

Radon in Groundwater in Orange County

What is radon? Radon is a colorless, odorless gas produced naturally during the decay of radium. Radium and radon are commonly found in soils and in granitic rock. Since radon forms naturally in the subsurface, it can be found in both air and groundwater.

What is the problem with radon? Radon is the second leading cause of lung cancer in the United States (after smoking) and causes nearly 21,000 deaths per year (EPA 2003). More people in the United States are killed each year by radon than by hurricanes, tornadoes, floods, earthquakes and lightning combined, making radon the single most deadly natural hazard (Wood, 2006).

According to the North Carolina Radon Program web site: “The health risk from radon occurs when it is inhaled. Radon gas decays... into radioactive particles which can damage lung cells and lead to lung cancer.” Most exposure is a result of the presence of radon in indoor air. Nearly all radon that enters buildings comes from soil, with an additional percentage of total indoor air exposure due to radon which is dissolved in water, once this water is used for laundry, bathing and other household tasks.

What about radon in water? The EPA Radon web site states: “The radon in your water supply poses an inhalation risk and an ingestion risk. Research has shown that your risk of lung cancer from breathing radon in air is much larger than your risk of stomach cancer from swallowing water with radon in it. Most of your risk from radon in water comes from radon released into the air when water is used for showering and other household purposes. A radon in water problem is more likely when the source of the water is ground water...”

How is radon exposure regulated? Since radon exposure can either occur through inhalation of the gas or through ingestion of dissolved gas in water, health-based regulations must address exposure to radon via both air and water.

The EPA sets drinking water standards for substances that are known to cause cancer. These standards establish a Maximum Contaminant Level (MCL) to restrict the exposure of the public to known carcinogens, while weighing health benefits, the costs and the benefits of various exposures. In 1991 the EPA proposed a MCL of 300 picocuries/liter¹ (pCi/l) for radon in drinking water and an alternative MCL (AMCL) of 4,000 pCi/L in drinking water. The AMCL would overrule the MCL if a state has adopted a Multimedia Mitigation (MMM) program to address reducing the concentration of radon gas in indoor air. Currently, the proposed MCL and AMCL limits have not been adopted by the Federal government. The National Ground Water Association (2007), when referring to the 300 pCi/L and 4,000 pCi/L levels, states “You might use these limits as your personal “action levels” when you test the water from your well.” In lieu of federal limits, some states have developed guidelines for radon in drinking water;

¹ The curie is a measure of radioactivity, and is defined as 0.037 decays/second, which is roughly the radioactivity of one gram of radium. A picocurie is 10⁻¹² curies.

including 2,000 pCi/L in New Hampshire (New Hampshire Department of Environmental Services, 2007) and a proposed state MCL in New Jersey of 800 pCi/L (New Jersey Drinking Water Quality Institute, 2009).

What is the indoor air radon situation in Orange County? According to the North Carolina Radon Program web site, “radon (in indoor air) has been found in elevated levels (>4pCi/L) in many counties throughout North Carolina. ...the upper piedmont and mountain areas have the greatest proportion of homes with elevated levels of radon.” The EPA has ranked all North Carolina counties from 1 to 3 in terms of average predicted indoor radon content, with Zone 1 counties having the highest predicted indoor radon concentrations and Zone 3 the lowest. Orange County is classified by the EPA as a Zone 3 county, meaning that the average predicted indoor radon level is less than 2 pCi/L. Even though Orange County is classified as a Zone 3 county, homes with elevated indoor concentrations of radon (>4pCi/L) have been found in all three Zones, not just in Zone 1 counties. **The EPA and the U.S. Surgeon General recommend that all homes should be tested for indoor air radon content.** In April 2010, the report of the President’s Cancer Panel recommended that the EPA consider lowering the 4 pCi/L action level for radon. This report also stated that “most radon-induced lung cancers arise from exposures below that level.” In 2009, the World Health Organization lowered their recommendation for a maximum acceptable radon concentration in a residential dwelling to 2.7 pCi/L (U.S. Dept of Health and Human Services, 2010).

