

**RADIUM IN DRINKING WATER:
EXPOSURE AND POTENTIAL HEALTH IMPACTS
SUMMARY REPORT**

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I. Description

Radium (Ra) is a naturally occurring radioactive element found in rock and soil that is derived from the decay of uranium and thorium; Ra-226 is the most plentiful radium isotope found in the environment but Ra-223, Ra-224, and -228 are also common ^{1,2}.

Radium in drinking water – municipal wells

Radium is found in most water sources; surface waters are generally low in radium but ground water sources can contain significant concentrations dependent upon the uranium and thorium content of the surrounding geology^{1,2}. In the City of Madison, municipal drinking water resources are derived from deep sandstone groundwater aquifers and are routinely tested for radium in accordance with state and federal guidelines. Testing of all wells between 2008-2009 yielded radium levels ranging from 0.35 to 4.90 picoCuries per liter (pCi/L) with the vast majority of the municipal wells (approximately 74%) containing less than 2 pCi/L of radium (combined Ra 226 and Ra 228). Although two wells (Wells 15 and 27) reported radium concentrations slightly under the maximum contaminant level (MCL) of 5 pCi/L established by the Environmental Protection Agency (US EPA), all wells were compliant with existing federal standards.

Recent testing conducted in 2011 of the six wells with the highest radium concentrations from 2008-2009 (Wells 7, 8, 15, 19, 27, and 28) ranged from 1.4 to 5.8 pCi/L. Specifically, reported results from Wells 7, 8, and 15 were < 3pCi/L, and Wells 27 and 28 reported 3.7 pCi/L; each meeting the federal water quality standards. Results reported from Well 19 were 5.8 pCi/L; slightly higher than the MCL. Additional samples will be analyzed to confirm results⁴. If confirmed to be greater than 5 pCi/L, quarterly sampling will be required to monitor compliance and options will be investigated to reduce radium levels in City of Madison municipal well 19 in an efficient and cost-effective manner⁴.

III. Radium in drinking water – private wells

In most cases, private wells are not drilled as deep as municipal drinking water wells and do not contain large concentrations of radium. However, radium has been located in a small number of Wisconsin private and non-community wells. Concerned owners whose wells have not been tested may contact a regional office of the Wisconsin Department of Natural Resources for an estimated concentration of groundwater radioactivity based upon previously conducted geological and geographical investigations across the state. If high concentrations of radium are detected, the ground water could be treated or the well updated or replaced to reduce detectable levels of radium. Possible treatment options include in-home water softening units and/or reverse osmosis systems⁵.

IV. Health impacts of radium

Long term exposure to elevated levels of radium in drinking water has been associated with an increased risk of bone cancer development^{1, 5}. Although the consumption of drinking water containing radium concentrations below the established MCL does not alleviate all potential risk, the overall impact to public health at these concentrations is considered negligible. Drinking water resources that exceed this standard are not inherently unsafe but do pose a small dose-dependent increase in disease risk compared to drinking water resources that are below the MCL^{1, 2, 5}. For example, the US EPA estimates that long-term consumption of water containing 5 pCi/L will cause an estimated 44 additional cancer deaths per every 1 million people exposed; an approximate 0.004% increase ($44/1,000,000 \times 100$) in the risk of cancer development. This risk doubles with long-term consumption of water containing 10 pCi/L and triples with the consumption of 15 pCi/L; approximate increases of 0.009% and 0.013%, respectively, compared to individuals consuming drinking water with radium concentration below federal standards⁵.

V. Summary and conclusion

Radium is a naturally occurring radioactive element commonly found in drinking water supplies that has been associated with an increased risk of bone cancer development when consumed in elevated levels. Recent testing of City of Madison municipal wells reported that the level of radium in Well 19 is slightly higher than the MCL established by the US EPA for acceptable levels of the contaminant; additional samples will be collected to confirm these results. Although the level is elevated, the increased risk of bone cancer development derived from the consumption of City of Madison drinking water is minimal and not expected to significantly impact disease incidence. Despite this limited increase in disease risk, steps are needed to reduce this contaminant to concentrations that are both in compliance with federal standards and reduce the potential risk of disease development to levels comparable to concentration below the established MCL.

VI. References

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