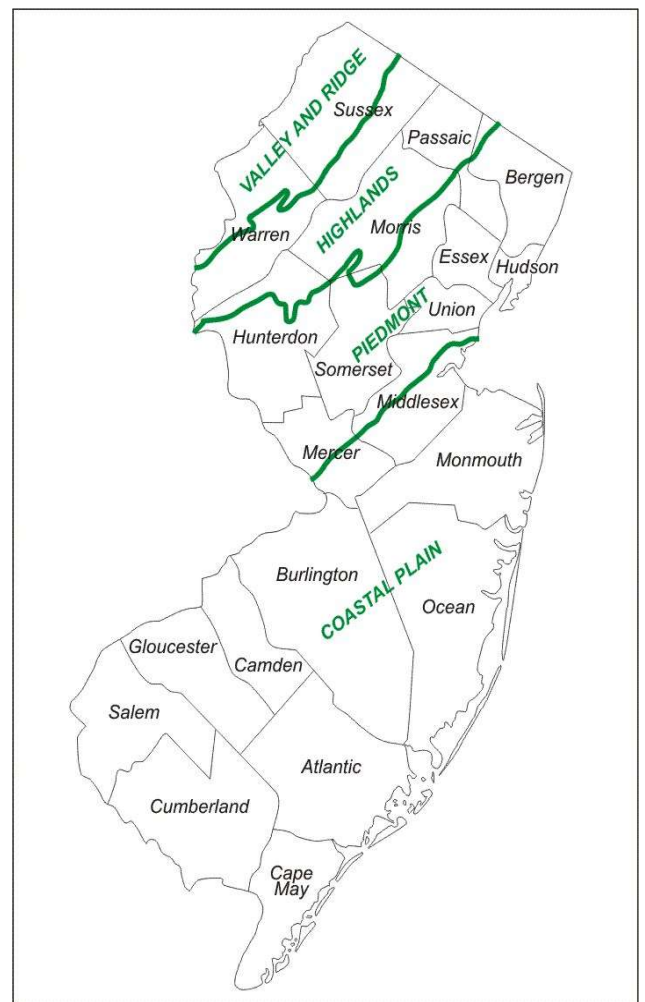


A North Jersey Homeowner's Guide to Radioactivity in Drinking Water: Uranium

Naturally occurring radioactive substances are frequently found in ground water in New Jersey. They are present at least to some extent in almost all rocks and soils. Radioactivity in drinking water is not a new phenomenon, having been present to some extent since the earth was formed. Despite this history, uranium in drinking water above the standard may be harmful to your health. Radionuclide testing of public drinking water systems has been required since the 1970's, however, uranium testing has not been required until recently. Concentrations of uranium in drinking water above the US Environmental Protection Agency's (EPA's) Maximum Contaminant Level (MCL) over a long period of time is believed to cause kidney damage and to increase one's lifetime risk of developing certain types of cancer. Therefore, this homeowner's guide was developed to provide important information for homeowners who are interested in testing their private drinking water wells for radioactivity and reducing their exposure.

Geologically, high levels of uranium in drinking water are most likely to be found in the Highlands Province and neighboring regions of North Jersey. It is also possible for radium and radon in water to be found in this area. The Highlands Province lies within the southeastern portions of Sussex and Warren Counties, as well as major portions of Hunterdon, Morris and Passaic and small parts of Bergen and Somerset. In Pennsylvania this region is called the Reading Prong while in New York, it is called the Hudson Highlands.



What Is Radioactivity And How Is It Measured?

Radioactive substances are those that are unstable in nature. Naturally occurring uranium, thorium, radium, and radon emit radiation to reach a more stable condition. This process is called radioactive decay. By measuring the type of radiation emitted, the specific energy level or levels of radiation and the rate of decay, scientists are able to identify a radioactive substance and determine how much of it is present. Radioactivity is usually measured in curies in the United States. The unit typically used to describe the concentration of radioactivity present in drinking water is the picocurie per liter (pCi/L) – one trillionth of a curie. Uranium is also expressed as micrograms per liter (ug/L), a mass per unit volume measurement. A microgram is one millionth of a gram.

What Are The Risks?

About 99 percent of uranium ingested in food or water will leave a person's body in the feces, and the remainder will enter the blood. Most of this uranium will be removed by the kidneys and excreted in the urine within a few days. A small amount of the uranium in the bloodstream will be deposited in a person's bones, where it is likely to remain for several years.

