OKLAHOMA

Farm & Ranch*A*Syst

Fact Sheet 1

Reducing the Risk of Ground Water Contamination by Improving Drinking Water Well Condition

1. Well Location

Whether a well taps water just below the surface or a hundred feet deep, its location is a crucial safety factor. Consider where the well is in relation to surface slope and potential sources of contamination. A well downhill from a livestock yard, fuel tank, or septic tank drain field, poses a greater risk of contamination than a well on the uphill side of these potential pollution sources.

In shallow aquifers, ground water flow is often in the same direction as the surface slope. However, if the aquifer supplying water to your well is deep, its slope may be different from the slope of the ground surface.

Criteria for New Wells

* Allow recommended distances between well location and known or potential contaminant sources (see your county health department or Extension agent).
* Avoid flood-prone areas.
* Locate the well upslope from known or potential contaminant sources.
* Make the well accessible for pump repair, cleaning, testing, and inspection.
* Deeper wells are safer from surface contamination than those that are shallow.
* Watertight casing should extend at least 10 feet below the surface, preferably below the ground water table or into a rock formation.
* Casing should be grouted and sealed at the surface.
* Decontaminate—The driller should disinfect the well with chlorine after construction, test the water for bacteria after drilling (as recommended), and provide detailed information about the well's depth and construction.
* Test well water periodically and protect and maintain it.
* Use a reputable, licensed well driller and pump installer.

Separation Distances

Oklahoma recommends minimum separation distances between a well and potential pollution sources to take advantage of the natural protection provided by soil. Always provide as much separation as possible between your well and any potential contamination source—especially if your well is 1) in highly permeable soils or thin soil overlying fractured or porous bedrock such as limestone, or 2) the contamination source or activity presents a high risk of contamination. Make every effort to exceed current standards whenever possible.

Both soil and slope can make siting a well a tricky business. Keep in mind that separation distances required by the state are minimums. You may want to choose greater separation distances in some cases, depending on factors at your site. This will help provide reasonable assurance that your well will not be polluted by farm or ranch activities in the future. Also, consider contamination sources on adjacent properties.

Changing the location of your well in relation to contamination sources may protect your water supply, but not the ground water itself. Any condition likely to cause contamination of ground water should be improved, even if your well is far away from the potential source. Whether or not drinking water is affected, contaminating ground water is a violation of Oklahoma law.

Simply separating your well from a contamination source may reduce the chance of pollution, but it does not guarantee that the well will be safe. Storm water and ground water can transport bacteria, oil products, pesticides, and other contaminants. Wells located in the path of polluted water run a risk of contamination from overland flow washing into an improperly sealed well. Some wells become contaminated through polluted recharge at great distances, depending on the depth of the aquifer and the well intake.

Well Types

Dug wells pose the highest risk of allowing drinking water supply contamination because they are shallow and often poorly protected from surface water. A dug well is a large-diameter hole (usually more than two feet wide), which is often constructed by hand.

Driven-point (sand-point) wells pose a moderate to high risk. They are constructed by driving assembled lengths of pipe into the ground. Driven-point wells normally have a diameter two inches or less, and are less than 50 feet deep. Driven-point wells can be installed only in areas with relatively loose soils and shallow water tables.

Drilled wells are all other well types, including those constructed by a combination of jetting and driving. Drilled wells (for farm and ranch use) are commonly four to eight inches in diameter. All bedrock wells should be at least six inches in diameter.

Well Depth

A shallow well draws from the ground water nearest the land surface, which may be directly affected by farm or ranch activities. Ground water supplying a deep well (more than several hundred feet below the water table) may have traveled a considerable distance underground over a long time, offering greater protection to the well. Keep in mind that local geologic conditions also determine how much protection a well has from contamination. For example, areas with thin soil over fractured bedrock or sand and gravel aquifers are particularly vulnerable. On the other hand, thick clay soils usually don't allow contaminants to reach the water table.

2. Well Construction

Poor well construction can allow contamination of ground water by letting surface water pass directly to ground water without filtering through soil. A well located in a pit, or a well that is not properly sealed, can allow surface water to carry bacteria, pesticides, fertilizer, oil products, or other contaminants into your drinking water supply. Proper well construction reduces the risk of pollution by sealing the well from anything that might enter it from the surface.

Information about the construction of your well may be available from the person who drilled it, from previous owners, or from the well construction report. The Oklahoma Water Resource Board (OWRB) can attempt to locate the construction report for you for a small fee.

This overview of well construction and inspection can help you understand your drinking water contamination risk ranking. For more information, contact a registered well driller or pump installer. Your county sanitarian can help interpret construction guidelines of the state water well standards (OAC 785:35).

Well Casing, Seal, and Cap

The well driller installs a steel or plastic pipe, called casing, during construction to prevent collapse of the borehole. The space between the casing and the sides of the hole provides a direct channel for surface water (and pollutants) to reach the water table. To seal off that channel, the driller fills the space with grout (cement or cement and bentonite clay mixture) and constructs a concrete pad at the surface.

