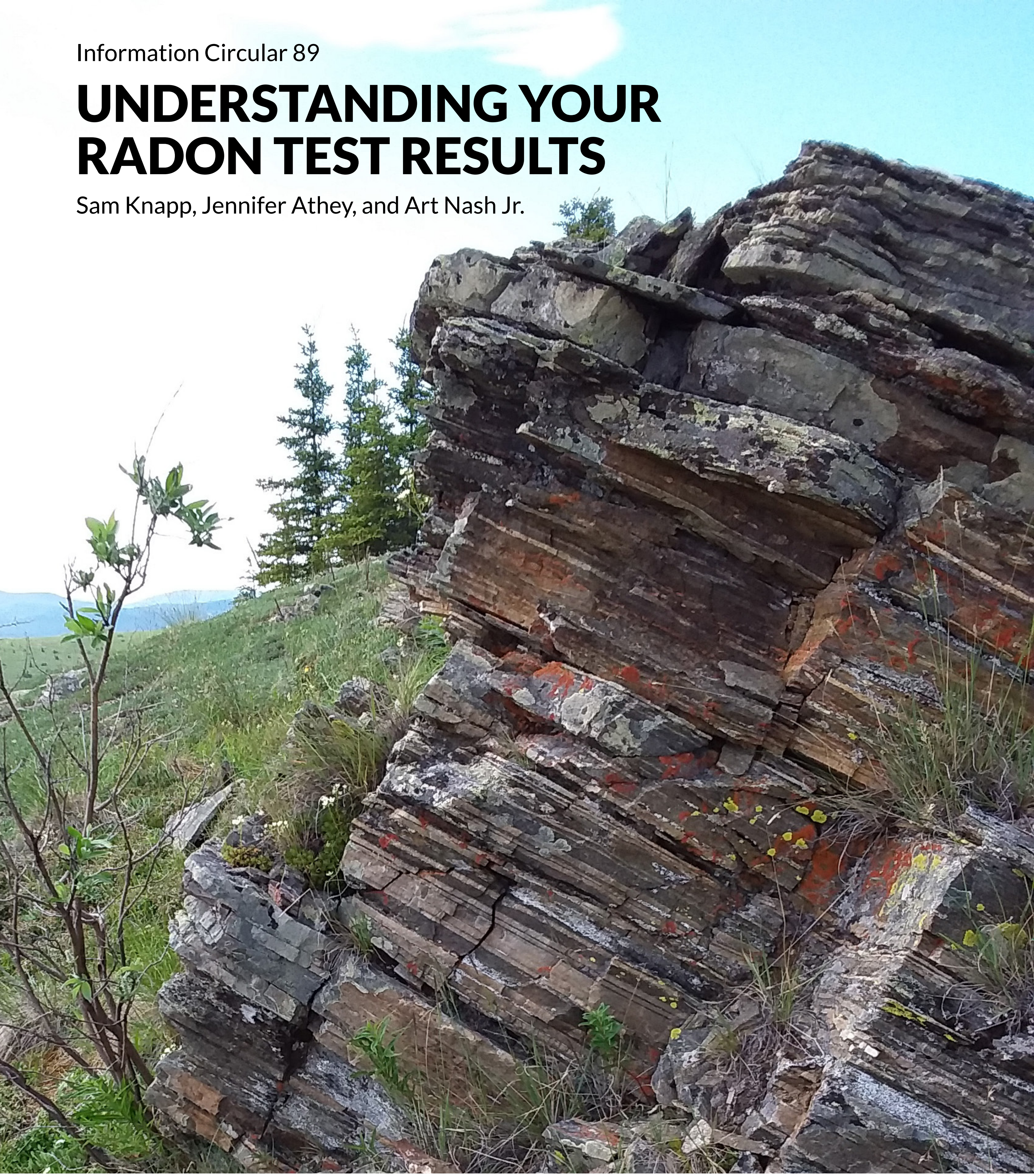
Information Circular 89

UNDERSTANDING YOUR RADON TEST RESULTS

Sam Knapp, Jennifer Athey, and Art Nash Jr.



