

Radon Levels in Missoula County: An Updated Study

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Abstract

While the science community has been aware of radon since the beginning of the twentieth century, it wasn't until 1986 that the Environmental Protection Agency (EPA) began to warn homeowners of the gas's potential health effects. When congress passed the Indoor Radon Abatement Act of 1988, it set long-term goals for the safety of indoor air across the country, and further, directed the EPA to survey every county in the United States in an effort to list those with the highest potential for radon. In 1989, the Missoula City-County Health Department (MCCHD) joined in this effort and began asking residents to monitor their homes. By 1993, the department had information on approximately 500 residences and began to assess radon potential in the Missoula Valley, an effort which continues today. Our current study summarizes the results to date, as well as discusses the trends and changes seen in these results versus the information gathered in a 1993 study headed by MCCHD's Doug Kikkert. This 2011 study, as well as the study done in 1993, demonstrates not only that Missoula County has a high potential for radon overall, but that the only guaranteed way of knowing the radon level in a particular house is to test.

Introduction

Radon is a colorless, odorless gas formed from the radioactive breakdown of uranium in soils, rock and water. While the gas itself is inert, the radioactive byproducts created during this natural process are a potential health threat. These byproducts, often captured on dust particles, get introduced into the lungs where they can affect the epithelium. Over time, these affects can lead to lung cancer. Each year, EPA estimates that 21,000 deaths are attributed to radon induced lung cancer, making it the second leading cause of that disease in the United States; and while the gas is a naturally occurring phenomenon, testing and prevention are both easy to do.

Knowing the radon level in one's home is the first step. Radon comes from the ground, drifting up through fissures in the rocks and seeping up through the soil. While it normally escapes into the atmosphere, when a structure like a home blocks its route, there is a potential for it to seep inside, most often through cracks or gaps in a basement or foundation. The gas can then get trapped inside the house, especially if the home does not have adequate ventilation or is energy efficient, inhibiting the exchange of gases with the outside. According to the U.S. Geological Survey, homes built in areas with light volcanic rocks, granite, dark shale, and coarse glacial deposits are most likely to have high indoor radon. In light of this, it should come as no shock that Montana, namely the Missoula Valley, which is an area rife with glacial till, has a high potential for radon exposure.

Method

Since 1993, Missoula City-County Health Department has distributed radon test kits by AirChek, a common radon test kit distributor. Since the late 1990's, the department has also increased test distribution with the use of state grant money intended for raising radon awareness. Most recently MCCHD used this money to fund newspaper advertisements/coupons, direct mailings and bus bench advertisements located in areas with high radon potential. Grant money was also used to provide free radon test kits to groups that serve high-risk populations such as University of Montana Off-Campus Housing; our local Women, Infants & Children (WIC) office; and Missoula child care providers.

All data points gathered through Air Chek for Missoula County since 1993 were compiled. Duplicate results were found by matching Lat/Long coordinates and the second result was discarded (unless noted as repeat samples following remediation) as well as any tests exposed outside of the recommended testing parameters of 72-168 hours. Data points were then sorted by zip code for consistency with the 1993 Kikkert study, and ease of viewing and sorting the data for target mailings and future awareness efforts. The points were mapped by GIS, using color indicators to delineate different radon levels, and then statistically analyzed.

Results and Discussion

The 2,833 data points had radon levels ranging from 0 pCi/L to 475.10 pCi/L (Table 1, Appendix : Radon Testing and Zip Codes). The overall arithmetic mean of the data, as well as the mean in each zip code with a substantial sample size, were all well above the EPA recommended action level of 4.0 pCi/L (Table 1, Figure 1). Zip Codes 59826 and 59868 had means below the action level of 1.8 (n=2) and 1.03 (n=3) respectively, but their sample sizes were too small to be statistically significant individually. As a result, they weren't included in the individual zip code analysis but, their data was taken into account for the county as a whole. The lowest average radon level of the remaining zip codes belonged to 59801, the area situated solely on the valley floor, while the highest average and most variable area belonged to 59821, the area situated just north of the I-90/Hwy 93N interchange, an area on the edge of the Missoula Valley. While all areas of Missoula County have concerning levels, 59821, along with 59825 (Clinton area) and 59834 (Frenchtown), were especially concerning, having average readings above 10 pCi/L, more than twice the recommended action level and more than 7.9 times the national average of 1.3 pCi/L listed by EPA.