You can visually inspect the condition of your well casing for holes or cracks at the surface or down the inside of the casing with a light. If you can move the casing around by pushing against it, it is not grouted properly. In areas of shallow (less than 20 feet from the surface), fractured bedrock, check on the condition of your well casing by listening for running water (the pump should be off). If you hear water, there could be a crack or hole in the casing, or the well may not be cased down to the water level in the

Recommended Minimum Separation Distances From Potential Sources of Contamination to Private Wells

2 ft.
- Pump house floor drain draining to ground surface.

10 ft.
- Watertight sewer line (cast iron or approved plastic).

25 ft.
- Farm silo.

50 ft.
- Watertight sewer line (clay tile, orangeburg, etc.).
- Septic tank subsurface drain field or lagoon (downhill from the well).
- House foundation (downhill from well).
- Other potential or known sources of pollution, such as oil and gas wells, manure piles, landfills, etc. (downhill from the well).

75 ft.
- Septic tank subsurface drain field or lagoon (same elevation as the well).
- House foundation (same elevation as well).
- Other potential or known sources of pollution, such as oil and gas wells, manure piles, landfills, etc. (same elevation as the well).

100 ft.
- Septic tank subsurface drain field or lagoon (uphill from the well).
- Septic tank, subsurface disposal field (soil percolation greater than or equal to one inch in less than five minutes).
- Seepage pit.
- Barnyard or feedlot.
- House foundation (uphill from the well).
- Other potential or known sources of pollution, such as oil and gas wells, manure piles, landfills, etc. (uphill from the well).

300 ft.
- Privies, cesspools, or other known sources of pollution.*

* For sources not addressed, provide as much separation as practical from the well. If the well is on a hillside or at the foot of a hill where pollutant sources are located, the corresponding separation value is a horizontal distance.

These distances constitute the minimum separation and should be increased in areas of fractured rock or limestone, or where the direction of ground water movement is from sources of contamination toward the well. These are distances in the well standards. Local waste storage ordinances may recommend or require different separation distances. (Source: OAC 785:35-7.)

well. Either situation is risky.

The driller also installs a tight-fitting, vermin-proof well cap to prevent entry by insects, rodents, or other pests. The cap should be installed with a screened vent (usually pointed downward). Check the well cap to see that it is in place and tightly secured. Any pump wiring should be in a sealed conduit. If your well has a vent, be sure that it faces the ground, is tightly connected to the well cap or seal, and is properly screened to keep insects out. (Not all wells have caps. Some wells may have pumping equipment attached at the surface.)

Casing Depth and Height

The well casing must extend at least 10 feet below the ground surface.

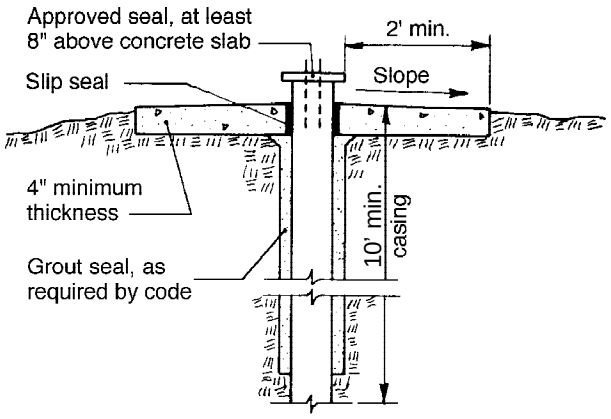

Figure 1. Recommended construction for water wells to protect the ground water supply from contamination.

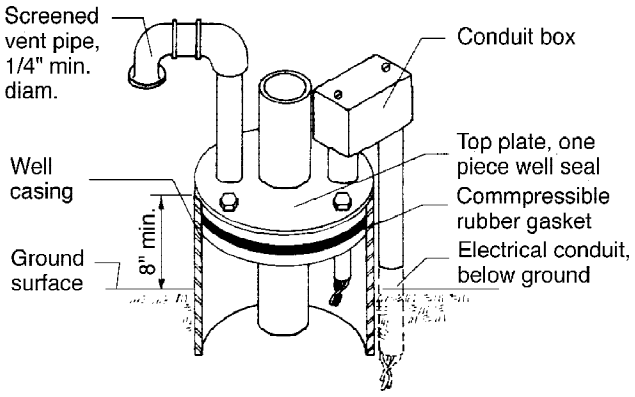

Figure 2. A sanitary well seal with screened vent pipe to protect a water well from surface water, vermin and foreign matter.

Source: Private Water Systems Handbook (MWPS-14). Midwest Plan Service, Iowa State University, Ames, Iowa. 1979.

