WATER Quality

K-STATE Kansas State University

Recommended Water Tests for Private Wells

The decision to have your water tested is one that may affect the health of everyone in your household. People want and need water that is safe to drink. Testing is the only reliable way to find pollutants and to evaluate safety of water. Color, turbidity, taste, and odor are discernible by the senses, but offer few clues concerning impurities that affect health. Water that appears problem-free may not be safe or acceptable for all uses.

The purposes of water testing discussed here are:

- to ensure water is safe to drink (meets Drinking Water Standards);
- to evaluate need for water treatment;
- to form a baseline of water quality for comparison.

You must understand that the most important factors for safe water are good well location and construction following current standards. Also critically important are management of activities near the well and annual maintenance including shock chlorination. See K-State Research and Extension bulletins: *Private Well Safe Location and Construction*, MF-970, *Private Well Maintenance and Protection*, MF-2396, and *Shock Chlorination for Private Water Systems*, MF-911 for more information. If well location, construction or maintenance are deficient, they should be corrected before testing the water.

One in nine Kansas households depend on private water supplies. System integrity, water quality, and well protection are the owner's responsibility. Lending institutions may require water tests and evaluation of the water system before approving a loan. Some county sanitary codes require water tests for private systems, but no state or federal law or regulation does. Public water systems are tested for bacteria at least twice a month. More than $1,000 of testing is done before a new well is put into service. These tests are repeated regularly.

This publication is provided to help users understand important factors and make critical decisions about when to test and which water tests to request.

How Water Becomes Contaminated

Chemically pure water does not exist for long in nature. Water, an excellent solvent, dissolves and carries with it some of almost everything it touches. While falling as precipitation, water picks up gases, ions, and dust particles from the atmosphere. When water reaches the earth, it flows over or through plant materials and surface layers of soil and rock, dissolving minerals. Minerals like calcium, magnesium, carbonate, sodium and chloride are of little concern in fresh water, and are even desirable because low levels contribute to good-tasting water. However, many undesirable chemicals also dissolve in water. See K-State Research and Extension bulletin *Groundwater and Well Contamination*, MF-932 for more information.

Monitoring shows that, in most cases, natural groundwater is quite safe. When contamination is detected, it is often a result of poor well location, poor well construction, lack of maintenance or poor management. Man's activities can overload the soil's natural filtering, absorption, and removal capacity. When pollutants from the surface or underground overload the soil's protection, they eventually reach the groundwater. Evidence of such things as sewage, fuel, wastes, pesticides, and fertilizer are found in groundwater. See K-State Research and Extension publications *Nitrate and Groundwater*, MF-857; and *Managing the Farmstead to Minimize Groundwater and Well Contamination*, MF-948; and Department of Biological and Agricultural Engineering publications *Farm•A•Syst*, EP33-48 for information about contamination and how to protect water.

Ensuring Safe Drinking Water

Health effects from contaminated water are often acute toxicity, an immediate response — within hours or days. Until the 1970s, drinking water limits mostly addressed acute effects like bacteria, nitrate, toxic elements, and heavy metals that accumulate in the body.

Chronic toxicity results from low-level exposure over years, decades, or a lifetime. Because many chemicals are found at low concentrations in water, the concern about long-term exposure is heightened. New standards based on chronic effects, long-term exposure, have been added including organic chemicals, pesticides and radioactive materials.

This publication focuses on acute toxicity because the risk is known, direct, short-term and much more common. The highest priority is to ensure that water is free of disease-causing organisms and pollutants that

immediately affect body functions and health. Tests for the highest risk factors should be requested first. K-State Research and Extension bulletins, *Understanding Your Water Test Report*, MF-912 and *Organic and Radiological Chemicals*, MF-1142 give drinking water standards or the maximum contaminant levels (MCL).

For parameters that affect health, it is important for decisions to be based on the best information. A record of several tests over a year or more is ideal before making critical decisions about water quality.

Recommended Tests and Frequency

Kansas Department of Health and Environment (KDHE) and K-State Research and Extension strongly recommend at least annual water tests for coliform bacteria and nitrate. However, a reliable indicator of safe water requires more bacteria tests, at least each quarter.

Water should be tested for common impurities and nuisance contaminants every few years. Except for a few cases of gross contamination, they change slowly so a test every 3 to 5 years is adequate. These tests form a basis for comparison to detect possible contamination.

Total Coliform Bacteria. An annual water test for total coliform bacteria is the most important (the primary indicator) to evaluate safety of drinking water. Tests at least four times a year are required for a reliable indication of safe water. Get screening test, sample kit, or information from local health department or K-State Research and Extension office. The sample for a bacteria test must reach the laboratory within 24 hours of collection. For more information, see K-State Research Extension bulletin: *Quality Water: Coliform Bacteria, Program 3*, EP-27.