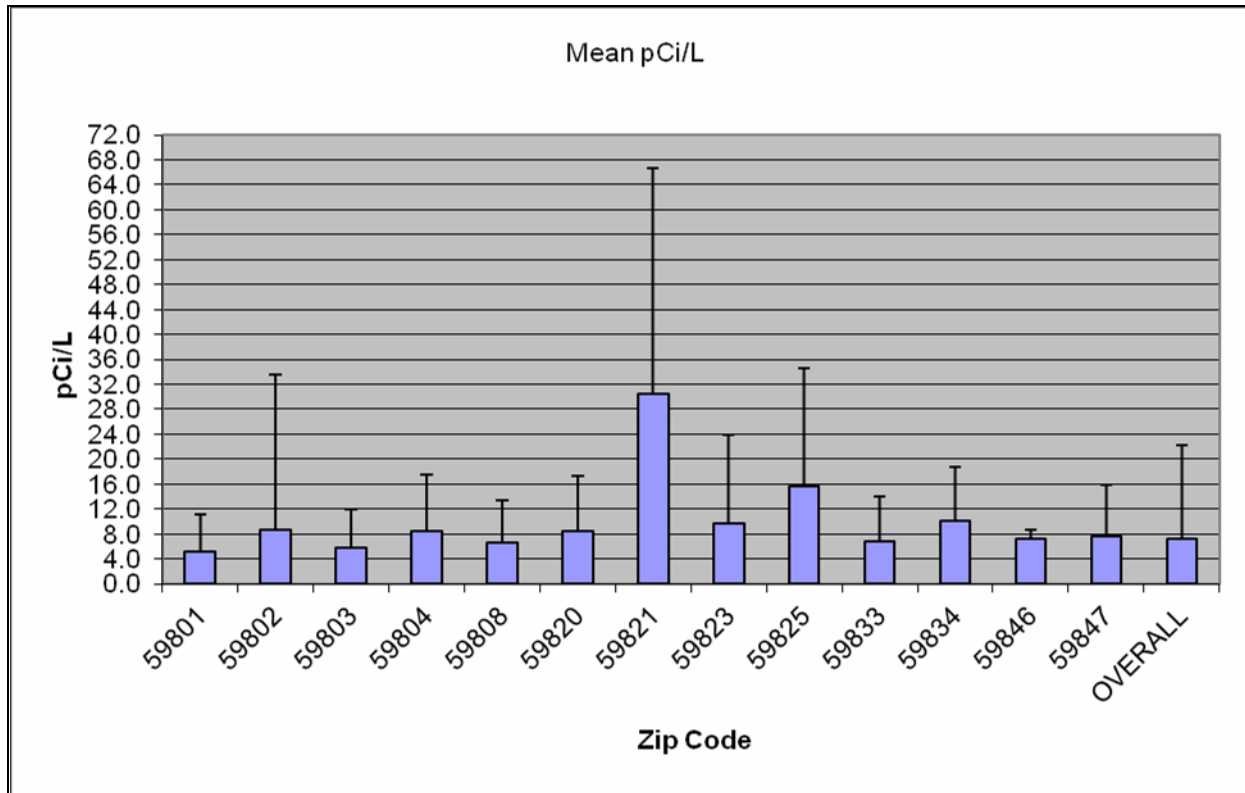
Table 1 – Averages and Stats Overall and by Zip Code

ZIP	N	AVERAGE	STDEV	MEDIAN	MAX
59801	776	5.1	6.07	3.7	97.2
59802	793	8.7	24.88	5.0	475.1
59803	580	5.8	6.13	4.1	50.9
59804	189	8.4	9.01	5.1	44.6
59808	220	6.5	6.88	4.6	49.3
59820	17	8.4	8.99	4.4	32.3
59821	22	30.5	36.09	9.4	100
59823	13	9.7	14.02	4.1	49.9
59825	32	15.6	18.97	8.2	84.1
59833	26	6.8	7.27	3.7	25.5
59834	18	10.1	8.56	6.5	29.2
59846	32	7.3	1.38	4.7	39.2
59847	103	7.6	8.16	5.4	45.1
OVERALL	2833	7.1	15.05	4.4	475.1

