Healthy Drinking Waters

for

MASSACHUSETTS

Safe and healthy lives in safe and healthy communities

Radon in Private Drinking Water Wells

Private well owners are responsible for the quality of their drinking water. The U.S. Environmental Protection Agency (EPA) does not regulate private wells. Homeowners with private wells are generally not required to test their drinking water, although local Boards of Health or mortgage lenders may require well water testing. While there is also no state requirement to have your well water tested, the Massachusetts Department of Environmental Protection (MassDEP) recommends that all homeowners with private wells do so, and use a state certified testing laboratory. There is currently no federal drinking water standard for radon.

Summary

Radon occurs naturally in Massachusetts. It is a radioactive colorless, odorless, and tasteless gas. The major health concern for radon is from breathing elevated amounts in the air, which can cause lung cancer. Although, there is a slight risk associated with ingesting water with elevated levels of radon, the primary concern is release of radon from normal water use into indoor air. The first step is to arrange to test your indoor air for radon. The treatment options for radon in water are aeration and the use of granular activated carbon filters.

Potential Health Effects

Exposure to radon gas does not yield immediate health effects. Its effects on the human body are chronic in that they take time to develop. The long-term health effect of exposure to elevated radon levels in indoor air is the increased risk of lung cancer. Radon gas in indoor air is the second leading cause of lung cancer. Drinking water that contains radon can present a risk for developing internal organ cancers, the leading one being stomach cancer. However, the risk of developing cancer from radon dissolved in water is smaller than the risk of developing cancer from radon released into the air.

Sources of Radon in Air and Water

Radon is a radioactive, colorless, odorless, and tasteless gas that is formed through the breakdown of uranium in soil and rocks. Uranium is present as a trace element in granite rock.

There are several ways for radon to enter the home's air:

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EPA United States Environmental Protection Agency New England

- The most common way is radon moving from the soil into the basement through cracks and other openings in the foundation and being released into the air. Homes that are built over bedrock containing radioactive materials are most susceptible to this. Sump pumps can also be a pathway for radon gas to enter the home.
- Radon may be present in groundwater. Therefore homes that are served by bedrock wells are at a further risk for elevated radon levels in the air. Radon gas dissolved in water can be released to indoor air through normal household activities such as showering, dishwashing, and laundry. In this sense, radon is acting like carbon dioxide in a soda bottle that is released once the soda bottle is opened. Some radon may remain in the water.
- Radon may potentially be released into the air from building materials such as granite block foundations, some fireplace materials, and floor or wall tiles.

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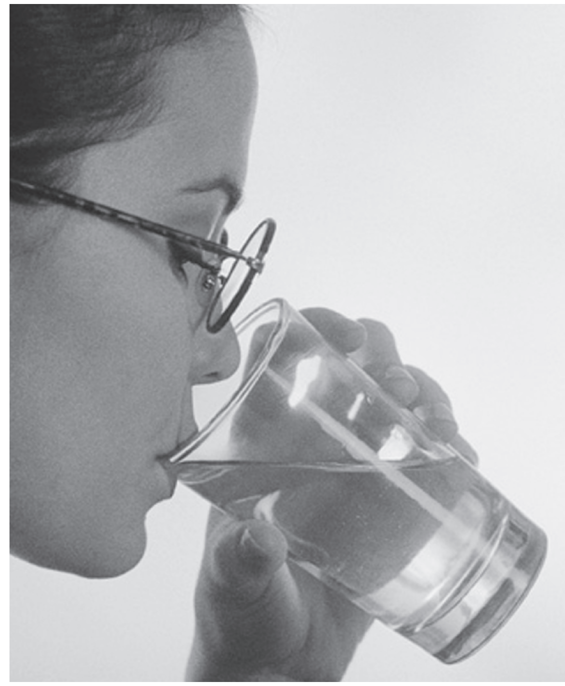
Although there are some exceptions, in general, the migration of radon up from the soil contributes the largest percent of radon found in the average home. Radon from a groundwater water supply source, particularly a bedrock well, contributes the next largest percentage of radon in the home. The radon contributed from building materials is typically very small.

Testing for Radon in Private Drinking Water Wells

It is recommended that both the interior air of a home and the private well water be tested for radon. As radon escapes from water it raises the radon level of the air within a building. The "radon transfer ratio" predicts the increased radon level of indoor air in a home due to the off-gassing of radon from the water. The transfer ratio can vary widely from one home to



another. On average, this transfer ratio predicts that *10,000 pCi/L (picocuries per liter of air) of radon in water can be expected to increase the overall annual average radon concentration of the air in a conventional single family home by approximately 1 pCi/L*. To illustrate this conversion assume the following example: if the radon in water concentration was 5,000 pCi/L, and the radon in the air measure was 3 pCi/L, then 0.5 pCi/L of the airborne radon would likely be attributed to the water and the remaining 2.5 pCi/L would be attributed to radon gas migration up from the soil through the home's foundation. It is important to note that this ratio is an approximation and may vary widely from home to home.

Testing the home for radon in air is simple and inexpensive. If detected, the problem can be fixed. Radon air test kits that meet EPA guidelines are available at some retail outlets, laboratories, or through a certified radon measurement consultant.