What do we know about radon in groundwater in Orange County? The “*Investigation of Ground-Water Availability and Quality in Orange County, North Carolina*” (Cunningham and Daniel, 2001) includes information concerning radon content in 51 water wells sampled in Orange County. This report states that “Radon activity measured in Orange County ground water ranged from 38 to 4,462 pCi/L county-wide, with a median activity of 405 pCi/L.”

The Orange County Health Department, Environmental Health Services has conducted radon analysis on 37 groundwater samples collected within the county. The radon content of these samples ranged from 80 to 4,220 pCi/L, with an arithmetic mean of 1,039 pCi/L. In total, of the 88 groundwater samples collected in Orange County in 1998 and 2001, 66% contained radon at a concentration greater than the proposed MCL of 300 pCi/L. Three percent of the 88 samples contained radon above the proposed AMCL of 4,000 pCi/L.

What can be done about radon in groundwater? The US Surgeon General has stated “It’s important to know that this threat (radon) is completely preventable. Radon can be detected with a simple test and fixed through well-established venting techniques.” A *Citizen’s Guide to Radon* (EPA, 2005) states “If you’ve tested your private well and have a radon in water problem, it can be fixed. Point-of-entry treatment can effectively remove radon from the water before it enters your home.”

What should homeowners do?

- **The EPA and the U.S. Surgeon General recommend that all homes be tested for indoor air radon content.** The Orange County Health Department, Environmental Health Services can assist residents with information about indoor air testing. Testing indoor air for radon content is quick and easy. If your indoor air contains more than 4 pCi/L of radon and you utilize well water, you should consider testing your well water for radon content. If you are concerned about potential radon exposure and would like to have your indoor air or well water tested for radon content, the Orange County Health Department, Environmental Health Services can assist residents with information concerning radon in air and water testing.
- Repairs to homes with elevated radon in air content should be considered to reduce the concentration of radon within the structure. Information concerning such repairs can be accessed from the sources listed below. The EPA recommends that buildings with indoor radon concentrations greater than 2 pCi/L be repaired to reduce the airborne concentration of radon.
- Efforts to reduce radon content in well water may also be warranted. Information concerning reducing radon in well water content can be obtained using the links listed below. An aeration system or a granular activated charcoal system to remove radon from water can easily be installed by a professional (National Ground Water Association, 2007).

Links and Contacts:

Orange County Health Dept., Environmental Health Services: (919) 245-2360

<http://www.co.orange.nc.us/envhlth/index.asp>

H2Orange, an Orange County initiative to provide information regarding water resources:

<http://www.co.orange.nc.us/ercd/h2orange/index.asp>

Orange County Environment, Agriculture, Parks and Recreation Department:

<http://www.co.orange.nc.us/deapr/index.asp>

NC Radon Program Web Site:

<http://www.ncradon.org/index.htm>

EPA Radon Web Site:

<http://www.epa.gov/radon/index.html>

- **1-800-SOS-RADON (767-7236)*** National Radon Info line
- **1-800-55RADON (557-2366)*** To get live help for your radon questions.
- **1-800-644-6999*** Radon Fit-It Hotline. For general information on fixing or reducing the radon level in your home.
- **1-866-528-3187*** Línea Directa de Información sobre Radón en Español. Hay operadores disponibles desde las 9:00 AM hasta las 5:00 PM para darle información sobre radón y como ordenar un kit para hacer la prueba de radón en su hogar.
- **1-800-426-4791** Safe Drinking Water Hotline. For general information on drinking water, radon in water, testing and treatment, and standards for radon drinking water. Operated under a contract with EPA

* Operated by the National Safety Council in partnership with EPA

References:

Campbell, T. R., 2006, Radon in the Ground Water Supplies of North Carolina, from the proceedings of: Workshop on Radon Occurrence, Health Risks and Policy, with an Emphasis on Radon in Ground Water Drinking Supplies, Duke University, Durham, North Carolina.

