

# **TESTING FOUNDATION TYPES DURING RADON SCREENING AND ITS IMPLICATIONS FOR CLIENT SAFETY AND MITIGATION**

Wallace O. Dorsey Jr., Radon-Ease Inc.

Richmond, VA USA

Email [wally@radonease.com](mailto:wally@radonease.com)

## **Abstract**

Many homes have multiple methods of attachment to the earth; e.g., crawl space, slab and sometimes multiples of each. Testing the living space above each of the areas is similar to testing a different home. When testing each area independently, one finds varying radon levels in each area, often substantially so. Sometimes the most elevated readings are in areas other than the basement, such as the living space above the crawl space. Here are described and quantified those differences and the importance of discovering those differences in the initial screening process, potentially protecting clients' health and reducing liability from future lawsuits.

## **Introduction**

Here, using several examples of tested, and subsequently mitigated, single-family, detached homes, are demonstrated the need to test each area of a building that has different or multiple means of contact with the earth during the radon screening process. Testing was conducted using continuous radon monitors (CRMs). The buildings and homes covered a broad region topographically and geologically across Central Virginia. The geology ranged, from heavy, dense clay soils, to sandy soils and areas of heavily decayed rock and rocky outcroppings. Various construction techniques, e.g., crawl spaces, conditioned crawl spaces, concrete slabs and basements, are reviewed.

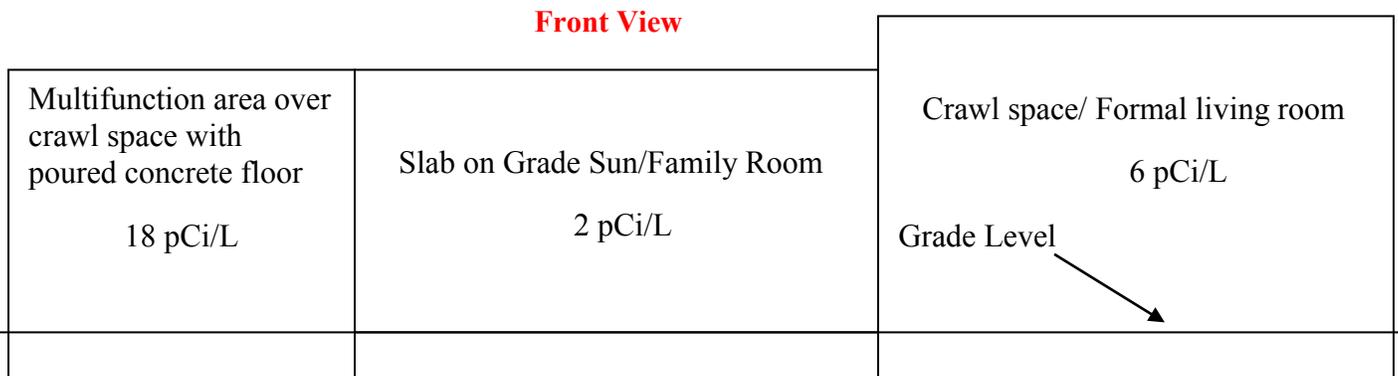
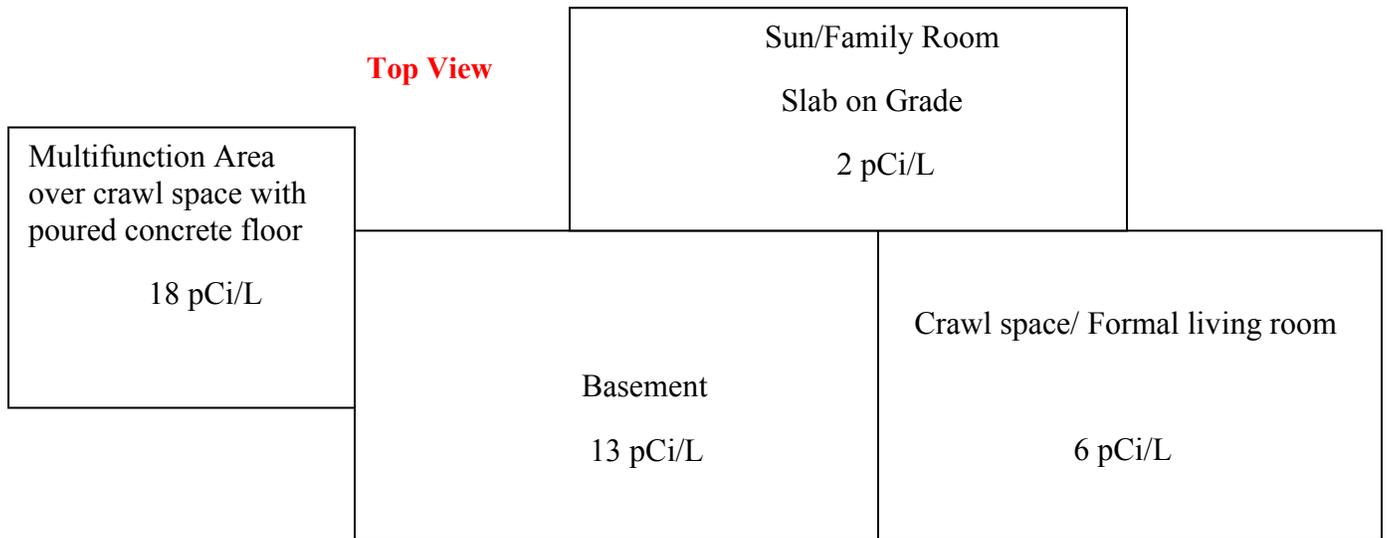
This discussion indicates the need to reevaluate the EPA's guidance to test only the lowest lived-in level of a structure during the screening process and furthermore indicates the need to consider instituting the guidance that all ground-contact areas of a structure should be tested during the initial screening process in order to better protect the inhabitants from exposure to radon. Additionally it demonstrates the need by both commercial and residential lenders to have their own testing protocols modified to match the ANSI/AARST Testing and Mitigation Protocols during Phase 1 Environmental Site Assessments and routine lender-driven residential radon testing due to the random nature of radon. Radon is not something that was installed into a structure by man and therefore cannot be accurately assessed by doing minimal random assessments as is done for lead, asbestos and other similarly introduced man-made contaminants.