Most coliform bacteria strains are not pathogens (disease-causing). They are found in large numbers in feces of warmblooded animals, in soil, and the environment. These bacteria indicate the well has been exposed to the environment and may be contaminated with sewage or animal wastes. Bacteria, viruses, and cysts, that would make you sick, may be present.

Environmental factors which suggest special or more frequent bacteria tests include:

- flooding of the well or near the well
- surface water supply
- change in color, turbidity, odor, or taste of water
- recurring digestive illness in people or animals
- following repair of well or plumbing system.

Fecal Coliform or *E. coli* Bacteria. A test for fecal coliform or *E. coli* bacteria is recommended any time total coliform bacteria are present. Finding fecal or *E. coli* bacteria means there is contamination from a human or animal fecal source. Pathogens can exist in the drinking water. Water must not be used for drinking, cooking, or washing without disinfection.

Fecal coliform live in the intestines of warm blooded animals and are included in the total coliform test. *E. coli*, short for Escherichia coli, are specific fecal coliform strains. Most fecal or *E. coli* bacteria are not disease agents but their presence suggests a high possibility of pathogens and disease.

Nitrate. An annual test for nitrate is the second most important for safe water. Obtain a screening test, sample kit, laboratory information, or wellhead protection information from local health department or K-State Research and Extension office. Surveys of private drinking water in Kansas showed 24 percent of home wells and 28 percent of farmstead wells were above the nitrate standard.

In warmblooded animals, nitrate may be reduced to nitrite, which readily enters blood. Nitrite attaches to the hemoglobin and restricts the blood's ability to carry oxygen. In extreme cases, it causes methemoglobinemia ("blue baby" syndrome) in human and animal infants. If untreated, death may result. It may affect adult horses and ruminant animals. Nitrate often interferes with livestock milk production, weight gain, or reproduction before other symptoms are observed.

Nitrate tests are especially important when livestock facilities, fertilizer storage or handling, or a septic system are or have been within 400 feet of the well. If no nitrogen sources or activities occur near the well, and a record of consistent low nitrate is established, the test interval may be lengthened. See *Nitrate and Groundwater*, MF-857, for more details.

Pesticide and Other Organic Chemicals. A test for pesticide is recommended when nitrate is above the standard and pesticide has been stored, mixed, handled, or disposed within 400 feet of the well. Also test when a large source such as a spill or accident, or commercial storage, handling and mixing site is within a quarter mile, especially upslope.

Pesticides have been detected with increasing frequency in Kansas well water. A 1986 study detected pesticide in 8 percent of farmstead wells. The 1994 private well survey, using a more sensitive test, detected atrazine in 19 percent of the wells. Pesticides also are found in large reservoirs and many streams and rivers. The chance of finding pesticide above the drinking water standard in groundwater is quite low - less than one half percent.

The farmstead well study found that wells with high nitrate are more likely to contain pesticide. When nitrate exceeded the drinking water standard, the chance of finding pesticides doubled. The likelihood tripled (to about 25 percent) when nitrate was more than twice the standard. By contrast, low nitrate, less than 4 milligram per liter, resulted in only a 2 percent chance of finding pesticides.

Tests for pesticides and other organic chemicals are expensive, and interpretation of results and health effects may be difficult and uncertain. Pesticide in groundwater is not considered an immediate health threat.

Lead and Other Metals. A lead test is recommended when plumbing contains lead pipe, fittings, or there is evidence of corrosion (bluish or greenish stains on fixtures), low pH, soft water, or a combination of these. EPA reduced the MCL for lead to 0.015 milligram per liter because of increased concern about lead exposure. Groundwater normally does not contain significant lead or other toxic metals. Lead may be leached from the plumbing system. Hard water deposits in the plumbing helps prevent lead from leaching.

Selenium. Testing for selenium is not recommended at this time. Concentrations above the MCL were found in only 2 percent of farmstead wells.

Nuisance Contaminants, Need for Treatment

The most common water quality problems are nuisances that make water less desirable for household uses but do not directly affect health. Standards are designated "secondary" when there is no direct health concern. These include chloride, copper, iron, manganese, sulfate, total dissolved solids (TDS) and zinc. Some laboratories have a drinking water suitability test that includes the most common anions and cations and nuisance impurities. These chemicals should be tested every 3 to 5 years as discussed above.

Below are common nuisance contaminants that make water less desirable. Testing helps identify the problem, evaluate the need for treatment, and size treatment equipment. Dealers usually do free tests for nuisance impurities to help select and size treatment equipment.

Additional information about nuisance contaminants is available in K-State Research and Extension publications: *Quality Water series: Hardness, Program 1*, EP-25; *Red Water (Iron), Program* 2, EP-26; Sulfate-Sulfide, Program 6, EP-29; and *Hard Water: To Soften or Not to Soften*, MF-848. The *Home Water Treatment Handbook*, NRAES-48 addresses water treatment and standards.