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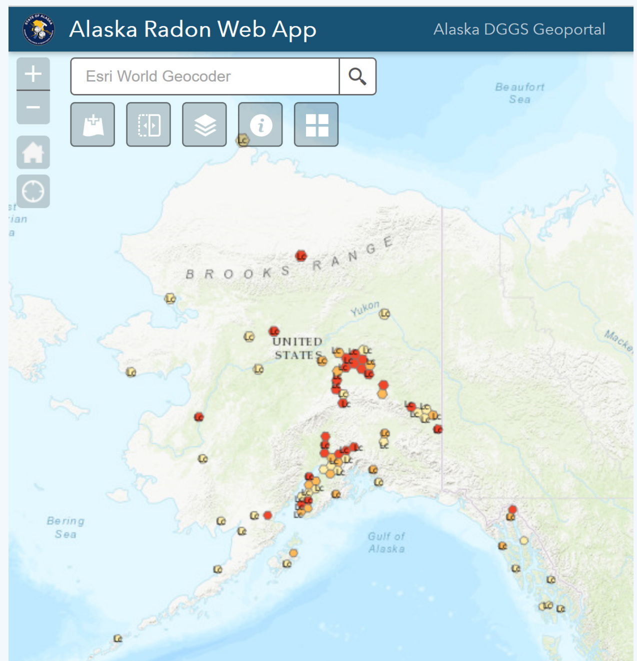
UNDERSTANDING YOUR RADON TEST RESULTS

Sam Knapp, Jennifer Athey, and Art Nash Jr.

If you have recently tested your home for radon, you may be wondering what your results mean and if any further actions are required. This Information Circular is meant to briefly guide you through interpreting radon test results, decision making related to in-home radon mitigation, and provide an overview of the most common mitigation techniques. Further resources for finding mitigation contractors and DIY mitigation advice for homeowners are also provided.

Units and Action Level

In the United States, radon gas concentrations are measured and reported in picocuries per liter of air (abbreviated as pCi/L). Curies are units measuring radiation, and the prefix pico means one-trillionth of a curie. The U.S. Environmental Protection Agency (EPA) has established 4 pCi/L—that is, 4 picocuries of radiation per liter of air—as the recommended action level for reducing radon gas concentrations. For buildings with radon levels at or above 4 pCi/L in living and workspaces, some type of *mitigation* is suggested to reduce radon concentrations below the action level. Based on our current data, the **average radon concentration of homes tested in Alaska is 1.9 pCi/L.**[1] Comparatively, the average indoor radon concentration for homes in the United States is 1.3 pCi/L, while the average ambient (outdoor) level is 0.4 pCi/L.[2]



An interactive map of radon prevalence in Alaska is available online from the Alaska Division of Geological & Geophysical Surveys, maps.dggs.alaska.gov/radon.

You've received your results. Now what?

If you've already tested for radon and received results, your next steps depend on the reported concentration and the type of test you used. **Short-term, activated-charcoal tests** usually sample indoor air for less than a week and provide a snapshot of radon levels in your home. They provide fast results but are subject to factors that affect indoor radon concentrations on a short-term basis such as weather events, barometric pressure, soil frost, and unusual use of the home. Short-term test results are only considered valid when tested under "closed building conditions" typical of winter heating.[2] **Long-term, alpha-track tests** last from several months to a year and provide an estimate of the average annual radon level in your home. For valid long-term test results, there must be a period of "closed-building conditions" during testing that is greater than or equal to the percentage of the year normally spent in the heating season. For example, if your heating season typically lasts for 6 months (50 percent of the year), a 4-month radon