## **Methods of deployment**

CRM devices were placed typically one per different method of the structure's attachment to the earth. If multiple slab pours, separated by footers and/or fire walls, or additional crawl spaces were observed that resulted from additions to a home or other structure, then an additional CRM device was placed in each of these areas. This leads to a much better understanding of the potential for elevated radon levels throughout a structure than does the EPA's guidance of one device, or one pair of devices, placed in the lowest lived-in level of the home, in many cases illuminating extraordinarily elevated radon levels in areas that wouldn't have been discovered using that guidance.

### Example # 1

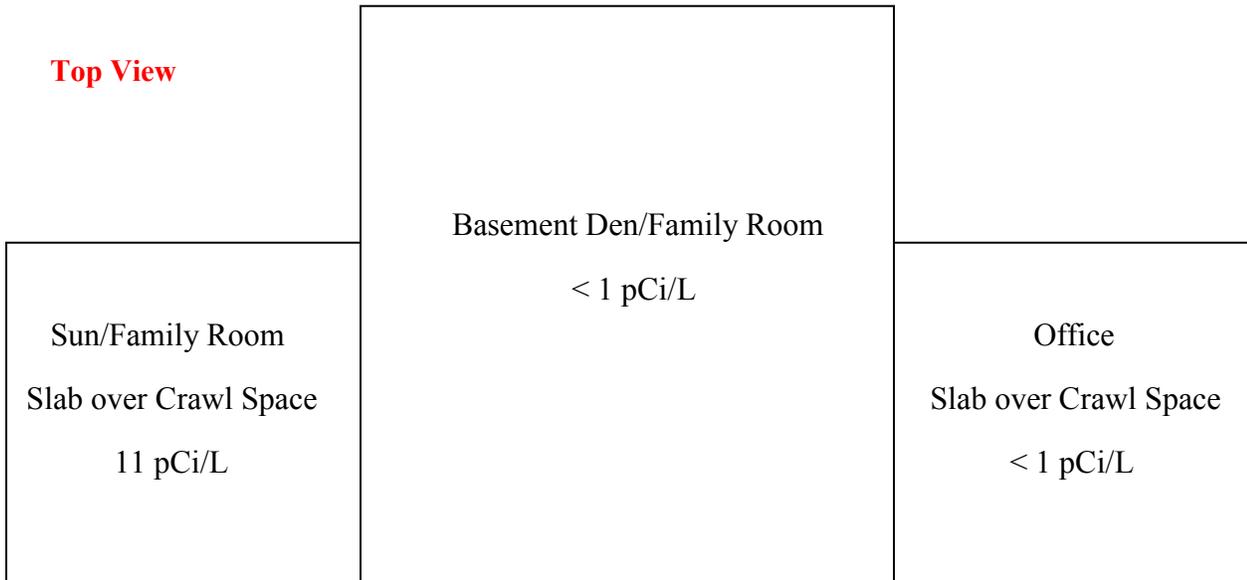
Real estate transaction. CRM test. 1930s single-family detached residence with multiple slabs, basement and multiple concrete floored crawl spaces of commercial grade construction. Four CRMs were used. Initial tests showed readings that varied from 2 pCi/L in a slab-on-grade sun room, 13 pCi/L in the basement, 6 pCi/L in a formal living room that was slab-on-grade to 18 pCi/L in a multifunction family/dining/kitchen area that was the family’s gathering center for home work/video games/TV and computer usage. On all visitations to the home the family was congregated in that