(see appendix for graphic representation of where zipcodes are located in county)

Note: Samples in zipcodes 59826 and 59868 were not included because of low sample sizes (n-values)

Figure 1 – Averages by Zip Code



The data also show a large degree of variability with the exception of those areas with a negligible sample size. This can be attributed to a number of factors such as age of home and type of home construction, floor of home tested, soil/geology type in the immediate area of the home, and operator error. The latter of these our department tried to control as much as possible, giving instructions with each kit, explaining proper testing methods to walk-in purchasers, and eliminating any data with exposure times outside the recommended parameters, but this did not completely control for operator error. Even the areas with the lowest averages and the highest n-values show a high degree of variability, making characterization of a Missoula area as low or high risk for radon impossible and risky considering that some areas have maximum readings as high as 365 times the national average and 119 times the EPA's action level (Table 1).

This conclusion that Missoula is an overall high radon area is supported by the percentage of homes which tested above 4.0 pCi/L, the EPA's action level (Table 2, Figures 2 and 3). There were very few zip codes with less than 50% of the homes tested above 4.0 pCi/L: 59801, 59826, 29833, and 59868. All of these zip codes, with the exception of 59801, had meager n-values, with 59826 and 59868 having n-values so low that they were excluded from the zip code analysis. The rest of Missoula County had more

than half of the homes above 4pCi/L, and one as high as 72.73% in 59821. Overall, more than 54% of the homes tested in the county were over the action level, 35% between 4.0 and 10pCi/L, and roughly 5% with levels higher than 20pCi/L.

Table 2 – Percentage of Homes Over 4.0 pCi/L

Zip	N	>4.0	% >4.0
59801	776	361	46.5
59802	793	457	57.6
59803	580	292	50.3
59804	189	105	55.6
59808	220	124	56.4
59820	17	10	58.8
59821	22	16	72.7
59823	13	8	61.5
59825	32	22	68.8
59833	26	12	46.2
59834	18	14	77.8
59846	32	19	59.4
59847	103	59	57.3
Total	2821	1499	768.8

