



# Breast Cancer and Environmental Risk Factors

March 1998

FACT SHEET #7A

## Reducing Potential Cancer Risks from Drinking Water

### *PART I: Contaminant Sources and Drinking Water Standards*

Many people are increasingly concerned about a variety of contaminants in drinking water, especially those which affect human health. Since the 1970s, when sampling for contaminants increased, hundreds of manufactured chemicals have been identified in various groundwater and other drinking water supplies. The presence of chemical contaminants in drinking water can be attributed to a variety of sources, including the improper disposal of household products and cleaning solvents, leaking landfills and underground storage tanks, discharge from commercial businesses and industries, and increased pesticide use during the past 50 years.

Fortunately, the capability of laboratories to detect a wide range of chemicals has improved greatly during the past two decades. In addition, our scientific understanding of the health risks associated with drinking water contaminants has also improved. As a result, several home water treatment options are now available for reducing exposure to chemicals in drinking water.

Part I (#7A) of this fact sheet provides a brief background regarding drinking water standards, sources of contaminants, and general cancer risks associated with exposure to certain drinking water contaminants.

Part II (#7B) of this fact sheet discusses several home water treatment options for reducing exposure to certain chemicals in drinking water, including some contaminants that are known or suspected to cause cancer in humans.

#### **Drinking water standards and health effects**

According to the Federal Safe Drinking Water Act, the U.S. Environmental Protection Agency (EPA) is required

to establish standards on the concentrations of certain contaminants allowed in public drinking water supplies. The purpose of these standards is to protect public health by ensuring quality drinking water.

Drinking water standards are established for contaminants that are known to occur, or have a substantial likelihood of occurring, in public water systems at levels that may result in adverse health effects. In addition, regulation of the contaminant must present a meaningful opportunity to reduce health risks for people served by public water systems. For this purpose, the EPA reviews all the research available on a contaminant as well as scientific studies regarding the costs and benefits of reducing health risks.

It is important to understand that primary drinking water standards do not guarantee that water with a contaminant level below the standard is risk-free, nor do they indicate that water with a higher level will cause adverse health risks. Current drinking water standards reflect sound scientific judgment and are based conservatively on all knowledge available at the time the standard was set. Drinking water standards are proposed and revised by the EPA on a regular basis.

#### **Understanding Drinking Water Standards**

mg	=	milligram = one-thousandth of a gram
mg/L	=	milligram per liter = part per million (ppm)
mcg	=	microgram = one-millionth of a gram
mcg/L	=	microgram per liter = part per billion (ppb)



## Sources of drinking water

Your drinking water supply is either public or private. A **public water supply** connects many people to the same drinking water system, which collects water from rivers, reservoirs, springs, or groundwater. Public water supplies are tested regularly for contaminants regulated by Federal and State drinking water standards. However, some public water systems may have problems associated with the drinking water treatment or distribution systems. These water quality problems must be reported to water consumers.

Most **private water supplies** rely on groundwater as the source for wells or springs. If you drink water from your own supply, you alone are responsible for its safety. For this reason, private drinking water sources should always be tested before a home is purchased and whenever a new

### TESTING PRIVATE WATER SUPPLIES

The question of whether to have your water tested concerns the health of you and your family. Everyone's water should be safe to drink and acceptable for all household uses. These guidelines will help you evaluate the quality of your private drinking water supply. Contact your local health department or Cornell Cooperative Extension office for additional guidance regarding home water testing and treatment options.

- If your well is located in an agricultural area, test for nitrate and specific pesticides commonly used by the farmer or commercial applicator.
- If you live near a mining operation, test for heavy metals, such as iron, manganese, and aluminum.
- If your drinking water smells like gasoline, or if your well is located near a gas station (operational or abandoned) or fuel storage tanks (above ground or below ground), test for volatile organic compounds (VOCs), such as benzene or toluene.
- If your well is located near a junkyard, landfill, factory, or dry cleaning operation, test for volatile organic compounds (VOCs) and heavy metals, such as nickel, lead, and cadmium.

water supply is being developed. Yearly testing for common contaminants, such as bacteria and nitrate, is recommended to ensure continued safety of your water supply. Occasional testing for specific contaminants, such as carcinogens, may be appropriate depending upon where you live and what activities take place around your water supply.