area on the sofas and chairs dispersed throughout the area. The multifunction area was over a crawl space that had a 4-inch concrete slab poured in it and also had the highest radon levels discovered in the home at 18 pCi/L. Mitigation was performed in the basement and the crawl spaces and reduced the basement levels to 3 pCi/L, the slab-on-grade formal living room to 2 pCi/L and the multifunction area to 5.5 pCi/L. Subsequent testing yielded similar results. Further mitigation was conducted in the multifunction area over the crawl space which then reduced the radon levels to less than 1 pCi/L in all living areas.



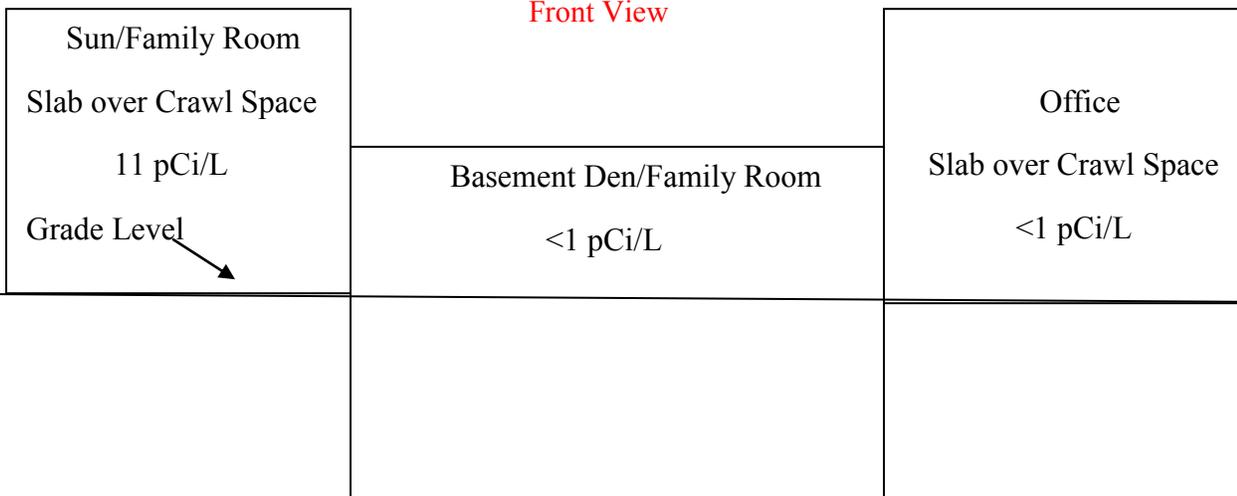
## Example 2

Test requested by homeowner. CRM Test. Three monitors deployed. 1960s single-family detached residence with a basement and two slabs over a crawl space. The basement results were <1 pCi/L, and an office that was a room with a slab over a crawl space was also <1 pCi/L. The sun/family room was the family gathering area, nicely furnished and outfitted with HVAC, television and computer station. This room had test results of 11 pCi/L. The homeowner indicated the family spent the bulk of their indoor waking hours in the space doing homework, watching TV and computer gaming. Post-mitigation results were less than 1 pCi/L in the sun room as well as the rest of the home.