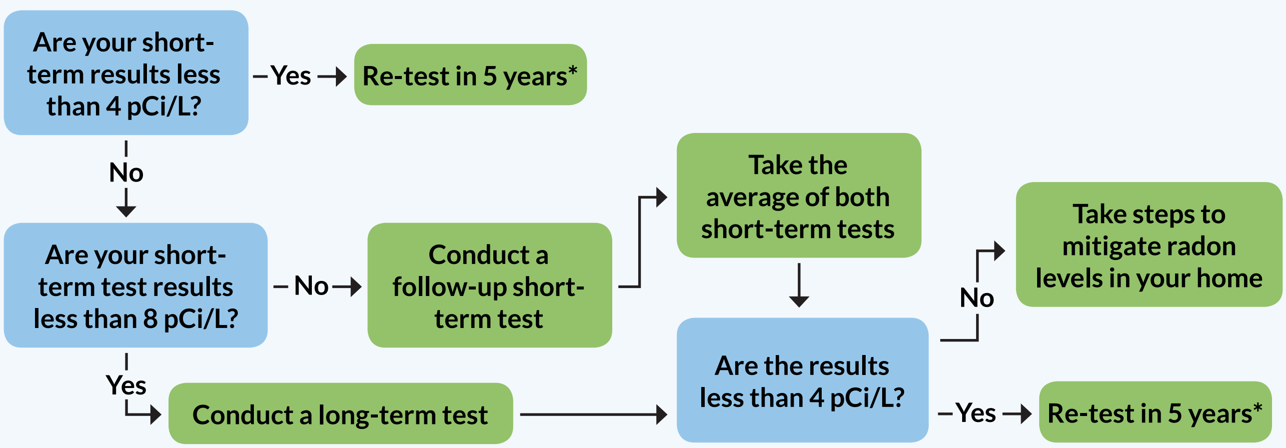
[1]EPA Assessment of Risks from Radon in Homes, June 2003. EPA 402-R-03-003. www.epa.gov/sites/production/files/2015-05/documents/402-r-03-003.pdf

[2]A Citizen's Guide to Radon: The Guide to Protecting Yourself and Your Family from Radon, September 2005. EPA 402-K02-006. www.epa.gov/sites/production/files/2016-12/documents/2016_a_citizens_guide_to_radon.pdf

test must include at least 2 months of "closed-building conditions."[2] Assuming the testing period meets requirements, long-term test results give a more complete picture of radon levels over time than short-term test results. **If the results of your long-term test are less than 4 pCi/L, no further steps are required.** That said, the EPA advises homeowners to still consider mitigation if radon concentrations are between 2–4 pCi/L. Even though radon gas poses some risk at any concentration, it is very difficult to reduce in-home radon levels below 2 pCi/L, so mitigation in homes with less than 2 pCi/L is not suggested. If long-term test results are at or above 4 pCi/L, you should take steps to mitigate radon levels in your home. You should re-test for radon in 5 years or sooner if you drastically alter your home's airflow or structure by remodeling or revamping heating systems. Likewise, retest sooner if a natural event such as a flood or earthquake disturbs soils or bedrock beneath your home. For short-term test results, use the flow chart below to determine your next steps.

You've received your radon test results. Now what?

If you have received results for a short-term radon test, use this flow chart to determine your next steps*

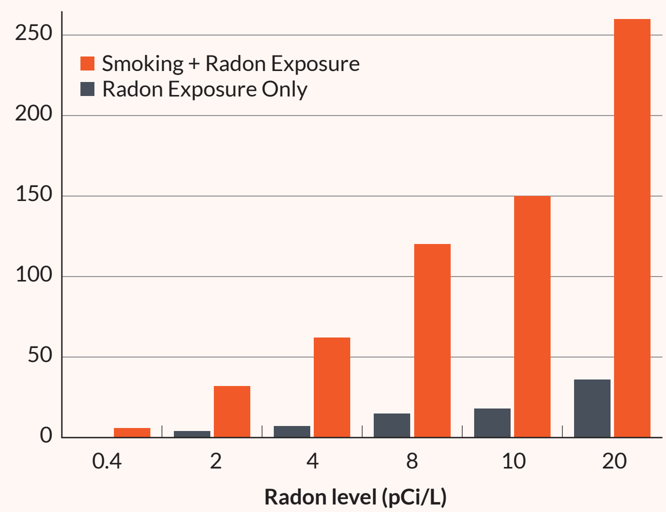


The EPA advises homeowners to still consider mitigation if radon concentrations are between 2–4 pCi/L. If the first short-term test result is in this range, consider re-testing with a long-term test and mitigating if follow-up results are between 2–4 pCi/L. For test results below 2 pCi/L, no additional actions are suggested because it is very difficult to reduce radon concentrations under 2 pCi/L.