Figure 2 – Percent Over 4.0 pCi/L

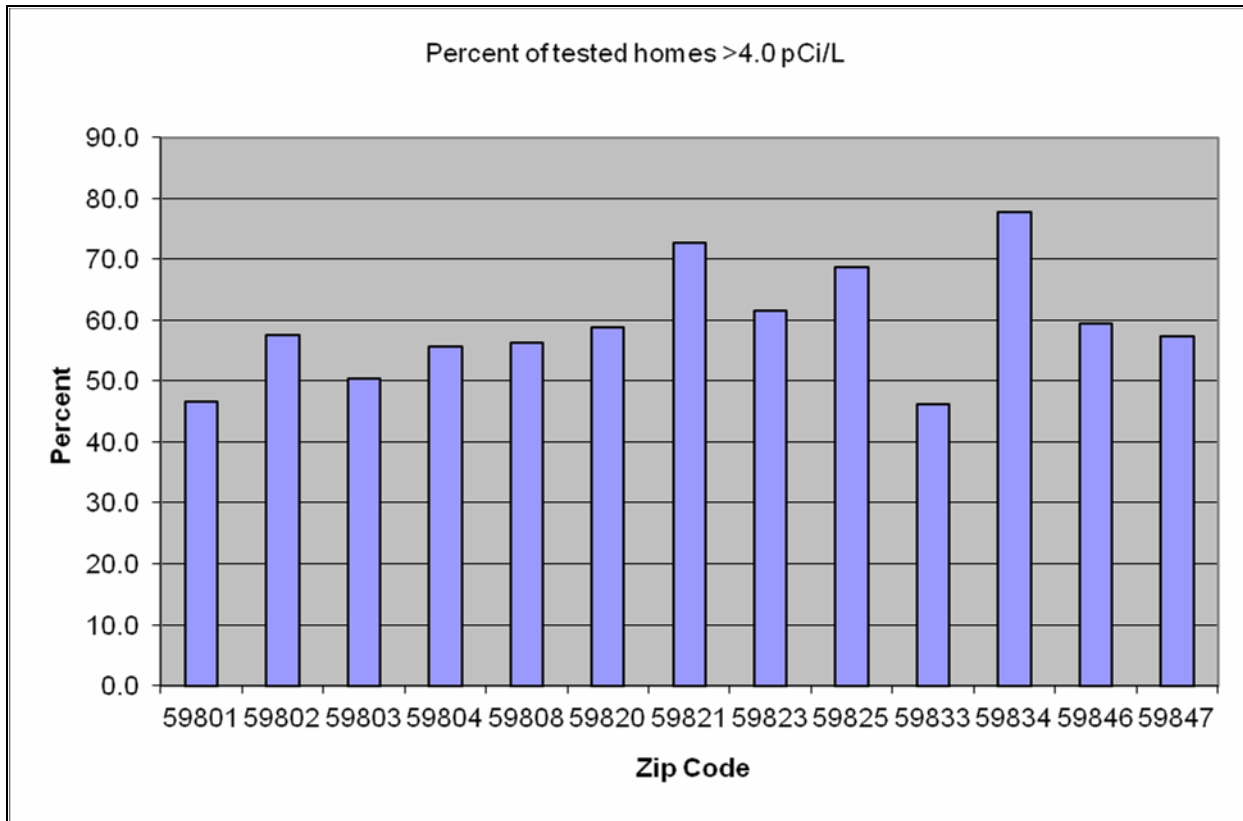
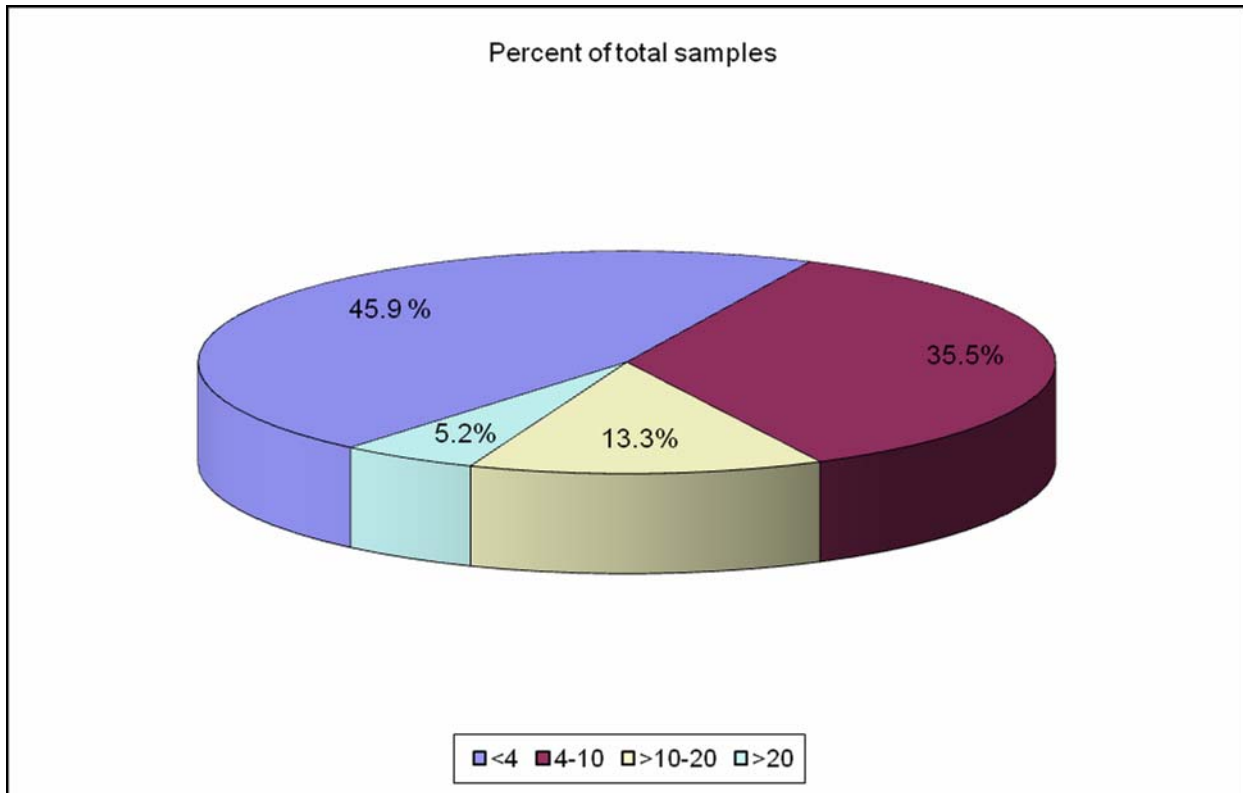