### Top View

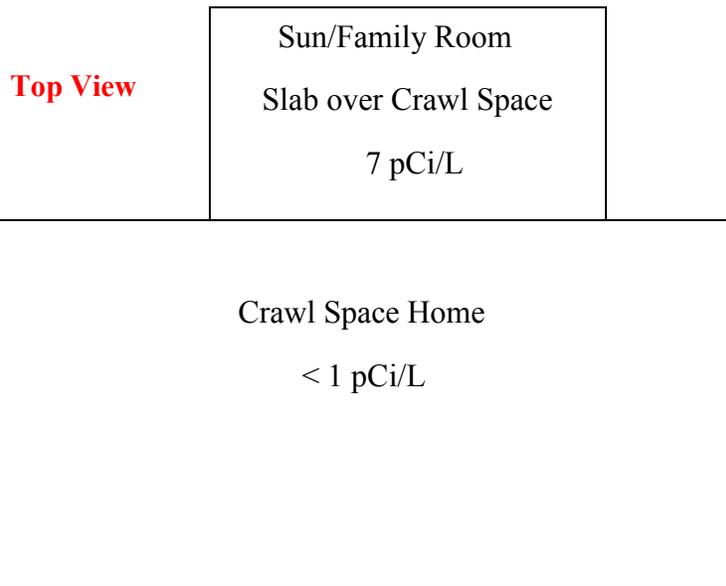


### Front View

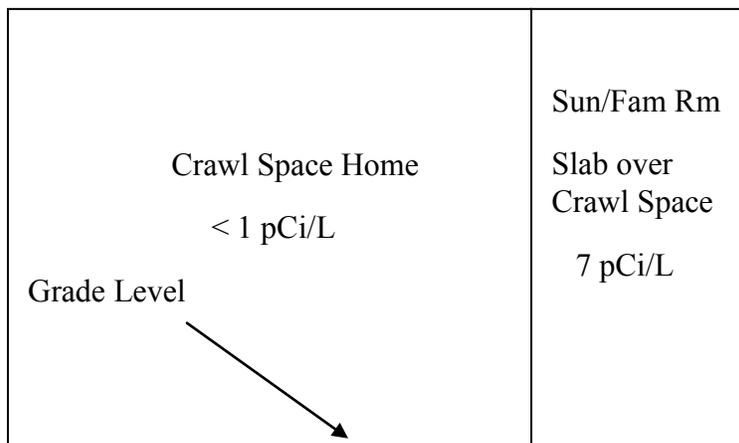


### Example 3

Real estate transaction. CRM test. Two monitors deployed. 1970s single-family detached home with crawl space, with a sun room that had a concrete slab over a crawl space. The family room over the crawl space yielded less than 1 pCi/L, sun/family room 7 pCi/L. The sun/family room was a nicely furnished, conditioned space with all of the crawl space vents open. It was once again the family's focal point for gatherings. Post-mitigation results yielded less than 1 pCi/L in both tested areas.



