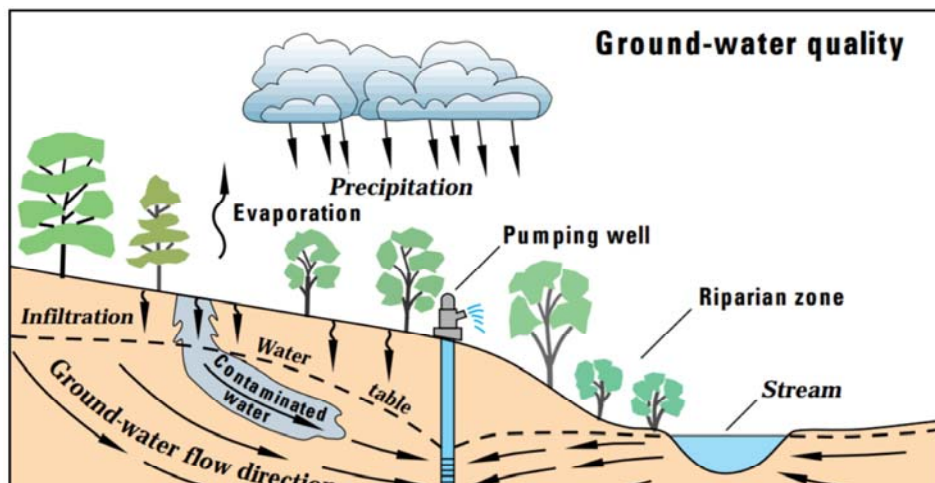
Figure 2-4. Pesticides are transported to streams and ground water primarily by runoff and recharge. Nonpoint sources of pesticides

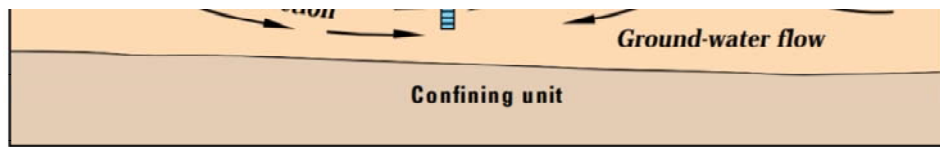
originating from areas where they were applied—rather than point sources such as wastewater discharges—are the most widespread causes of pesticide occurrence in streams and ground water. (Modified from Majewski and Capel, 1995.)

**Sources and Pathways in the Hydrologic System.** Pesticides, like most other water contaminants, enter the hydrologic system from point sources, which are associated with specific points of release, and from nonpoint sources, which are diffuse and widely dispersed. Nonpoint sources are the dominant sources of pesticides found in streams and groundwater. Nonpoint sources include **runoff to streams** from agricultural and urban land, **seepage to ground water** in areas where pesticides are used, and deposition of pesticides from the **atmosphere**. Potential point sources of pesticides include pesticide manufacturing plants, mixing-and-loading facilities, spills, waste water recharge facilities (wells or basins), waste disposal sites, and sewage treatment plants. Once pesticides and their degradates (new compounds formed by the transformation of a pesticide by chemical or biological reactions) reach the atmosphere, **streams**, or ground water, they move through the hydrologic system with air, water, or particles, depending on the chemical and physical properties of the compounds.

## Chemicals can take a long time to appear in groundwater

The effects of past and present land-use practices may take decades to become apparent in groundwater. When weighing management decisions for protection of groundwater quality, it is important to consider the time lag between application of pesticides and fertilizers to the land and arrival of the chemicals at a well. This time lag generally decreases with increasing **aquifer** permeability and with decreasing depth to water. In response to reductions in chemical applications to the land, the quality of shallow groundwater will improve before the quality of deep groundwater, which could take decades.





Pesticides are mostly modern chemicals. There are many hundreds of these compounds, and extensive tests and studies of their effect on humans have not been completed. That leads us to ask just how concerned we should be about their presence in our drinking water. Certainly it would be wise to treat pesticides as potentially dangerous and, thus, to handle them with care. We can say they pose a potential danger if they are consumed in large quantities, but, as any experienced scientist knows, you cannot draw factual conclusions unless scientific tests have been done. Some pesticides have had a designated Maximum Contaminant Limit (MCL) in drinking water set by the U.S. Environmental Protection Agency (EPA), but many have not. Also, the effect of combining more than one pesticide in drinking water might be different than the effects of each individual pesticide alone. It is another situation where we don't have sufficient scientific data to draw reliable conclusions.

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Below are other science topics associated with pesticides and groundwater.

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Date published: OCTOBER 9, 2018

Status: Completed

### Groundwater Information by Topic

Groundwater is one of our most valuable resources—even though you probably never see it or even realize it is there. There is water somewhere beneath your feet no matter where on Earth you live.

Groundwater starts as precipitation, just as surface water does, and once water penetrates the ground, it continues moving, sometimes quickly and sometimes very slowly. Eventually groundwater emerges...

Contacts: [Ask USGS](#)



Date published: MARCH 1, 2019

Status: Active

## Pesticides and Water Quality

Pesticides are chemicals designed to kill pests, including insects (insecticides), weeds (herbicides), and fungi (fungicides). The USGS assesses the occurrence and behavior of pesticides in streams, lakes, and groundwater and the potential for pesticides to contaminate our drinking-water supplies or harm aquatic ecosystems.

