



Arsenic Water Treatment for Residential Wells in New Jersey

ARSENIC

Arsenic has been found to occur in well water of the Piedmont Physiographic Province of New Jersey (Figure 1) at levels exceeding the drinking water standard. Research by the NJ Geological Survey (NJGS) indicates the arsenic is predominantly naturally occurring.

Arsenic is a toxic element that is known to increase the risk of adverse health effects in people who drink water containing it. Arsenic is a known human carcinogen that causes cancer of the skin, bladder, lung, kidney, and liver. It also causes increased risk of cardiovascular disease, peripheral neuropathy, skin hyperpigmentation and keratoses, and diabetes. The major exposure pathway for arsenic in residential well water is drinking and cooking with the untreated water. There may also be exposure from other uses of water in the home through bathing, showering, and brushing teeth. The NJ Department of Environmental Protection (NJDEP) adopted 5 ppb as the arsenic drinking water standard in New Jersey, effective in January 2006.

TESTING

Arsenic in well water is colorless, odorless, and tasteless. The only way to identify its presence is to have the water specifically tested for arsenic. You should have your water tested for arsenic if you have your own well and live in the shaded area of the map in Figure 1. Water testing labs can usually be found in the telephone book under “Laboratories-Testing” or “Water Analysis.” A list of certified labs can also be found on the Private Well Testing Act web site at <http://www.state.nj.us/dep/pwta/>. Use a

lab that is certified to test drinking water for arsenic and can provide a method detection limit (MDL) of 3 ppb or lower. The lab will report the total arsenic concentration. Although arsenic in New Jersey well water has been found to occur in two species commonly referred to as As3 and As5, the tests for these species are difficult and not widely available from commercial labs at this time. For this reason, if your well requires arsenic treatment, it is important to choose a treatment system that removes both arsenic species.

Confirm your arsenic level by re-sampling your water for arsenic. If you have tested your well and the arsenic level is reported to be greater than 5 ppb, you should re-test to confirm the result before obtaining a treatment system. When re-sampling for arsenic, also test for pH, iron, manganese, sulfate, and silica, as their levels need to be known when designing your arsenic treatment system.

TREATMENT

NJDEP tested and evaluated treatment systems to determine the most efficient, cost effective, user friendly, and environmentally sound water treatment technologies to remove arsenic from residential well water in New Jersey. Arsenic removal requires special considerations. Water softeners and granular activated carbon do not remove arsenic. As of the publication date, the research has resulted in the following treatment guidance.

The preferred treatment technology for arsenic removal in New Jersey is a whole-house granular ferric adsorption system as shown in the below table. It effectively removes both arsenic species from all water in the home, is easy to operate and maintain, and the arsenic is

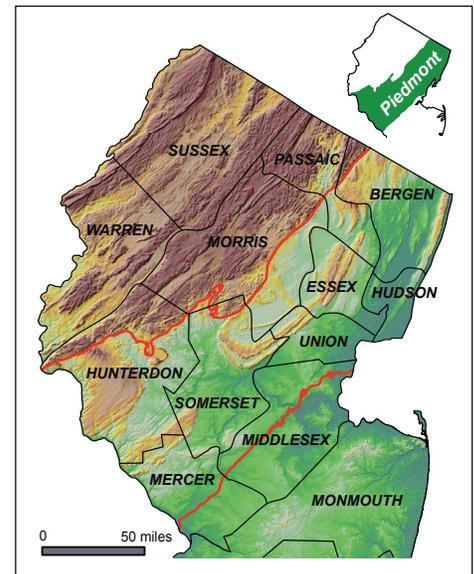
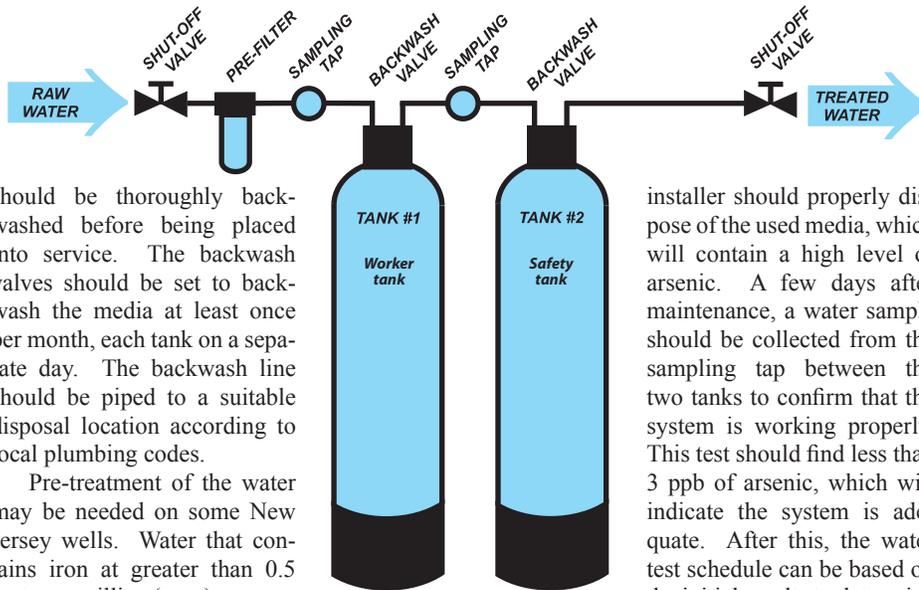