### End View



### Example 4

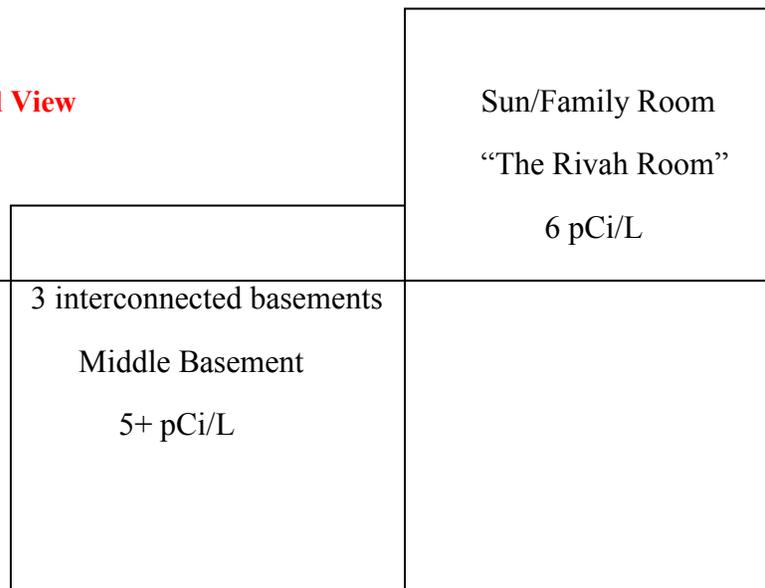
Real estate transaction. CRM test. Four monitors deployed. 1940s single-family residence with three interconnected basements and a sun/family room with a crawl space. The home already had two radon mitigation systems in place on opposite ends of the basement treating the two “new” basement additions; however, leaving the original core basement untreated, as was the sun/family room over the crawl space. The original home had one basement, subsequently another basement addition was added, then another at the opposite end of the home. The crawl space was added off of the back of the home as was a family/sun room. This was a focal point for family gatherings due to its extraordinary river views. The initial radon test yielded 2 pCi/L in a mitigated portion of the new basement, 1 pCi/L in a master bedroom that was over a new basement, 5.9 pCi/L in a den that was located in the original portion of the basement and 6 pCi/L in the sun/family room off of the back of the home over a crawl space with the foundation vents open. Subsequent mitigation was done in the original basement as well as the crawl space by tying one of the “new basement” mitigation systems to the old portion of the basement den as well as the crawl space. Post-mitigation testing showed results of < 1 pCi/L in all areas of the home.

#### Top View

<p>Mitigated “new basement” 2 pCi/L (1 pCi/L in MBR above)</p>	<p>Nonmitigated original basement Den 5+ pCi/L</p>	<p>Mitigated “new basement” Family room/Audio room 2 pCi/L</p>
--	--	--