Cunningham, W. L. and Daniel, C. C., 2001, *Investigation of Ground-Water Availability and Quality in Orange County, North Carolina*: U.S. Geological Survey Water-Resources Investigations Report 00-4286, 59 p.

National Ground Water Association, 2007, *Radon: What You Need to Know*. 1p.

National Research Council, Committee on Risk Assessment of Exposure to Radon in Drinking Water, 1999, *Risk Assessment of Radon in Drinking Water*, Executive Summary, 6p.

New Hampshire Department of Environmental Services, 2007, *Radium, Radon, and Uranium: Health Information Summary*, Environmental Fact Sheet, 4p.

New Jersey Drinking Water Quality Institute, Department of Environmental Protection, 2009, *Recommendation for the Regulation of Radon in Drinking Water Memorandum*, 1p.

North Carolina Cooperative Extension Service, 1996, *Radon in Water*, Publication Number HE-396, 3p.

Spruill, T.B., Williams, J.B., Galeone, D.R., and Harned, D.A., 1997, *Radon In Ground Water in Guilford County, North Carolina*: U.S. Geological Survey Fact Sheet FS-147-97, 4p.

United States Department of Health and Human Services, National Institutes of Health, National Cancer Institute, April 2010, *Reducing Environmental Cancer Risk: What We Can Do Now, 2008-2009 Annual Report of the President's Cancer Panel*, 240 p.

United States Environmental Protection Agency, Indoor Air Division, 2005, *A Citizen's Guide to Radon: The Guide to Protecting Yourself and Your Family from Radon*: EPA 402-K02-006, 16p.

United States Environmental Protection Agency, Indoor Air Division, 2003, *Assessment of Risks from Radon in Homes*: EPA 402-R-03-003, 99p.

Radon Occurrence in Groundwater in Orange County

Radon, a colorless, odorless gas, occurs naturally and has been detected in well water samples and in the air of some homes in Orange County. Radon is the second leading cause of lung cancer in the United States after smoking. When radon decays after it is inhaled, the resulting radioactive particles can damage lung cells and cause lung cancer. The most common route of exposure to radon is through breathing indoor air which contains radon. Radon in water can also be a source of exposure if your water supply is groundwater, especially if the underlying bedrock contains granite, which can produce higher concentrations of radon gas than other types of bedrock.

In 1991 the U.S. Environmental Protection Agency (EPA) proposed a Maximum Contaminant Level (MCL) for radon in drinking water of 300 picocuries per liter (pCi/L), and an alternative MCL (AMCL) of 4,000 pCi/L if a state has adopted a program to address radon concentrations in indoor air. Since neither the MCL or AMCL have been adopted at the Federal level, and since North Carolina has also not adopted regulations governing exposure to radon, these values can possibly be used as advisory or action levels.

The EPA recommends that all homes be tested for indoor air radon content. If you utilize water from a private well, you may also want to have your water tested for radon. If you would like to find out how to have your indoor air or well water tested for radon content, contact the Orange County Health Department, Environmental Health Services at 919-245-2360.

Radon Concentrations in Groundwater (picocuries/liter- pCi/L)

- Radon detected below the proposed MCL of 300 pCi/l
- Radon detected between 300 pCi/l and 3,999 pCi/l (above proposed MCL and below alternative MCL)
- Radon detected equal to or above alternative MCL of 4,000 pCi/l

Data Sources: Radon in groundwater data from 1998, 1999 and 2001 sampling events and from the North Carolina Department of Environment and Natural Resources - Division of Water Quality and the United States Geological Survey.
Cunningham, W. L. and Daniel, C. C., 2001, *Investigation of Ground-Water Availability and Quality in Orange County, North Carolina*: U.S. Geological Survey Water-Resources Investigations Report 00-4286, 59 p.

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