

Common Water Test Parameters Related to Natural Gas Drilling

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The "Typical Concentrations" column reports results from research projects conducted in Pennsylvania (see end for references). Keep in mind that these "typical" results can vary considerably depending upon well properties and geographic location. As such, the data presented may not be representative of water obtained from your geographic area or water source. Proper testing is recommended to identify your water quality in relation to federal safe drinking water standards. The "Acceptable Levels" column provides U.S. Environmental Protection Agency drinking water standards where applicable. Standards reported as a "MCL" refer to pollutants with health effects while "SMCL" refers to pollutants with only aesthetic (taste, stains, odor, etc.) effects.

Parameter	Description	Typical Concentrations (See references for source of data)	Acceptable Levels
Alkalinity	A measure of materials in water that can neutralize acidity. Common sources are carbonates and bicarbonates from bedrock--especially limestone.	68% of water wells had alkalinity between 100 and 300 mg/L. ¹	No standard. Higher alkalinity water supplies may be more likely to have high hardness and/ or total dissolved solids which may cause aesthetic issues.
Arsenic	Naturally occurring metal which was also commonly found in industrial wastes, pesticides and treated lumber.	85% of water wells were below 0.005 mg/L while just 2% exceeded 0.010 mg/L. ⁴	Water should contain arsenic below the MCL of 0.010 mg/L to be safe to drink. Higher amounts are carcinogenic and can cause many other health problems.
Barium	A metal which typically occurs naturally in low concentrations but can be found in a variety of waste fluids from gas drilling and other industries.	94% of water wells had concentrations below 0.5 mg/L while just 1% exceeded 2.0 mg/L. ¹	Water should be below the MCL of 2.0 mg/L to be safe to drink due to gastrointestinal illness, muscular weakness and high blood pressure.

Parameter	Description	Typical Concentrations (See references for source of data)	Acceptable Levels
Bromide	Found abundantly in salt waters, brines, and various waste fluids, bromide is usually found at very low concentrations in freshwater in Pennsylvania.	Bromide in pristine groundwater is typically below 0.10 mg/L. ^{1,2}	No standard. Bromide in water can form carcinogens when chlorine is added to water for disinfection.
BTEX	Acronym stands for Benzene, Toluene, Ethylbenzene and Xylene. Organic compounds found commonly in petroleum products--can be an indication of natural petroleum products or leaks from fuel tanks, gas/oil drilling, etc.	Detectable concentrations are rare (less than 1% of water wells). ¹	Water should have less than the MCL's of 0.005 mg/L of benzene, 0.7 mg/L of ethylbenzene, 1 mg/L of toluene, and 10 mg/L of xylene due to health effects.
Chloride	Naturally occurring salt which can also occur at elevated levels from road salt, gas drilling, septic systems and other activities.	83% of water wells were below 20 mg/L while less than 1% exceed 250 mg/L. ¹	Water should have less than the SMCL of 250 mg/L to avoid salty taste, metal corrosion and other aesthetic problems.
Coliform bacteria	Group of bacteria common in surface water. Subgroups such as fecal coliform or E. coli bacteria, indicate animal or human waste contamination.	33% of private water wells contained coliform bacteria and 14% contained E. coli bacteria. ⁴	Coliform bacteria including fecal coliform and/or E. coli bacteria should be absent (MCL <1) to avoid gastrointestinal illness.
Gross alpha	Measure of alpha radiation given off by naturally occurring radionuclides like radium in water.	16% of wells in southeast PA exceeded 15 pCi/L ⁵ . Sample of 21 water wells in Marcellus region found average of 1 pCi/L and 0% above 15 pCi/L. ¹	

Parameter	Description	Typical Concentrations (See references for source of data)	Acceptable Levels
Hardness (Calcium and Magnesium)	Naturally occurring minerals (mostly calcium and magnesium) which can cause grayish or white scale, and other aesthetic issues.	25% of water wells had very hard water (above 180 mg/L) while 9% had soft water (below 17 mg/L). ⁴	No standard. High hardness causes scale build-up, especially where water is heated.
Iron	Mineral which can occur naturally or from disturbances (mining, etc.). Causes orange/brown stains and metallic taste.	44% had measurable iron, 20% exceed the SMCL of 0.3 mg/L. ¹	Water should contain less than the SMCL of 0.3 mg/L due to aesthetic problems (orange or brown stains and metallic taste).
Manganese	Mineral which can occur naturally or from disturbances (mining, etc.). Causes black stains or sediment and metallic taste.	48% had measurable manganese, 27% exceed the SMCL of 0.05 mg/L. ¹	Water should contain less than the SMCL of 0.05 mg/L due to aesthetic problems (black stains and metallic taste).
Methane / Ethane	Naturally occurring or from fossil fuel production, animal manure, biomass decomposition, landfills. May cause bubbling noise in well, spurting faucets, white gas bubbles in water.	24% of water wells had measurable methane and 4% exceeded some level of concern. ¹	No standard. Vented well caps suggested when levels exceed about 7 to 10 mg/L and aeration suggested above 28 mg/L.
Nitrate-N	Nutrient typically found at less than 1.0 mg/L in pristine groundwater and streams. Increased levels (above 3 mg/L) often related to fertilizer, animal wastes, and septic systems.	51% of water wells were below 1.0 mg/L. 20% exceed 5.0 mg/L and about 10% exceed 10.0 mg/L. ³	Water should contain less than the MCL of 10 mg/L as nitrate-N due to health concerns related to blue-baby disease.