#### End View

Grade Level

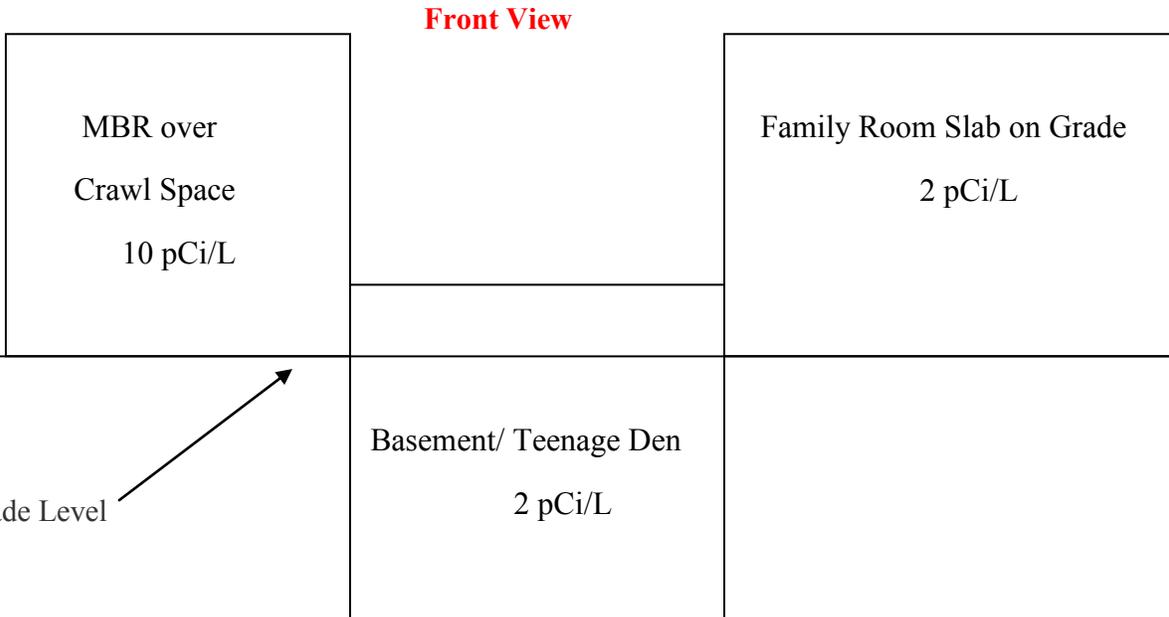


### Example 5

Test requested by homeowner. CRM test. Three monitors deployed. 1950s single-family residence comprised of a basement with a slab and a master bedroom addition over a crawl space. The basement was a utility room and teen hangout. The slab on grade was a garage converted into a very nice family room. The Crawl Space addition was a master bedroom and the “office” of the Realtor/Homeowner. The basement tested at >2 pCi/L. The slab-on-grade family room was also >2 pCi/L. The master bed room/office over the crawl space was >10 pCi/L.

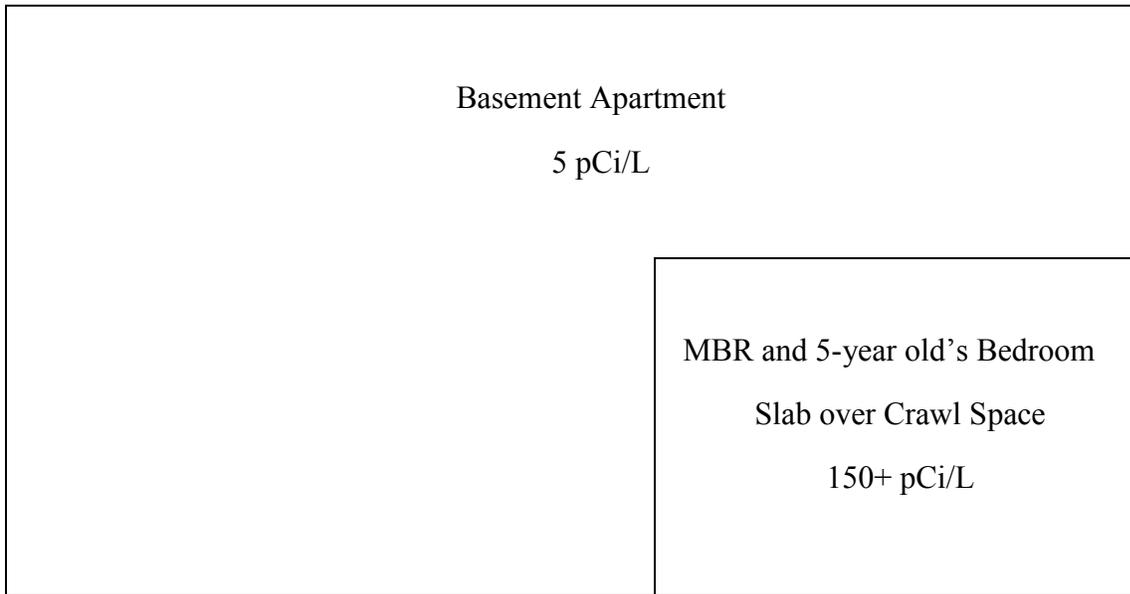
MBR over Crawl Space 10+ pCi/L	Basement/Teenage Den 2 pCi/L	Family Room. Slab on Grade 2 pCi/L
-----------------------------------	---------------------------------	---------------------------------------