Toxic Effects

In addition to the risk of cancer posed by uranium and all other radionuclides discussed below, uranium is associated with non-cancer effects. The organ of concern, the "target organ", of uranium's chemical toxicity is the kidney. Uranium interferes with reabsorption of proteins. Miners and millers who were exposed to high doses of uranium showed effects which were usually mild and reversible. The EPA set a Maximum Contaminant Level for uranium of 30 micrograms per liter based on the chemical toxicity of uranium.

Radiological Effects

Radioactivity is a health risk because the energy emitted by radioactive materials can damage or kill cells. Exposure to radionuclides from drinking water results in

increased risk of cancer. Alpha radiation is a type of particle emitted through the decay of certain radioactive substances, such as uranium. The level of risk depends on the level of ingested uranium concentration. Alpha particles released by uranium cannot penetrate the skin, so uranium that is outside the body is less harmful than that which is inhaled or swallowed.

The EPA has estimated that the additional lifetime risk associated with drinking water that contains 30 ug/L, the MCL for uranium, is about 1 in 10,000. This means that if 10,000 persons were to consume two liters of this water per day for 70 years, we might expect to see one additional fatal cancer in the 10,000 people exposed. This increased risk should be viewed in the context of current cancer statistics. According to the American Cancer Society, approximately 4,300 people in 10,000 will develop cancer at some point in their lifetimes and approximately 2,200 of the 10,000 eventually will die of cancer. Consuming drinking water containing uranium at the MCL permitted under the Safe Drinking Water Act might increase the number of deaths in the 10,000 individuals so exposed by one.

The greatest risk from radon in drinking water is from the radon that escapes to the indoor air. If you haven't tested your home for radon in air, call 1-800-648-0394 for an information packet, or visit our website at <http://www.njdepradon.com>.

What Is The Procedure For Testing?

Due to the Highlands geology, the likely source of radioactivity in drinking water is uranium, radon, or both. A gross alpha test is the first step in determining the type and level of radioactivity in drinking water. This test serves as a preliminary screening and determines whether additional testing is advisable. A gross alpha test typically costs from \$75 to \$150

The gross alpha standard in New Jersey (15 pCi/L) is calculated by first measuring gross alpha activity and then subtracting the uranium and radon contributions from this value. If the gross alpha test result is above 15 picocuries

per liter, then further testing for uranium, radium, and radon is recommended. Since all of these radionuclides are found in this part of the State, with uranium and radon being the most prevalent, the additional tests are necessary in order to ensure the correct treatment is installed. Each requires a different kind of treatment system.

The standard for uranium is 30 micrograms per liter (ug/L). The cost of testing for uranium is approximately \$200.

There is currently no standard for radon in drinking water, but the EPA has proposed a level of 4,000 pCi/L as an Alternate MCL assuming the community water system contributes to mitigating radon in air problems throughout the State. The EPA proposed that no action was needed for community water systems if the level of radon in water was 300 pCi/L or below. A certified laboratory should be contacted if radon in water testing is desired. The cost of testing is approximately \$125 if the sample is taken by the laboratory personnel. If you take the samples yourself, the cost is approximately \$60. Be sure to follow the instructions carefully when taking a sample for radon since radon is a gas and can diffuse out of the water as the sample is taken thereby underestimating the concentration. The certified method for radon in water calls for two samples to be collected and analyzed. If there is a significant difference between the two samples then the samples were probably not collected properly. Make sure you ask the laboratory for two vials so that you can get two results.

Testing for Radium 226 and 228, will cost \$100 to \$200. The maximum contaminant level for radium 226 and radium 228 (combined) is 5 pCi/L. See the South Jersey Homeowner's Guide to Radioactivity in Drinking Water: Radium for further information on how to test for and treat a radium in drinking water problem. This guide is available by calling (609) 292-5550 or at <http://www.state.nj.us/dep/rpp/radwater.htm>.

Who Should Test?

If your drinking water comes from a public water supply, your water supplier is required by law to test it to ensure that it meets the state

and federal standards for radioactivity. You do not need to test your water. You can get the most recent test results for your water system by contacting your water supplier or the DEP Bureau of Safe Drinking Water at (609) 292-5550. Given the elevated levels of naturally occurring uranium that have been found in the Highlands, the DEP recommends that private well owners living in the Highlands Province (Sussex, Warren, Passaic, Morris and Hunterdon, and small parts of Bergen and Somerset counties) and neighboring regions test their well water beginning with the gross alpha test. If you have your own well, testing your water is your responsibility. If you decide to test your well, the DEP recommends that you use a DEP-certified laboratory. It is very important that you collect your water sample properly and that you send the sample to a laboratory that will analyze it for gross alpha particle activity within 48 hours of collection. If you have questions about testing or your results, contact your local health officer. If your water has color, odor, or taste problems, these are not caused by radioactivity. Your local health officer can help you determine the cause of these problems.