Figure 1. Location of the Piedmont Physiographic Province (shaded area in upper illustration) and color-shaded relief map (lower illustration) of northern New Jersey

not returned to the environment via regeneration. This type of system is called a “Point-of-Entry” system because the water is treated where it enters the home and all the water in the home is treated. This type of system should be installed as shown in Figure 2. The system consists of a shut-off valve, a 5-micron sediment pre-filter, a raw water sampling tap, two 10x40 inch or 9x48 inch tanks each containing at least one cubic foot of adsorption media (if arsenic concentrations are greater than 50 ppb, a greater volume of media should be considered in consultation with your water treatment professional), backwash control valves on each tank, a sampling tap between the tanks, and a shut-off valve after the system. The system

Arsenic Treatment Option Summary								
Treatment Type	Preferred	Process & Maintenance	Chemical Use	Waste Generated	Arsenic Species Removed	Typical Media Life	Average Installation Cost	Average Maintenance Cost
Granular Ferric Adsorption Whole House	1 st Choice	Simple	None	Low	As3 & As5	2-3 Years	\$2,740	\$0.67-1.00/day
Gran Ferric Single Tap Cartridges	2 nd Choice	Simple	None	Low	As3 & As5	1 year	\$365	\$0.32/day
Anion Exchange Whole House	No	Complex	Salt	High	As5 Only	10 Years	\$2,000	\$0.27/day
Reverse Osmosis Single Tap	No	Moderate	Disinfectant	Low	As5 Only	3 Years	\$700	\$0.33/day

Figure 2. Point-of-entry treatment system



should be thoroughly backwashed before being placed into service. The backwash valves should be set to backwash the media at least once per month, each tank on a separate day. The backwash line should be piped to a suitable disposal location according to local plumbing codes.

Pre-treatment of the water may be needed on some New Jersey wells. Water that contains iron at greater than 0.5 parts per million (ppm), manganese at greater than 0.05 ppm, sulfate at greater than 1 ppm and/or a hardness greater than 300 ppm may foul an arsenic adsorption system. If water with these constituents is not pre-treated, the useful life of the arsenic treatment system may be shortened and the maintenance costs greatly increased. Your water treatment professional should be able to recommend pre-treatment methods.

PERFORMANCE

To confirm that the system is working properly, a water sample should be collected from the sampling tap between the two tanks a few days after installation. All water samples collected to test the arsenic treatment system should be collected while stressing the system. To do this in a typical home, run the water for 10 minutes at 3-5 gallons per minute (simultaneously running the cold water in a bath tub and a sink is usually sufficient) before filling the sample container at the tap between the tanks.