**Top View**



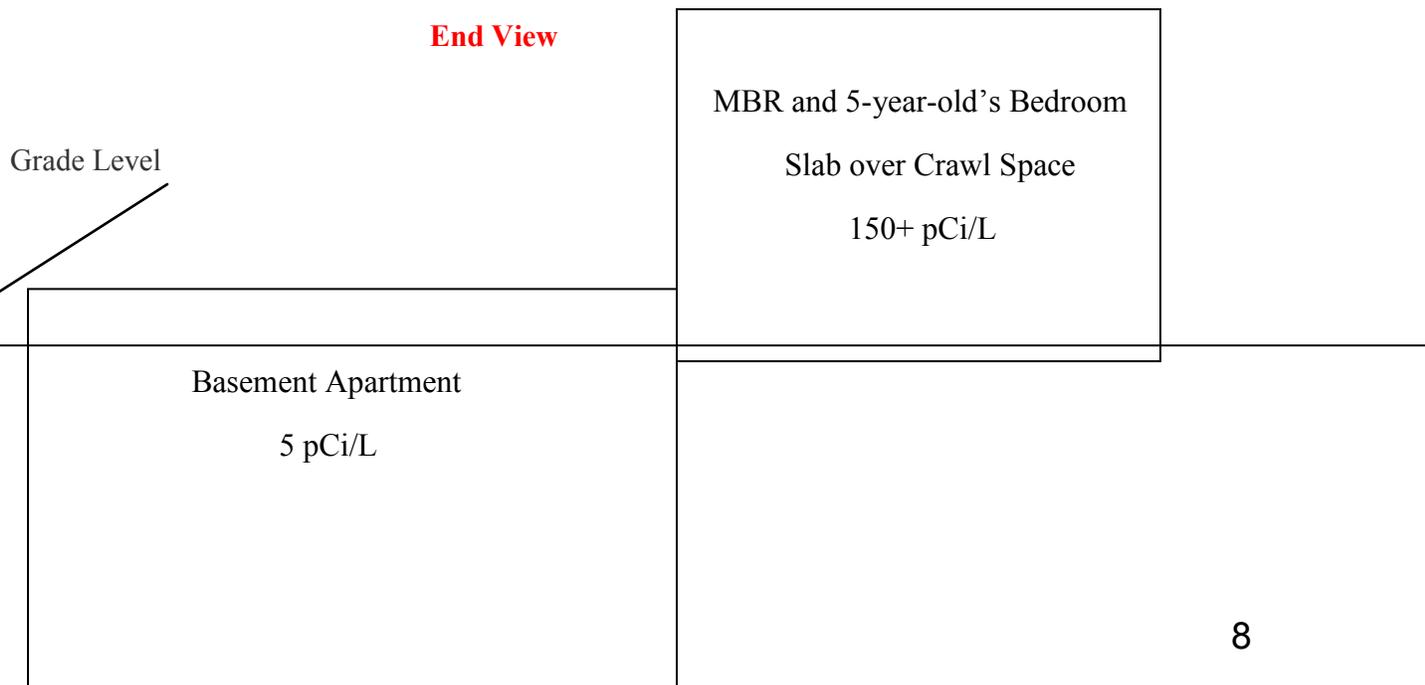
### Example 6

Real estate transaction. CRM Test. Two monitors deployed. 1950s single-family detached basement home with a slab over a crawl space that comprised a 5-year-old girl's bedroom and the master bedroom. The basement test result was 5 pCi/L. The little girl's slab-on-grade bedroom measured 157 pCi/L. This stunning difference in measurements prompted a second CRM test with duplicate monitors placed in each location. The subsequent testing yielded very similar results; 5 pCi/L in the basement and 161 pCi/L in the little girl's bedroom. Post-mitigation results were <1 pCi/L in both areas. Had the EPA's guidance been followed, the child would have been sleeping in a room with >150 pCi/L of radon.



**Top View**

**End View**



## CONCLUSIONS

In all but one of the examples given, had the EPA's guidance of testing the lowest lived-in level been followed the most elevated radon concentrations would have been missed. In all of the examples given, the highest radon levels found were in the most frequently and consistently occupied spaces, not the basement or lowest lived-in levels. In the example that fell within the EPA's guidance of testing the lowest lived-in level the basement would have been mitigated leaving the families principal gathering still harboring radon levels  $>4$  pCi/L.

With the exception of the Example 6, these data came from one quarter year of radon testing. This does not include the homes that had to be mitigated in multiple areas, with multiple areas of contact with the earth, that were all above the 4-pCi/L action level, and all needed to be mitigated. In how many homes have we collectively tested the lowest living level only, or only one area, when the home had many foundations or foundation types? How many families have we left in harm's way due to this misguided guidance?