Figure 3 – Missoula County Radon Data



Comparison to the 1993 Kikkert Study:

This study, as well as the study Kikkert compiled in 1993, confirms Missoula Valley’s potential radon risk. In 1993, Kikkert had roughly 450 data points with a range of 0.0 to 63.5 pCi/L in comparison with our current study which analyzed over 2800 data points and had a maximum of 475.10 pCi/L (Table 3). Both studies had highly variable data sets.

Both studies demonstrate an overall risk of radon exposure in Missoula County, finding that over half of the homes tested had over 4.0 pCi/L; our current study showing an increase from 1993 by approximately 3% (Table 3). The 2011 study also found an increase in the number of homes with radon levels in the 10-20pCi/L range, and in the percentage above 20 pCi/L. 2011 also revealed an increase in 59801 and 59802 mean values, but oddly enough, a decrease in the results in 59803. Kikkert did not report data in the other zip codes looked at in our 2011 study.

Kikkert did however look at several parameters not reviewed in 2011. He conducted phone interviews and collected data on home age and construction, floor of home tested, and compared radon levels in relation to homes with basements versus crawl spaces. He also used test kits designed for a longer

exposure time and considered the underlying geology in the county, attributing the lower values associated with 59801 to the difference in the bedrock of the side hills versus that of the valley floor.

Kikkert concluded in 1993 that that older, or less energy efficient homes, had lower indoor radon potential and that lower floors had higher readings than upper floors of the home. He also discovered that homes with crawl spaces instead of basements had consistently lower indoor radon levels.

Table 3: Comparison to 1993 Study

	1993	2011
N	455	2833
Range (pCi/L)	0-63.5	0-475.1
% over 4pCi/L	51.2	54.1
% 4-10pCi/L	37.4	35.5
% 10-20pCi/L	10.1	13.3
% over 10pCi/L	3.7	5.2
59801 Mean (pCi/L)	4.2	5.1
59802 Mean (pCi/L)	5.8	8.7
59803 Mean (pCi/L)	7.1	5.8

Conclusions and Future Applications:

There is no doubt that Missoula is a high radon area as discovered in the 1993 study and reconfirmed in 2011. The data clearly demonstrate that we cannot assume that there is any “safe” or “low radon” area, and due to the differences in home construction, location and other factors, each home has a different potential risk for radon, meaning the only way to assess one’s radon level is to test.

Based on this information, Missoula City-County Health Department will continue to make radon awareness one of our missions. Using the data gathered in this study, as well as other information regarding home construction gathered by Kikkert in 1993, MCCHD will be able to better focus our efforts to areas where little testing has been done, averages are higher and the homes are newer.

Acknowledgements and References:

US Environmental Protection Agency. 2003 June. EPA Assessment of Risks from Radon in Homes. Available at www.epa.gov.

US Environmental Protection Agency [Internet]. Radon|Indoor Air. Available at <http://www.epa.gov/radon/index.html>

Kikkert, D. 1993. Radon Levels in Missoula and Surrounding Vicinity.

US Geological Survey [Internet]. 1995 October. The Geology of Radon. Available from: <http://energy.cr.usgs.gov/radon/georadon/3.html>

Appendix:

Radon Testing by Zip Code, Missoula County 1994-2011

Zip Codes Radon Levels

59801	0 - 4 pCi/L
59802	4.1 - 8 pCi/L
59803	8.1 - 12 pCi/L
59804	12.1 - 20 pCi/L
59808	20.1 - 40 pCi/L
59820	40.1 - 60 pCi/L
59821	60.1 - 100 pCi/L
59823	100.1 - 200 pCi/L
59825	200+ pCi/L
59826	
59833	
59834	
59836	
59846	
59847	
59851	
59868	