Acidic (low) or basic (high) pH may cause corrosion that contributes to health concerns and staining of plumbing fixtures when some metals are corroded. PH adjustment is simple with treatment.

Hardness is the most common nuisance problem in Kansas groundwater. It causes difficulty with cleaning and laundry, deposits in water heater, and shortened life of water using appliances. Softening is readily available.

Hydrogen sulfide gives water a disagreeable "rotten egg" or sulfur odor. A sensitive nose is a highly effective test. Shock chlorination or periodic disinfection of the well are highly effective treatment.

Iron and manganese are called the stainers because they contribute to permanent black or red stains of water fixtures and laundry. Special iron filters are effective.

TDS/salts are the sum of all impurities dissolved in water which gives it the characteristics. At low levels they are a benefit because they give water its taste.

Showing Contamination

The activities of businesses and people may damage the quality of well and groundwater. Water tests before pollution or in the early stages are helpful in showing damage to the supply. Some activities that may affect groundwater quality and tests that may help show a cause are shown in Table 1.

To prove damage for litigation requires careful planning. The strongest evidence is provided when an unbiased third party, such as licensed engineer or health department sanitarian, collects the sample and delivers it to the laboratory using a chain-of-custody record. This record shows who handled the samples and the time so accountability is available for testimony.

How to Take a Water Sample

Instructions for collecting a water sample usually accompany the sample container from the laboratory. Use the container provided and follow directions to ensure a representative sample. If no directions are given, contact the laboratory or refer to K-State Research and Extension publication *Taking a Water Sample*, MF-963. Samples should always be taken from cold, unsoftened, and untreated water. Select a faucet that is regularly used. Remove the aerator and allow the water to run several minutes. For lead tests, sample the first flush after water has remained in the system overnight.

Where to Get Water Tested

Some local health or environmental departments provide screening tests. Water treatment dealers often do tests for nuisance problems. However, for decisions that affect health use a laboratory certified by KDHE for the tests needed or desired. A certified laboratory is vitally important if results might be used as evidence of pollution or in litigation.

More than 12 laboratories in Kansas and adjacent states are certified for bacteria and nitrate tests. About 20 laboratories in Kansas and nearby states are certified for drinking water testing. See the latest copy of *Testing to Help Ensure Safe Drinking Water*, MF-951 for laboratory information. Current information about certified laboratories is available through KDHE, Laboratory Improvement <http://www.kdhe.state.ks.us/lipo> or phone (785) 296-1639.

Interpreting a Laboratory Test Report

A water test report may look confusing. It often has terms and abbreviations that are unfamiliar. The laboratory may not provide information about the MCL. The local health department or K-State Research and Extension office may help interpret, or contact the laboratory. See K-State Research and Extension publication *Understanding Your Water Test Report*, MF-912 for help with interpreting test reports, MCLs, possible sources of contaminants, and health risks.

Table 1. *Common activities, causes of contamination and suggested test parameters.*

Activities	Possible Causes	Parameters to Test
Bulk storage facilities. cleanup	Leaks, spills, disposal,	Material(s) being stored or. that have been stored
Mining: salt, coal, lead, zinc other metals and minerals	Mine drainage, leaks, spills, storage areas, subsidence areas, mined lands, tailings, or spoil piles	Total dissolved solids (TDS), chloride, sodium, pH, heavy metals, corrosion index, sulfate
Oil and gas: test holes, old wells, abandoned wells, storage, brine disposal, etc.	Leaks, failed casings, poor plugging, unplugged test holes or abandoned well, spills	TDS, sodium, chloride, hydrocarbons, volatile organic chemical (VOC) scan, petroleum components
Landfills, waste disposal sites	Percolation from site, spills, pollutant plume in groundwater	Chemical oxygen demand (COD), total organic carbon (TOC), ammonia, dissolved oxygen (DO), VOC scan, heavy metal scan, synthetic organic chemicals (SOC).
Wastewater: lagoons, septic systems, sludge, and septage disposal, etc.	Leaks, spills, overloading, poor maintenance	Total and fecal coliform bacteria, fecal streptococcus, nitrate, ammonia, TDS, TOC, chlorides, sodium
Livestock facilities	Accumulation of waste, improper storage or disposal of wastes, runoff of wastewater	Total and fecal coliform bacteria, biochemical oxygen demand (BOD) ammonia, nitrate, phosphorus, TOC, COD, TDS
Industrial sites	Leaks, disposal, failures, poor management, spills	VOC and SOC scan of chemical used, produced, or stored on the site; process chemicals
Water wells for household, domestic or livestock uses	Wells with poor: location, construction, maintenance or management	Total and fecal coliform bacteria, nitrate

This publication is provided to help improve management of private water supplies. It was written by K-State Research and Extension specialists in cooperation with Kansas Department of Health and Environment.

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