Contacts: [Lisa Nowell](#)

Attribution: [Water Resources](#), [National Water Quality Program](#)



Date published: FEBRUARY 6, 2019

Status: Completed

## Groundwater Quality

Even though the ground is an excellent mechanism for filtering out particulate matter, such as leaves, soil, and bugs, dissolved chemicals and gases can still occur in large enough concentrations in groundwater to cause problems.

Contacts: [Ask USGS](#)



Date published: NOVEMBER 13, 2018

Status: Completed

## Water Quality Information by Topic

What is in that water that you just drank? Is it just hydrogen and oxygen atoms? Is it safe for drinking? All water is of a certain "quality" (and you can't tell by just looking), but what does "water quality" really mean? Water full of dirt and grime might work fine for a tomato plant but would you want to drink it? Water quality can be thought of as a measure of the suitability of water for...

Contacts: [Ask USGS](#)



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Contacts: [Ask USGS](#)



Date published: NOVEMBER 8, 2018

Status: Completed

## Groundwater True/False Quiz

How much do you know about the water below your feet? Take our Groundwater True/False Quiz and find out.

Contacts: [Ask USGS](#)



Date published: JUNE 18, 2018

Status: Completed

## How the U.S. Geological Survey Monitors Water

There are many pieces of equipment, both mechanical and electronic, that are installed at stream-monitoring sites all around the world to measure, record, and transmit both water-quantity and water-quality information. The U.S. Geological Survey (USGS) monitors "real-time" streamflow and water-quality conditions for thousands of streams ...

Contacts: [Ask USGS](#)



Date published: JUNE 6, 2018

Status: Completed

## Contamination of Groundwater

Groundwater will normally look clear and clean because the ground naturally filters out particulate matter. But did you know that natural and human-induced chemicals can be found in groundwater even if it appears to be clean? Below is a list of some contaminants that can occur in groundwater.

Contacts: [Ask USGS](#)



Date published: JUNE 6, 2018

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## Contamination in U.S. Private Wells

Groundwater is crucial to millions of Americans as well as many more worldwide. Groundwater provides drinking water to many. Thus, having reliably clean groundwater is of concern for many throughout the world. But, groundwater can



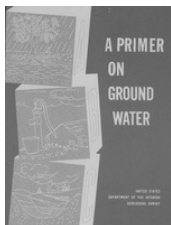
become contaminated with chemicals, biologic organisms, and other possibly-harmful agents.

Contacts: [Ask USGS](#)

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Below are publications associated with pesticides and groundwater.

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Year Published: 1963

### [A primer on ground water](#)

Most of us don't have to look for water. We grew up either in big cities where there was a public water supply, or in small towns or on farms where the water came from wells. But there are some people to whom finding a new supply of water is vitally important.

Baldwin, Helene L.; McGuinness, C.L.

*Attribution:* [United States of America](#)

[View Citation](#) ✓



Year Published: 2010

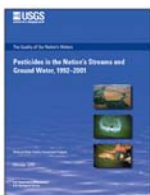
### [Trends in pesticide concentrations in urban streams in the United States, 1992-2008](#)

Pesticide concentration trends in streams dominated by urban land use were assessed using data from 27 urban streams sampled as part of the U.S. Geological Survey National Water-Quality Assessment Program. The sites were divided into four regions, Northeast, South, Midwest, and West, to examine possible regional patterns. Three partially...

Ryberg, Karen R.; Vecchia, Aldo V.; Martin, Jeffrey D.; Gilliom, Robert J.

*Attribution:* [Dakota Water Science Center](#), , [Water Resources](#)

[View Citation](#) ✓



Year Published: 2006

## Pesticides in the Nation's Streams and Ground Water, 1992–2001

This report is one of a series of publications, The Quality of Our Nation's Waters, that describe major findings of the NAWQA Program on water-quality issues of regional and national concern. This report presents evaluations of pesticides in streams and ground water based on findings for the first decadal cycle of NAWQA. 'Pesticides in the Nation'...

Gilliom, Robert J.; Barbash, Jack E.; Crawford, Charles G.; Hamilton, Pixie A.; Martin, Jeffrey D.; Nakagaki, Naomi; Nowell, Lisa H.; Scott, Jonathan C.; Stackelberg, Paul E.; Thelin, Gail P.; Wolock, David M.

*Attribution:* [Water, Ohio-Kentucky-Indiana Water Science Center, Water Resources](#), , [Region 1: North Atlantic-Appalachian, United States of America](#)

[View Citation](#) ✓



Year Published: 2006

## Pesticides in the nation's streams and ground water, 1992-2001 - a summary

Gilliom, Robert J.; Hamilton, Pixie A.

*Attribution:* [United States of America, Water Science School](#)

[View Citation](#) ✓



Year Published: 1994

## Water resources professional's outreach notebook; ground water, grade level 6-8

Vandas, S.J.

[View Citation](#) ✓

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Below are news stories associated with pesticides and groundwater.

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Date published: OCTOBER 12, 2017

## Pesticides, Pollinators, and Pestilence: Protecting Public Health and Pollinators

Tick and mosquito control provides important public health protection, but can also affect pollinator populations. The effects are often dependent on specific local conditions, such as how close the pesticide application is to places pollinators frequent, and when they frequent them.



Date published: AUGUST 9, 2017

## Pesticides Prevalent in Midwestern Streams

One hundred small streams in the Midwest were tested for pesticides during the 2013 growing season and found to contain, on average, 52 pesticides per stream

*Attribution: [Water Resources](#), [National Water Quality Program](#)*

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