The initial test should find less than 3 ppb of arsenic, which will indicate the system is adequate. After this, a water sample should be collected between the two tanks every six months to determine when the arsenic is breaking through Tank #1 (worker tank). When the arsenic level at this sampling tap reaches 5 ppb, it is time to schedule maintenance of the system, which involves media replacement for Tank #1.

For a family of three, with typical water use, and adequate pre-treatment, this type of system will likely need to have the Tank #1 media replaced after two to three years, depending on the arsenic concentration. The water treatment installer will remove Tank #1, place Tank #2 into the Tank #1 position, and place a tank with new media into the tank #2 position. The

installer should properly dispose of the used media, which will contain a high level of arsenic. A few days after maintenance, a water sample should be collected from the sampling tap between the two tanks to confirm that the system is working properly. This test should find less than 3 ppb of arsenic, which will indicate the system is adequate. After this, the water test schedule can be based on the initial results to determine when the arsenic will again break through Tank #1. A

water use meter with a warning light indicating when Tank #1 will likely need to be replaced can be installed and greatly reduce the need for obtaining water samples.

The advantages of the granular ferric system are that it removes both As₃ and As₅, it removes the arsenic from all the water in the home, arsenic is not returned to the environment via regeneration disposal to a septic system or elsewhere, and it is easy to operate and maintain. If new and improved adsorption media become available in the future, they can likely be used with the same equipment.

A maintenance plan provided by your water treatment professional should be a serious consideration when dealing with arsenic treatment. Because you can't see, smell, or taste arsenic in your water, it is very important that your system be monitored and maintained as recommended. The results of a 2003 cost survey for domestic/residential well arsenic water treatment installation and maintenance are shown in the Summary Table on page 1.

OTHER OPTIONS

For water treatment at a single tap in the home, a granular ferric adsorption point-of-use system can be installed. This system uses under-sink cartridges to remove both As₃ and As₅. The cartridges contain the same media as the whole-house system. These systems should be installed and maintained according to the manufacturer's instructions. They typically produce only two quarts per minute and are used to provide treated water for drinking and cooking only. Cartridges are typically changed once per year. The disadvantages of this type of system are that arsenic exposure may continue in the home from other water uses (e.g., drinking from other taps, bathing, showering,

and brushing teeth), and it is not uncommon for homeowners to exceed the useful life of the cartridges.

New arsenic treatment technologies may be developed in the years ahead. Arsenic water treatment research is continuing in New Jersey and around the globe. It is likely that new and improved adsorption technologies will be developed and reported on in future issues of this circular.

Systems that remove only As₅ from water are not recommended. Anion Exchange and Reverse Osmosis are two systems in this category. They should only be used if As₅ has been determined to be the only species in the water. Anion exchange systems are also problematic due to required maintenance to prevent arsenic dumping into the water, and the disposal of the extracted arsenic to the environment near the home.

Water heaters may have accumulated minerals that contain arsenic in homes with high levels of arsenic in their water. These minerals may release arsenic back into the treated water as it passes through the water heater, resulting in the hot water containing arsenic. Therefore, homeowners with high arsenic levels should consider testing their hot water after installing a whole-house treatment system and replacing the water heater if the levels are elevated.

Sources of Information

NJDEP, 2004, NJGS Information Circular, Arsenic in New Jersey Ground Water, <http://www.njgeology.org>

NJDEP, 2004, A Homeowner's Guide to Arsenic in Drinking Water: <http://www.state.nj.us/dep/dsr/arsenic/guide.htm>

NJDEP, 2002, Private Well Testing Act Web Site, <http://www.state.nj.us/dep/pwta/>

STATE OF NEW JERSEY

Jon S. Corzine, *Governor*

Department of Environmental Protection

Lisa P. Jackson, *Commissioner*

New Jersey Geological Survey

Karl Muessig, *State Geologist*



Prepared by Steven Spayd - 2007

Comments or requests for information are welcome. Write: NJGS, P.O. Box 427, Trenton, NJ 08625 Phone: 609-292-2576, Fax: 609-633-1004 Visit the NJGS web site @ www.njgeology.org This information circular is available upon written request or by downloading a copy from the NJGS web site.