Health Risks of Radon Exposure

As radon gas decays, it produces alpha radiation. Alpha radiation is the weakest type produced by radioactive materials, and it cannot pass through clothing, skin, or even a single sheet of paper. However, alpha radiation can harm the soft, relatively unprotected tissues in your lungs when radon gas is inhaled. Exposure to radon gas over a lifetime increases your risk of contracting lung cancer, and the risk is compounded if you smoke. Not everyone exposed to radon will develop lung cancer, and the cumulative risk increases with exposure time. For example, 15 non-smokers or 120 smokers out of 1,000 would likely develop lung cancer after a lifetime of exposure to radon levels of 8 pCi/L, twice the EPA action level (graph, below). There is still a risk of developing lung cancer after a lifetime of exposure to radon levels under the EPA action level of 4 pCi/L. For this reason, the EPA and the American Association of Radon Scientists and Technologists recommend you still consider mitigating your home for levels between 2–4 pCi/L. Reducing in-home radon levels below 2 pCi/L is often prohibitively difficult and expensive. Comparatively, the average ambient radon concentration in the United States is 0.4 pCi/L and poses little risk to non-smokers.

Estimated cases of lung cancer per 1,000 people over a lifetime of radon exposure*



Radon level (pCi/L)	Estimated cases of lung cancer for 1,000 **non-smokers** after a lifetime of exposure	Estimated cases of lung cancer for 1,000 **smokers** after a lifetime of exposure
0.4	0.6 people	6 people
2	4	32
4	7	62
8	15	120
10	18	150
20	36	260

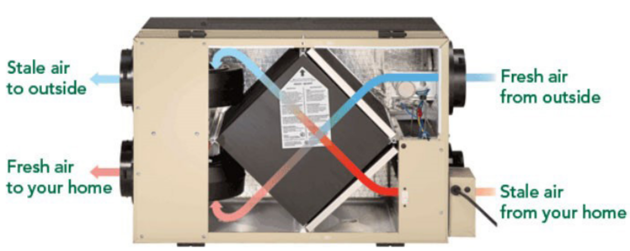
*U.S. Environmental Protection Agency, 2003, EPA Assessment of Risks from Radon in Homes: EPA 402-R-03-003. www.epa.gov/sites/production/files/2015-05/documents/402-r-03-003.pdf

Overview of Mitigation Methods

Radon concentrations can be reduced to safe levels in almost any home, regardless of initial measurements. The steps to mitigate, or reduce, radon levels in your home depend on the home's design and the radon concentration inside. Most mitigation strategies work by either (1) bringing in fresh air from outdoors or (2) preventing radon from entering. Most Alaskan homes can be mitigated for under $4,000 by professional contractors and often much less when done by homeowners. The investment may improve overall indoor air quality and will improve the long-term safety of you and your family. The list of techniques below is not exhaustive but covers the most common contemporary mitigation strategies.

Radon Dilution

Bringing in fresh air from the outdoors and exhausting stale indoor air will reduce radon levels by diluting the radon inside your home. Passive or active (mechanically assisted) ventilation is often expensive in cold climates due to heating costs. However, an air-exchange technique called **heat recovery ventilation** (HRV, for short, shown below) facilitates heat transfer between outgoing indoor air and incoming outdoor air to preheat fresh air before entering your home. HRV units usually cost less than $1,500 and can drastically improve your indoor air quality—in addition to reducing radon concentrations—if properly installed and calibrated. However, this technique by itself may only be effective in homes with mildly high radon levels (that is, up to 8–10 pCi/L). Energy recovery ventilation (ERV) is a similar technique that preserves indoor humidity in addition to heat during air exchanges.