How Do I Go About Testing?

If you are concerned about possible exposure to naturally occurring radioactivity in your drinking water, the first step is to conduct a test for gross alpha particle activity. You should:

1. Either contact your local health officer to arrange for testing to be performed at the state radiological laboratory or contact a DEP-certified commercial laboratory to arrange for testing. If you contact your local health officer, he or she will advise you of what steps to take. If you contact a commercial laboratory, be sure to advise the laboratory that your sample must be counted within 48 hours of collection and make arrangements to get the sample to the laboratory either in person or through an overnight mail service. You must carefully follow the directions of the laboratory for collecting the sample including the use of an approved sample collection container.

2. Take your sample from the cold water tap closest to your storage tank after the water system has been purged of the water in storage so that you are obtaining water directly from the well. This requires running the water forcefully for about 15 minutes.
3. Send your sample to the laboratory and await your result.
4. Follow the recommendations above in "What are the Procedures for Testing?" to determine whether further testing is advisable.

How Can I Reduce Radionuclides in Drinking Water?

Once you have determined which radionuclides are in your drinking water (see Section "What is the Procedure for Testing?"), you can reduce them by selecting one of the following options:

- Hook up to a municipal water system if this option is available.
- Install the treatment system or systems that remove the radionuclides that were detected above the Maximum Contaminant Levels.
- Purchase bottled water for drinking and food consumption. While this option may be useful in the short term, it generally will not be cost effective in the long term. Bottled water will not be effective if radon is present in the drinking water, since the radon can escape to the air where it poses the greatest health risk.

A typical point of use (the kitchen tap used for cooking and drinking water) reverse osmosis system (installed under the sink or on the counter top) costs about \$1000 and will remove both uranium and radium. Alternately,

a whole house system that removes both uranium and radium can be designed using two different kinds of water softeners which can range from \$1500 - \$2500. Homes with standard water softeners are removing radium only, and only if the unit is properly maintained.

Radon removal requires an aeration system for levels above 4000 pCi/L (approximately \$4000) or a granulated activated carbon system for levels between 300 and 4000 pCi/L (approximately \$1500).

Whatever treatment system is installed, it must be maintained according to the manufacturer's directions. For further information on all such units, contact your local health officer to determine which type is best for your home and water quality situation *before* installing a radioactivity removal system. Also, ask if a local health department permit is required. If you install a water treatment system, conduct another gross alpha test after the installation to verify that the system is working effectively to reduce radioactivity to an acceptable level.

Who Is Certified To Test?

To get the most current information on the certification status of laboratories, call DEP's Office of Quality Assurance (OQA) at (609) 292-3950. The OQA will be able to provide you with a list of laboratories which are currently certified to perform gross alpha, radium, uranium, and radon analyses.

This guide is also available on the DEP's Radiation Protection Programs' web site at <http://www.state.nj.us/dep/rpp/radwater.htm>

A South Jersey Homeowner's Guide to Radioactivity in Drinking Water: Radium

Radioactive substances in ground water, such as radium, uranium and thorium, occur naturally. They are present at least to some extent in almost all rocks and radium, in particular, dissolves more readily into ground water in contact with sands or soils. The acidity of the water, which may be increased by the presence of elevated levels of nitrates associated with agricultural land use, is believed to increase the amount of radium that dissolves into ground water from contact with sands and soils.

Sampling of public and private wells that draw water from southern New Jersey's Cohansey aquifer has shown elevated levels of naturally occurring radioactivity. The aquifer, sometimes referred to as the Kirkwood-Cohansey aquifer, is present in all, or parts of Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Monmouth, Ocean and Salem counties (see map at right). Elevated levels of radioactivity most recently were found in the area of Dover township, Ocean County, where an investigation is under way into specific childhood cancers in that area. It is important to note, however, that radioactivity in drinking water, especially at these low concentrations, is not known to cause these types of cancers.



Results from investigations in Dover Township, Ocean County, which used a new testing procedure that detects radiation from short-lived radioactive substances, indicated that elevated levels of radioactivity existed in some area drinking water supplies. Consequently, the N. J. Department of Environmental Protection and the U. S. Geological Survey conducted studies to better understand the presence of radioactivity in this aquifer. The results of these studies confirmed that Radium 226, 228 and 224 may be found in elevated concentrations in parts of the Cohansey aquifer.

