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RADON EDUCATION

HOUSEHOLD WATER QUALITY SERIES 16

YOUR HOUSEHOLD WATER QUALITY: RADON IN YOUR WATER

Radon is a naturally occurring, radioactive gas formed from the decay of uranium and radium found in geologic deposits. When released from underground rocks like granites or shales, radon may easily move toward the surface in air or water. Radon is colorless, odorless, and tasteless. Exposure to radon gas most commonly occurs through elevated levels in home air. However, in Georgia (and the neighboring states of South and North Carolina) there is a lesser, though still significant, risk of exposure to radon dissolved in drinking water.

THE SOURCE OF YOUR WATER IS IMPORTANT

Radon exposure from drinking water is primarily a concern in private wells. In Georgia, wells drilled into granitic crystalline rock aquifers, usually in the northern part of the state (above the "fall-line"; see Figure 1), are at risk of naturally occurring radon contamination. This is where the uranium that decays to radon can be found at higher levels. The aquifer systems in the southern part of Georgia are mainly composed of limestone, rather than granite.

While the Environmental Protection Agency (EPA) estimates that the average concentration of radon in groundwater is between 200 and 600 picocurie (pCi) per liter, the average concentration from granite aquifers may exceed 8,000 pCi per liter. Shallow wells (dug or bored) are often not deep enough to access water in contact with concentrated uranium or radon sources. Surface waters in contact with the air allow radon to escape into the atmosphere.

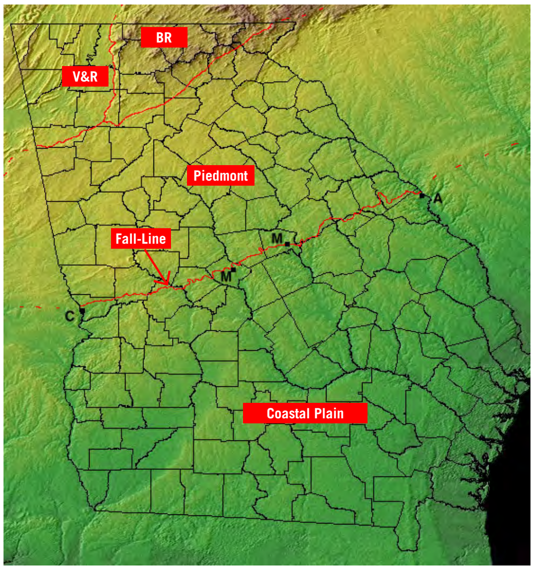

Figure 1. Location of the Fall-Line and Regions in Georgia. Valley and Ridge (V&R); Blue Ridge (BR); Columbus (C); Macon (M); Milledgeville (M); and Augusta (A).

Limited data available from surveys of public drinking water supplies suggests that smaller well-water supply systems contain higher concentrations of radon than larger systems. Crystalline rock aquifers are not porous and release water mainly from large cracks. In most cases, they do not have the capacity to serve larger systems. However, they often provide adequate supplies for small systems. Private homes represent the smallest well water systems, and for these, very little data exist. If you are served by a public water supply system sourced from groundwater, the risk is considered lower than that of a private well. You may wish to ask your water provider if they test for radon.

RADON EXPOSURE PATHWAYS IN THE HOME

Increased radon inhalation from indoor air is considered to be the most important exposure pathway. This may increase the risk of lung cancer. However, a smaller increased risk of stomach cancer is also associated with exposure by direct ingestion of radon dissolved in water.

When radon enters a home through the water supply, it may be released as a gas into the indoor air through the turbulence associated with showering, washing dishes, washing clothes, etc. It is estimated that 10,000 pCi per liter of radon in drinking water contributes 1 pCi per liter of radon to the indoor air of a home through these types of water-use activities. The current action level for radon in indoor air is 4 pCi per liter. However, at present, there is no action level set at the federal or state level for radon in drinking water.

TESTING FOR RADON

University of Georgia Extension can test for the radionuclides—uranium and radon—in your drinking water. Contact your local county Extension office **(1-800-ASK-UGA1)** for details on sampling and submission. In the areas above the Fall-Line, every drilled well should tested; two adjacent wells may show very different radon concentrations. Home indoor air can also be tested for the presence of radon through UGA Extension.