Parameter	Description	Typical Concentrations (See references for source of data)	Acceptable Levels
pH	An important overall measure of water quality. Low pH may cause corrosion of metal plumbing components while high pH can cause taste issues.	80% of wells fell within the SMCL range for pH of 6.5 to 8.5 while 18% were below 6.5 and 2% were above 8.5.	Water should have a pH between the SMCL levels of 6.5 and 8.5 to avoid aesthetic problems like metal corrosion and poor tasting water.
Sodium	Common naturally occurring element which can also occur at increased levels due to road salt, gas drilling and other activities.	64% of water wells were below 20 mg/L. About 6% exceed 100 mg/L. ¹	No standard but sodium levels above 20 mg/L could be a concern to those on low sodium diets.
Strontium	Naturally occurring metal found in low concentrations in water. A by-product of ceramics, glass and other industries. Radioactive isotopes originate from historical nuclear testing.	83% of water wells were below 1 mg/L. ¹	No standard but U.S. EPA has developed a lifetime health advisory suggesting that water contain less than 4 mg/L.
Sulfate	A common, naturally occurring constituent of water. High sulfates can originate from bedrock or from mining activity.	Average sulfates were less than 20 mg/L. Over 90% of water wells were below 100 mg/L. About 1% exceed 250 mg/L. ¹	Water should contain less than the SMCL of 250 mg/L due to aesthetic effects including bitter taste and laxative effects.
Surfactants, Methylene Blue Active Substances (MBAS)	Materials used in various detergents and foaming agents. May originate from septic systems, sewage treatment or various industrial wastes.	Detectable concentrations are not common in PA water wells. In a recent survey, 0% exceeded 0.5 mg/L. ¹	Water should have less than the SMCL of 0.5 mg/L to avoid aesthetic problems. Presence of surfactants may indicate other problems (bacteria, etc.)

Parameter	Description	Typical Concentrations (See references for source of data)	Acceptable Levels
Total Dissolved Solids (TDS)	A measure of all of the dissolved constituents in water. High levels can be caused by natural minerals (like hardness) or pollution from various activities (mining, gas drilling, road salt, etc.)	75% of wells had TDS levels between 100 and 500 mg/L. ⁴	Water should have less than the SMCL of 500 mg/L due to aesthetic effects including bad tastes and stains.
Total Suspended Solids (TSS)	A measure of the visible sediment and particles in the water due to soil, metals, etc.	22% of water wells had measurable TSS levels above 1.0 mg/L. ¹	Causes cloudiness to water. No standard for TSS but there is a MCL for <i>Turbidity</i> of 1 NTU which may be produced by about 1 mg/L of TSS.

Table 1. Common test parameters and acceptable levels in well water

mg/L stands for milligrams per liter. This is a common water testing measurement and is equal to parts per million (ppm).

pCi/L stands for picocuries per liter. This is a common measurement of radioactivity in water.

More Information

The Pennsylvania [Department of Environmental Protection](#) (DEP) regulates gas drilling in the state. Visit the DEP [Office of Oil and Gas Management](#) page for more information.

Penn State Extension has many fact sheets and publications that provide more details about these water quality problems and solutions.

References

1. Boyer, E. W., B.R. Swistock, J. Clark, M. Madden and D.E Rizzo. (2011). [The impact of Marcellus gas drilling on rural drinking water supplies](#). Final report to The Center for Rural Pennsylvania, Harrisburg, PA. 29 pp. (sampling of 233 water wells in Pennsylvania)
2. Davis, S.N., J.T. Fabryka-Martin and L.E. Wolfsberg. (2004). Variations of bromide in potable ground water in the United States. *Ground Water* 42:(6-7):902-9. (sampling of 91 groundwater wells in the United States)
3. Swistock, B.R., W.E. Sharpe, & P.D. Robillard. (1993). A survey of lead, nitrate and radon contamination of private individual water systems in Pennsylvania. *Journal of Environmental Health*, 55(5), 6-12. (sampling of 1,600 water wells in Pennsylvania)

4. Swistock, B.R., S. Clemens & W.E. Sharpe. (2009). [Drinking water quality in rural Pennsylvania and the effect of management practices](#). Final report The Center for Rural Pennsylvania, Harrisburg, PA. 24 pp. (sampling of 701 water wells in Pennsylvania)
5. U.S. Geological Survey, 2000. Naturally occurring radionuclides in groundwater of southeastern Pennsylvania. Fact sheet 012. (sampling of 256 water wells in southern Pennsylvania)

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