Radioactivity in drinking water is not a new phenomenon, having been present to some extent for thousands of years. Nevertheless, exposure to radium over a long period of time is believed to increase one's lifetime risk of developing certain types of cancer. Therefore, homeowners should be aware of the steps they might wish to take to test their private drinking water wells for radioactivity and to reduce their exposure.

What Is Radioactivity And How Is It Measured?

Radioactive substances are those that are unstable in nature. Radioactive types of uranium, thorium and radium emit radiation to reach a more stable condition. This process is called radioactive decay. By measuring the type of radiation emitted, the specific energy level or levels of radiation and the precise rate of decay, scientists are able to identify a radioactive substance and determine how much of it is present. Radioactivity is usually measured in curies in the United States. The unit typically used to describe the concentration of radioactivity present in drinking water is the picocurie per liter – one trillionth of a curie.

Initial water testing to determine the presence of radioactivity measures gross alpha activity. Alpha radiation is a type of particle emitted through the decay of certain radioactive substances. Additional testing may be required to measure the presence of specific types of radium, including Radium 226 and Radium 228. An improved testing procedure for gross alpha activity also will reflect the presence of Radium 224, a short-lived radioactive material. Until recently, it was not thought to be a problem, and there is no federal or state standard for Radium 224. However, recent studies in southern New Jersey, particularly in the area of Dover Township, have shown Radium 224 to be present and to account for a number of instances of elevated levels of gross alpha activity.

What Are The Risks?

The U.S. Environmental Protection Agency (EPA) has estimated that the additional lifetime risk associated with drinking water that contains the maximum contaminant level for gross alpha or combined Radium 226 and 228 is about 1 in 10,000. This means that if 10,000 persons were to consume two

liters of this water per day for 70 years, we would expect to see one additional fatal cancer in the 10,000 people exposed. Increased risk of bone cancers has been associated with the ingestion of Radium 224 and 228, and bone cancers and cancers of the head sinuses with Radium 226. This increased risk should be viewed in the context of current cancer statistics. According to the American Cancer Society, approximately 4,300 people in 10,000 will develop cancer at some point in their lifetimes and approximately 2,200 of the 10,000 eventually will die of cancer. Consuming drinking water containing radioactivity at the maximum level permitted under the Safe Drinking Water Act will increase the number of deaths in the 10,000 individuals so exposed by one.

What Is The Procedure For Testing?

A gross alpha test is the first step in determining the level of radioactivity in drinking water. This test serves as a preliminary screening device and determines whether additional testing is advisable. A gross alpha test typically costs from \$75 to \$150. If the level is above 5 picocuries per liter, then further testing for Radium 226 and 228 is recommended. Testing for Radium 226 and 228, if indicated, will cost an additional \$100 to \$200. A typical water softener costs between \$400 and \$600 and offers other benefits besides reducing radium levels. Therefore, homeowners whose gross alpha test exceeds 5 picocuries per liter – the federal and state screening criteria for further testing, may decide that it is more cost-effective to seek out water treatment rather than additional tests. If the gross alpha particle activity is above 15 picocuries per liter, then treatment is recommended without further testing. Gross alpha particle activity is highest when analyzed within 48 hours of sample collection, but declines rapidly within the first 4 days after sample collection. It

gradually levels off after about 7 to 14 days following sample collection. Since most private well owners consume water generally no more than a few hours after it has been pumped from the aquifer, they may be consuming water when its gross alpha activity is the highest. Results of recent testing of water from the Kirkwood-Cohansey aquifer system indicate that when a gross alpha particle activity measurement is completed within 48 hours, about one-half of the samples exceed the EPA gross alpha standard of 15 picocuries per liter. See the Homeowner's Guide to Uranium in Drinking Water for further information on how to treat a uranium in drinking water problem.

<http://www.state.nj.us/dep/rpp/radwater.htm>

Who Should Test?

If your drinking water comes from a public water supply, your water supplier is required by law to test it to ensure that it meets the standards for radioactivity. You do not need to test your water. You can get the most recent test results for your water system by contacting your water supplier or the DEP Bureau of Safe Drinking Water at (609) 292-5550. Given the elevated levels of naturally occurring radioactivity that have been found, the DEP recommends that private well owners drawing from the Cohansey aquifer test their well water. If you have your own well, testing your water is your responsibility. If you decide to test your well, the DEP recommends that you use a DEP-certified laboratory. It is very important that you collect your water sample properly and that you send the sample to a laboratory that will analyze it within 48 hours of collection. If the sample is not analyzed within that time, it is unlikely that the results will reflect short-lived Radium 224 if it is present. If you have questions about testing or your results, contact your local health officer. If your water has color, odor, or taste problems,

these are not caused by radioactivity. Your local health officer can help you determine the cause of these problems.