Sealing the Foundation

Radon typically enters the home through gaps in the foundation leading directly to soil or bedrock, so sealing these gaps can prevent soil-gas infiltration and reduce indoor radon concentrations. For homes with concrete slabs, either belowground (basements) or on the ground surface (slab-on-grade), you should seal all accessible cracks and gaps in the slab and basement walls with polyurethane caulk. Pay particular attention to expansion joints between basement slabs and walls, which can be significant paths of entry and should be sealed if accessible. For homes with crawlspaces, high-density polyethylene sheeting sealed to the perimeter of the crawlspace wall can be used to make an airtight barrier between the soil and the living space. Other common entry points for radon include gaps around plumbing, gas, and electrical lines; floor drains; and sump holes. It's not always possible to seal all gaps and openings, especially in finished basements where framing, drywall, and flooring often prevent access to the slab and walls. As such, sealing the foundation is often ineffective as a standalone mitigation technique. However, more effective mitigation techniques such as soil depressurization require a sealed foundation to work properly.

A homeowner seals a crawlspace with high-density polyethylene sheeting and polyurethane caulk. Screenshot taken from UAF Cooperative Extension Service video available online at: www.uaf.edu/ces/foodhealth/radon/

Soil Depressurization

This technique has become the gold standard for radon mitigation in residential buildings. The basic idea is to draw radon-laden soil gases from beneath your home's foundation through a series of PVC pipes. Low pressure in the piping system—created by either a specially-designed active fan or the passive stack effect—creates a preferential path for radon to exhaust safely outdoors rather than enter your home. Soil depressurization can successfully mitigate radon in most homes to safe levels and has been used to reduce radon concentrations over 1,000 pCi/L to below the EPA action level. If installed by a contractor, soil depressurization systems in Alaska may cost up to $4,000. However, materials may be purchased and installed by a homeowner for a few hundred dollars, depending on the situation and layout of the home. Additionally, the specially designed fans usually cost between $150–$200, last 10–15 years with constant use, and use 300–550 kWh of electricity annually. When building a new home, consider installing the necessary components of a soil depressurization system before the foundation is complete. This is the easiest and least expensive option for mitigating potential future radon problems, as opposed to retrofitting an existing home.

Tips for Finding a Mitigation Contractor:

As of 2020, there is only one contractor certified by national organizations to test for and mitigate radon in the State of Alaska (nrpp.info/pro-search/). However, several current Alaskan contractors and engineers were certified and passed competency testing for radon mitigation in the past. Other contractors not specifically certified may have experience installing effective mitigation systems.

It's a good idea to choose a licensed, bonded, and insured contractor for a radon mitigation project. This helps ensure the quality of their work and holds them accountable for installing an effective system. For your own comfort, you may want to ask a potential contractor additional questions such as:

- How many radon mitigation systems have you successfully installed?
- Do you have equipment to check the efficacy of the system when completed?
- Do you have a policy of ongoing system monitoring to ensure continued efficacy?
- Do you have references from past jobs that I may contact?

Other Resources

Organizations in both the United States and Canada publish resources for homeowners attempting Do-It-Yourself radon mitigation:

- Center for Environmental Research and Technology, Inc. Colorado Springs, CO: certi.us/cms/index.php
- Mitigating Radon Levels at Home, Alaska Division of Geological & Geophysical Surveys IC 90: doi.org/10.14509/30474
- The American Association of Radon Scientists and Technologists (AARST): aarst.org
- Health Canada: www.canada.ca/en/health-canada/services/health-risks-safety/radiation/radon.html
- The Canadian Association of Radon Scientists and Technologists (CARST): carst.ca

Alaska Radon Hotline
1-800-478-8324

DGGS Radon Program
dggs.alaska.gov/hazards/radon.html

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