## Types of drinking water contaminants

Presently, the EPA regulates more than 40 different contaminants that are known or suspected to cause cancer. These contaminants are called **carcinogens**, and it is assumed that no concentration in drinking water is safe. However, the EPA must decide what level of risk is acceptable for regulation. Scientists therefore focus on the relationship between concentration in drinking water and the risk of causing a specified number of cancer cases in a specified population size during the course of a lifetime. For many carcinogens, the concentration causing no more than one cancer per million people is typically in the range of a few parts per billion.

### *Organic Chemicals: Pesticides, VOCs, and THMs*

Pesticides are one category of **synthetic organic chemicals**, which are manufactured by humans from carbon, hydrogen, nitrogen, chlorine, and other elements for a variety of purposes. Pesticides may enter drinking water as a result of accidental spills, illegal dumping, industrial discharge during manufacturing, improper field applications, or excessive rainfall after a normal field application. The health effects of pesticides depend on their chemical characteristics.

Before the 1940s, most pesticides contained heavy metals such as arsenic, mercury, copper, or lead. These pesticides were not readily soluble and rarely leached into groundwater. A group of **chlorinated organic pesticides** were introduced during World War II that were considered to be safer because of their low solubility and tendency to attach to soil particles. These pesticides included DDT, chlordane, heptachlor, heptachlor epoxide, and toxaphene. When it was discovered that these pesticides accumulated in the environment and reached toxic concentrations, most of their uses were restricted, suspended, or canceled. However, some chlorinated organic pesticides may still pose a general cancer risk because of their persistence in the environment and their ability to concentrate in the fat tissues of fish and wildlife.

A new group of organic pesticides, **phosphorus-based compounds** such as malathion and diazinon, replaced the



low solubility chlorinated pesticides. Although highly toxic to humans in their original chemical form, these pesticides generally break down rapidly in the environment and rarely leach to groundwater. Another group of organic pesticides, **carbamates** such as aldicarb and carbofuran, also replaced the chlorinated pesticides. These non-carcinogenic pesticides tend to be soluble in water and may reach groundwater if not degraded in the soil. At the present time, however, very few pesticides currently used by applicators and regulated by the EPA in drinking water are known to cause cancer.

### REDUCING THE RISK OF PESTICIDE CONTAMINATION

Special precautions should be taken when disposing of empty pesticide containers. Rinse the container three times with water and use the rinse water in the same manner the original pesticide was intended. Then wrap the container securely in plastic or newspaper and dispose of it with other household trash. Waste pesticides that have been banned in New York State, as well as unopened containers of household pesticides, usually can be returned directly to the store they were purchased from or to the manufacturer. Check with your local health department, Cornell Cooperative Extension office, or the NYS Department of Environmental Conservation (DEC) for names of pesticides banned in New York State.

**Volatile organic compounds (VOCs)** are chemicals that tend to evaporate rapidly at normal room temperature. When dissolved in water that is heated or stirred, VOCs readily move into the surrounding air. VOCs are commonly found in agricultural and industrial areas where leaking fuel storage tanks, pesticide runoff, seepage from landfills, industrial discharge, and accidental chemical spills may contaminate groundwater. Some VOCs, such as benzene and carbon tetrachloride, are known to cause certain forms of cancer, including leukemia.

Another category of organic chemicals that has been associated with increases in certain cancers is **trihalomethanes (THMs)**. These compounds are actually by-products of the disinfection process known as chlorination. THMs are formed in drinking water when chlorine combines with naturally occurring organic material, such as decomposing leaves or animal waste. Some examples of THMs that may exist in drinking water are chloroform and bromoform.

Since groundwater rarely contains high levels of organic matter, chlorinated private water supplies are less susceptible to the formation of THMs. In fact, THMs are most often found in chlorinated surface waters used for public drinking water supplies. The risk of consuming THMs in chlorinated public drinking water varies with season, water temperature, water chemistry, disinfection method, and other factors. However, the health risks associated with drinking non-disinfected water when there is evidence of pathogenic contamination (i.e. bacteria, viruses, etc.) are much greater than the risk of exposure to THMs. The current drinking water standard for total THMs is 100 micrograms per liter (mcg/L).