The Private Well Testing Act (PWTA)

The Private Well Testing Act requires that certain wells be tested as a condition of each contract for sale of real property. The law became effective September 14, 2002. This rule is being phased in and details are available at the NJDEP website:

<http://www.state.nj.us/dep/pwta/>

Please note that for samples that are part of a real estate transaction under the PWTA, the samples are required to be taken by a firm that is certified by the New Jersey DEP's Office of Quality Assurance as a certified collection firm. To obtain a current list of these firms, call DEP's Office of Quality Assurance (OQA) at (609) 292-3950.

How Do I Go About Testing?

If you are concerned about possible exposure to naturally occurring radioactivity in your drinking water, you obtain your water from a private well in the Cohansey aquifer and do not have a water softener or other treatment system that removes radium, you should:

1. Either contact your local health officer to arrange for testing to be performed at the state radiological laboratory or contact a DEP-certified commercial laboratory to arrange for testing. In either case, the cost of the testing will be approximately \$100. If you contact your local health officer, he or she will advise you of what steps to take. *Remember that samples for a real estate transaction under the PWTA must be taken by a DEP certified collection firm.* If you contact a commercial laboratory and you are taking the sample for your own benefit, be sure to advise the laboratory that

your sample must be counted within 48 hours of collection and make arrangements to get the sample to the laboratory either in person or through an overnight mail service. The laboratory may provide you with a container or may want you to furnish one of your own. Make certain that the laboratory is aware of the 48-hour time requirement and when you will be sending in your sample.

2. Take your sample from the cold water tap closest to your storage tank after the water system has been purged of the water in storage so that you are obtaining water directly from the well.
3. Send your sample to the laboratory and await your result.
4. Follow the recommendations below to determine whether further testing or water treatment is advisable.

How Can I Reduce Radioactivity?

You can reduce radioactivity in your drinking water by selecting one of the following options:

- Hook up to a municipal water system if this option is available.
- Install a water softener or ion exchange water treatment system (known as a point-of-entry system).
- For the average home, this is usually the most feasible and cost effective method of reducing radioactivity in drinking water.
- Install a point of use (e.g., at the kitchen sink) ion exchange or reverse osmosis water treatment system and use this water for drinking and food preparation.

- Modify your well or drill a new well so that water is obtained from another, deeper aquifer that has been tested or can be tested to show that its radioactivity levels are acceptable.
- Purchase bottled water for drinking and food consumption. While this option may be useful in the short term, it generally will not be cost effective in the long term.

The DEP recommends the following actions for homeowners who test and are concerned about radioactivity in their drinking water:

- **If testing shows that gross alpha activity is greater than 15 picocuries per liter,** water treatment is recommended.
- **If gross alpha activity is greater than 5 but less than 15 picocuries per liter,** testing for Radium 226 and Radium 228 is advised. If the combined radium levels are above 5 picocuries per liter, water treatment is recommended. Alternatively, a homeowner may evaluate the additional cost of radium testing and determine whether it is better simply to proceed to water treatment.
- **If gross alpha activity is less than 5 picocuries per liter,** no further action is required.

Homeowners using water softeners, ion exchange units or reverse osmosis units should maintain them according to the manufacturer's directions. If you are currently using an activated carbon system to treat your well water, and your gross alpha results indicate that treatment is

necessary, then the treatment system for gross alpha should be placed before the carbon filter. This is to prevent possible accumulation of radioactivity on the carbon bed. For further information on all such units, contact your local health officer to determine which type is best for your home and water quality situation *before* installing a radioactivity removal system. (Ask if a local health department permit is required.) If you install a water treatment system, conduct another gross alpha test after the installation to verify that the system is working effectively to reduce radioactivity to an acceptable level.

Who Is Certified To Test?

To get the most current information on the certification status of laboratories, call DEP's Office of Quality Assurance (OQA) at (609) 292-3950. The OQA will be able to provide you with a list of laboratories which are currently certified to perform gross alpha and radium analyses.

This guide is also available on the DEP's Radiation Protection and Release Prevention Programs' web site at <http://www.state.nj.us/dep/rpp/radwater.htm>