RADON IN DRINKING WATER TEST RESULTS INTERPRETATION

The University of Georgia Agricultural and Environmental Services Lab has adopted the following interpretations for radon in drinking water test results:

- < 300 pCi/L: The radioactivity from radon in the water is considered low and does not pose any considerable health risk from radon due to ingestion. No treatment necessary.
- 301–4,000 pCi/L: The radioactivity from radon in this water is "slightly elevated" but may not pose a significant health risk. Treatment may be considered if the well owners are concerned about radon in their water. A point-of-entry (or whole-house) granular activated carbon treatment system may be considered.
- 4,000–10,000 pCi/L: The radioactivity from radon in the water poses significant health risk due to ingestion and may additionally result in a significant increase in indoor air radon concentrations. A point-of-entry (or whole-house) granular activated carbon or aeration treatment system for removal of radon is recommended.
- > 10,000 pCi/L: The radioactivity from radon in the water poses significant health risk due to ingestion and may additionally result in a significant increase in indoor air radon concentrations. A point-of-entry (or whole-house) aeration treatment system for removal of radon is recommended. Testing for uranium (^{238}U) and radium (^{226}Ra) in the water, using gross-alpha measurement, is recommended because these may be present and may be more hazardous to human health.

Regardless of the results of your radon-in-water tests, we highly recommend testing your indoor air for radon by ordering a test kit (https://radon.uga.edu/). If your indoor-air radon test result is 4 pCi/L or higher, radon mitigation for indoor air is highly recommended.

REMOVING RADON FROM HOME WATER

Because radon gas can be released from water anywhere in the home, it is important to remove it at the point of entry, rather than at the point of use. This means that the radon should be removed at or before the point the water enters the home. Two approaches are recommended for removing radon from drinking water.

- **Aeration Treatment**—these types of systems may bubble air through the water or draw the water into a holding tank. The resulting radon gas is safely vented to the atmosphere (up to 99% effective; ~$4,000 installed). Generally recommended when radon-in-water is > 10,000 pCi/L.

- **Granular Activated Carbon (GAC) Treatment—**this technology traps radon onto activated carbon surfaces until the radon can decay. The carbon requires replacement on a regular basis determined by radon concentration and other water quality factors. Also, there is a chance that decay products can accumulate in the carbon filter to levels that require special disposal measures. Due to this accumulation, it is recommended that GAC systems be located outside the home or in an isolated area. (> 95% effective when radon < 10,000 pCi/L, but not very effective for results higher than 10,000 pCi/L; ~$1,000 installed).

When choosing a treatment system, consider both the initial cost and the operating costs (such as electricity) needed to operate the system, consumable supplies and filters, repairs and general maintenance, the system's radon removal efficiency, life expectancy and warranty, and reputation of the manufacturer.

It is important to note that home water treatment systems are not regulated by federal or state laws. However, there are national and international organizations that offer certification of such products. Look for National Sanitation Foundation International (www.nsf.org) or Water Quality Association (www.wqa.org) certified treatment systems. Certification by one of these two organizations generally assures that the product will perform as specified.

It is also wise to get answers to questions from water treatment professionals before purchasing costly equipment. For a list of such questions and their importance, refer to UGA Extension Bulletin 939, *Water Quality and Common Treatments for Private Drinking Water Systems*. 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.

RADON FACTS

- Uranium (^{238}U), radium (^{226}Ra), and radon (^{222}Rn) emit alpha particles as they decay.
- Radon does not react chemically in the environment, so it travels easily in soil, air, and water.
- Alpha (α) particles are made up of two protons and two neutrons. Alpha particles do not travel very far in air and cannot penetrate skin. When inhaled or ingested, however, they can cause severe damage to sensitive body organs. This is what leads to an increased risk of cancer from radon exposure.
- The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the Environmental Protection Agency (EPA) consider radon to be a human carcinogen.
- As of 2015, the EPA has set no guideline for acceptable levels (*maximum contaminant limits*) of radon in drinking water.
- Some U.S. states have set limits on radon levels in drinking water to between 4,000 and 10,000 pCi per liter.
- Average concentrations of radon in U.S. groundwater range from 200 to 600 pCi per liter.
- The highest known measured concentration of radon in drinking water from a Georgia well was 140,000 pCi per liter.
- Home air can be elevated by 1 pCi per liter for every 10,000 pCi per liter of radon in drinking water.

Note: *PicoCuries (pCi) and Becquerels (Bq) are units of radioactivity. One Bq = 27 pCi.*

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