### REDUCING THE RISK OF EXPOSURE TO THMS

If disinfection of your water supply is necessary, but you are concerned about the formation of THMs, an effective alternative is the use of ultraviolet (UV) radiation. One advantage of UV radiation is that it requires no chemical input. A low-pressure mercury lamp (resembling a fluorescent lamp) produces UV radiation that passes through a special quartz glass sleeve and into untreated water flowing over the lamp. The UV spectrum of light is higher in frequency than visible light and lower than X-rays. Although UV radiation inactivates bacteria and renders them harmless as a contaminant, it does not remove bacteria from the water. This means that bacteria which survive the UV radiation or enter the drinking water system at a later point may still pose a risk of contamination.

#### *Inorganic Chemicals: Heavy Metals, Arsenic, and Asbestos*

Unlike organic chemicals, which contain carbon, **inorganic chemicals** may or may not contain carbon. Inorganic chemicals may enter groundwater as it passes through contaminated rock or soil, or they may appear as a direct result of human activities: mining, oil or gas drilling, industrial discharges, agricultural practices, leaking landfills, improper disposal of household cleaning products and batteries, corrosion of water distribution systems, and other sources. Long-term consumption of water containing high levels of certain inorganic chemicals is known to cause chronic health effects, including some forms of cancer.

**Heavy metals** comprise one category of inorganic chemicals. Iron, copper, and zinc are common heavy metals found in



drinking water, but they are not considered carcinogens. Heavy metals which are known or suspected to cause cancer include beryllium, cadmium, chromium, lead, and nickel. The EPA has established drinking water standards for each of these inorganic contaminants.

Arsenic and asbestos are also inorganic chemicals known to cause cancer. Arsenic typically exists in a soluble state and may easily enter groundwater from the use of certain defoliants and insecticides. The current drinking water standard for arsenic is 50 mcg/L. However, the EPA is considering strengthening this drinking water standard based on studies that suggest arsenic may cause cancer at lower levels. Asbestos, which under natural conditions is a mineral found in certain rock formations, can be traced to a variety of manufactured sources such as building and fireproofing materials. Although asbestos poses a greater risk to humans who breathe it in the air, it is not related to breast cancer. The current drinking water standard for asbestos is 7 million fibers per liter.

#### *Radioactive Chemicals: Radon and Radium*

Radon is a colorless, odorless, and tasteless gas that is known to cause cancer when inhaled or consumed over long periods of time. Radon is produced by the natural radioactive decay of radium (from uranium) in the ground. Some rocks, such as granite, limestone, and sandstone, contain high concentrations of radium and produce significant amounts of radon. Groundwater found in these rock formations may contain elevated concentrations of radon.

Radon moves easily from the water to the air, which means that waterborne radon contributes to airborne radon. In general, airborne radon poses a greater health risk than waterborne radon. However, the EPA reports that the general cancer risk associated with waterborne radon is higher than any other drinking water contaminant. Scientists estimate that the lifetime risk of developing cancer from water containing high levels of radon is approximately one chance in 10,000.

Certain regions of the United States have groundwater supplies with elevated concentrations of radon. However, scientists agree that completely removing radon from drinking water probably will reduce the average cancer risk by only a few percent because most radon enters the air in a home directly from soil and rocks. Although the EPA has yet to establish a final drinking water standard for radon, it has proposed a drinking water standard of 20 picoCuries per liter (pCi/L) for radium, the radioactive source of radon. Excessive exposure to radium is known to cause bone cancer and other adverse health effects.

## Summary

Some contaminants are known or suspected to cause cancer in humans. These contaminants are called carcinogens, and their presence in drinking water can be attributed to a variety of chemical sources and/or natural conditions. When the EPA establishes primary drinking water standards for carcinogens, it assumes that no concentration in drinking water is safe, but it also must decide what level of risk is acceptable for regulation. For many carcinogens, the concentration in drinking water causing no more than one cancer per million is typically in the range of a few parts per billion.