If indoor air levels of radon are 4 picoCuries or higher, EPA suggests that you arrange to have your well water tested for radon at a state certified laboratory. Water testing can be done at any time of the year. If the well/water system has not been in regular use, the entire system should be flushed for at least 20 minutes to ensure that fresh water is captured in the sample container. "Old" water will have a lower radon concentration due to radon's half-life of approximately 3.6 days. A review of well water data shows that radon concentrations in water may vary substantially from one test to another due to many reasons including the level of saturated soil above the rock, atmospheric pressure, prior well pumping and other factors. It is recommended that at least two radon tests (at least one month apart when possible) be processed before determining the average radon concentration in water. Follow laboratory instructions carefully to avoid contamination and to obtain a good sample. If your well water contains elevated levels of radon, the levels that may be considered safe or unsafe depends on the levels detected in indoor air and if you reduce indoor air levels. The design of a treatment system for radon in air should consider radon levels in water, where applicable.

Testing For Other Radionuclides In Water

In addition to radon gas, other radioactive minerals such as radium and uranium may be dissolved in drinking water. A test of drinking water for radon gas does not provide meaningful knowledge concerning the presence or absence of any other mineral radionuclides, nor does an elevated level for these dissolved minerals imply the presence of an excessive amount of radon gas. In other words, a minimum of three different laboratory tests are necessary to make an initial assessment of the radioactivity level of a particular well. These tests are:

- Radon gas.
- Dissolved analytical gross alpha radioactivity.
- Radium 228 testing.
- Radium 226 testing - the need for radium 226 testing can be partially evaluated by a review of the analytical gross alpha data.

If you have a bedrock well, radon gas and dissolved analytical gross alpha are the testing priorities.

Interpreting Test Results

Radon in Indoor Air

The U.S. Environmental Protection Agency (EPA) has set an advisory "action level" of 4 pCi/L for radon gas in indoor air. While not a mandated health standard, this level is a guideline for people to use in assessing the seriousness of their exposure to airborne radon. Concentrations noticeably lower than 4 pCi/L are desirable. 4,000 picoCuries of radon in water contribute roughly 0.4 picoCuries of radon to the air for a 1,000 square foot, single story home. The radon concentration in water will determine the type of water treatment option best suited for your situation.

Development of the Radon in Drinking Water Standard

At present there is no federal standard for radon in drinking water. Such a standard is known as a *maximum contaminant level* (MCL). However, the MassDEP Office of Research and Standards has developed a guideline of 10,000pCi/L for radon in drinking water.

Reducing Your Exposure to Radon

Whole house treatment, also known as point-of-entry treatment, is the most effective way to remove radon from your water. Aeration and granular activated carbon filters are the two types of treatment options for radon removal in water. Radon gas can be easily removed from drinking water by the process known as

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aeration. Aeration can achieve over 99 percent removal of radon gas from water. The process consists of mixing large volumes of clean air with the well water. The moist radon laden air is discharged outside the home. The treated water is then repressurized to flow through your plumbing.

Activated carbon is generally not recommended for radon removal, since radioactivity will build up on the carbon. In some cases this could make the carbon in the treatment container too radioactive to be near (in the basement or floor above) and would result in very expensive disposal. Granular activated carbon filters should only be used for water with radon levels less than 10,000 pCi/L. If carbon filters are used, the filters should be handled by a water treatment professional and properly disposed.

Manufacturers and suppliers of radon water treatment devices can be found in the Yellow Pages. Look under the listings for "Water Treatment," "Water Conditioning," or "Radon Testing & Services." Well drillers, pump installers, realtors, and local building and Board of Health officials, often know of local radon treatment equipment suppliers.

Consider both the initial cost and the operating costs. Operating costs include the energy needed to operate the system, additional water that may be needed for flushing the system, consumable supplies and filters, repairs, and general maintenance.

Regardless of the quality of the equipment purchased, it will not operate well unless maintained in accordance with the manufacturer's recommendations. Keep a logbook to record equipment maintenance and repairs. Equipment maintenance may include periodic cleaning and replacement of some components. Also consider any special installation requirements that may add to the equipment cost. For more information, refer to fact sheet: *Questions to Ask When Purchasing Water Treatment Equipment*.

Treatment Options for Air

The most common removal method for radon in indoor air is soil-gas ventilation, which draws radon gas away from the foundation of the house. You can also use a preventative measure such as sealing off potential gas entryways (cracks in walls and floors) to help keep radon out. New construction may provide escape routes for gas generated beneath the foundation to further divert radon gas from entering the house.

Resources

UMass Extension

This fact sheet is one in a series on drinking water wells, testing, protection, common contaminants, and home water treatment methods available on-line at the University of Massachusetts website:
http://www.umass.edu/nrec/watershed_water_quality/watershed_online_docs.html
and Cape Cod Cooperative Extension:
508-375-6699
http://www.capecodextension.org

MA Department of Environmental Protection, Division of Environmental Analysis

Offers assistance, information on testing and state certified laboratories: 617-292-5770
For a listing of MassDEP certified private laboratories in Massachusetts:
http://www.mass.gov/dep/service/compliance/wespub02.htm

U.S. Environmental Protection Agency, New England Office

Information and education on where drinking water comes from; drinking water testing and national laws; and how to prevent contamination:
http://www.epa.gov/ne/eco/drinkwater

US Environmental Protection Agency

For a complete list of primary and secondary drinking water standards:
http://www.epa.gov/safewater

MA Department of Conservation and Recreation, Division of Water Supply Protection

Maintains listing of registered well drillers, information on well location and construction: 617-626-1409
http://www.mass.gov/dcr/waterSupply/welldril/index.htm

NSF International

The NSF International has tested and certified treatment systems since 1965. For information on water treatment systems:
800-NSF-MARK (800-673-6275)
http://www.nsf.org/consumer/

Water Quality Association

The Water Quality Association is a not-for-profit international trade association representing the household, commercial, industrial, and small community water treatment industry. For information on water quality contaminants and treatment systems:
http://www.wqa.org

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