If you suspect that your drinking water is unsafe, one of the first steps to consider is to contact your local water supplier for a copy of recent test results or have your private water supply tested for the specific contaminants of concern. If a water quality problem is detected, you may choose to consider broad treatment options. Part II (#7B) of this fact sheet discusses several home water treatment options for reducing exposure to certain chemicals in drinking water, including some contaminants that are known or suspected carcinogens.

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**Selected list of carcinogens regulated by the EPA\*, their primary drinking water standard,\*\*  
and potential home treatment options\*\*\***

<b>Organic contaminant</b>	<b>Drinking water standard</b>	<b>Treatment</b>
acrylamide	n/a	AC
adipate (diethylhexyl)	400 mcg/L	AC, aeration
alachlor	2 mcg/L	AC
atrazine	3 mcg/L	AC
benzene	5 mcg/L	AC
benzo(a)pyrene (PAH)	0.2 mcg/L	AC
carbon tetrachloride	5 mcg/L	AC
chlordane	40 mcg/L	AC
di(2-ethylhexyl)adipate	2 mcg/L	AC, aeration
dibromochloropropane (DBCP)	0.2 mcg/L	AC
1,2-dichloroethane	5 mcg/L	AC
1,1-dichloroethylene	7 mcg/L	AC
dichloromethane	5 mcg/L	aeration
1,2-dichloropropane	5 mcg/L	AC
dioxin (2,3,7,8-TCDD)	0.0003 mcg/L	AC
<b>Organic contaminant</b>	<b>Drinking water standard</b>	<b>Treatment</b>
di(2-ethylhexyl)phthalate (PAE)	6 mcg/L	AC
epichlorohydrin	n/a	AC
ethylene dibromide (EDB)	0.05 mcg/L	AC
heptachlor	0.4 mcg/L	AC
heptachlor epoxide	0.2 mcg/L	AC
hexachlorobenzene	1 mcg/L	AC
lindane	0.2 mcg/L	AC
pentachlorophenol (PCP)	1 mcg/L	AC
polychlorinated biphenyls (PCBs)	0.5 mcg/L	AC
simazine	4 mcg/L	AC
styrene	100 mcg/L	AC
tetrachloroethylene	5 mcg/L	AC
total trihalomethanes (TTHMs: bromodichloromethane, bromoform, chlorodibromomethane, chloroform)	100 mcg/L (interim) 80 mcg/L (proposed)	AC, aeration, RO (20-90%)
toxaphene	3 mcg/L	AC
1,1,2-trichloroethane	5 mcg/L	AC, aeration
trichloroethylene (TCE)	5 mcg/L	AC
vinyl chloride	2 mcg/L	AC
<b>Inorganic contaminant</b>	<b>Drinking water standard</b>	<b>Treatment</b>
arsenic (interim)	50 mcg/L	distillation
asbestos	7 million fibers/L	RO
beryllium	4 mcg/L	AC, WS, RO, distillation
cadmium	5 mcg/L	IE, RO, distillation
chromium (total)	100 mcg/L	IE, RO
lead	15 mcg/L (action level)	IE, RO, distillation, AC
nickel	100 mcg/L	WS, RO, distillation
<b>Radioactive contaminant</b>	<b>Drinking water standard</b>	<b>Treatment</b>
Radium 226, 228 (proposed)	20 pCi/L	IE, RO, distillation
Radon (proposed)	300 pCi/L	RO, distillation, aeration

\* All contaminants are classified as known, probable, or possible human carcinogens by the EPA (1996), except for tetrachloroethylene, cadmium, chromium, and nickel, which are classified as known, probable, or possible human carcinogens by the International Agency for Research on Cancer (1997).

\*\* The maximum contaminant level goal for acrylamide, epichlorohydrin, and lead is 0.0 mcg/L. For these contaminants, the EPA requires a treatment technique instead of a primary drinking water standard.

\*\*\* Treatment abbreviations: RO = reverse osmosis, AC = activated carbon, IE = ion exchange, WS = water softener/cation exchange. Aeration devices and some ion exchange units are not listed by NSF International. Consult with a local water professional before making water treatment decisions.



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