Where practical, the casing should extend down to any geologic formation that is impermeable to water, such as a rock or clay layer. Where this is not possible, wells cased below the water level in the well can offer greater protection from contamination. If the well casing extends at least 30 feet below the water level in your well, it ensures that surface water is filtered through soil and geologic materials before entering the well. However, deeper cased wells may result in hard-water water problems caused by dissolved solids, such as minerals and iron.

Typically, the well casing extends one to two feet above the surrounding land. Such casing extension prevents standing surface water from running down the casing and into the well. The private well code requires that at least 12 inches of casing pipe extend above the final grade of the land. If your well is located in an area that is prone to frequent, severe flooding, no amount of casing height extension will offer complete protection from contamination by surface flooding.

Note: Meeting well code minimums does not guarantee a safe water supply, so you may want to exceed the minimum casing depth.

Well Age

Well age is an important factor in predicting the likelihood of contamination. A well constructed more than 70 years ago is likely to be at the center of the farm or ranch; it may be shallower and surrounded by many potential contamination sources. Some older well pumps are more likely to leak lubricating oils that can get into the well. Older wells are also more likely to have thinner casing that is corroded through. Even wells with modern casing that are 30 to 40 years old are subject to corrosion and perforation. If you have an older well, you may want to have it inspected by an OWRB specialist, a sanitarian, or a qualified well driller. Water wells drilled between 1978 and 1983 may be of particular concern. Because of a large number of housing starts during a time of rapid economic growth, many unlicensed well drillers operated in the

state during this period. If your well was drilled during this time, you may want to check its history to ensure that proper construction standards were followed.

3. Care and Maintenance to Protect Existing Wells

You wouldn't let a tractor run too long without an oil change. Your well deserves the same attention. Good maintenance means...

* Testing the water periodically.
* Keeping the well area clean and accessible.
* Keeping pollutants as far away as possible.
* Periodically having a qualified well driller or pump installer check the well mechanics.
* Improve wells, get rid of well pits, install caps, or extend casings.
* Improve or better manage your septic system (consult the ODH for regulations).

Changing the location of potential contaminant sources may be expensive. If your livestock feeding area is too close to your well, you should move it. You could install concrete curbs to direct livestock yard runoff away from the well. Manure stacks may also pose a risk of well contamination by bacteria or nitrates. Until you can meet minimum separation distance standards, change the way you manage such structures to control contaminants.

Backflow Prevention

Backflow or backsiphoning from pesticide mixing tanks can allow chemicals to flow back into the well through the hose if the water system loses pressure unexpectedly. Use an anti-backflow device when filling pesticide sprayer tanks to prevent the chemical mixture from flowing back into the well and contaminating ground water. Inexpensive anti-backflow devices for hoses used to fill farm sprayers are available from hardware stores or spray equipment suppliers. If you don't have such a device, maintain an air gap by keeping the hose out of the tank when filling the pesticide sprayer.

Consider purchasing an inexpensive plastic nurse tank. A nurse tank is filled with water at the well, and then used to fill the sprayer away from the farm or ranch—and away from the well. (For more information about preventing well contamination from pesticide mixing and loading practices, see Worksheet and Fact Sheet 2, Pesticide Storage and Handling.)

You should also consider anti-backflow devices on all faucets with hose connections, or maintain air gaps between hoses or faucets and the water level. Otherwise, you risk having water from laundry tubs, sinks, washing machines, pressure washers, landscape irrigation systems, and swimming pools that flow back through plumbing contaminate your water supply. Water supplies that have cross-connections between them also put your drinking water at risk.

All backsiphon and spill events should be reported to the Oklahoma Department of Agriculture or the Department of Environmental Quality.

Water Testing Recommendations:

It is your responsibility to monitor the water quality from your drinking well. The health of you and your family depends upon having a safe water supply. Most lending institutions require a water test before they will approve a loan for purchase or construction of your home. Most of Oklahoma's ground water satisfies the Safe Drinking Water Act (SDWA) standards for safe drinking water without any treatment. In some areas, however, there are health concerns such as nitrate or fluoride concentrations above the drinking water standard. More common problems, such as hardness or high concentrations of sulfate or chloride, are not primarily health concerns.

Private well users may experience water quality problems from chemical use or waste disposal near their wells, poor well construction, the proximity of septic systems, adjacent land use, or drastic weather events, such as severe drought or flooding. The only way to be certain your water supply is safe is to test it regularly for likely contaminants and conduct additional tests if your suspect a particular contaminant.

What Should You Test For?

A number of tests can be performed to check for specific water contaminants. To test for all possible pollutants would be expensive. Instead, tests should be conducted for the most common problems or for suspected problems.

Remember:

* Test your well periodically if there are high risk factors (see Worksheet 1).
* Where the well draws from sandy materials or granite bedrock, testing once for corrosivity is also recommended.
* A good initial set of tests for a private well includes nitrate, coliform bacteria, hardness, salinity, alkalinity, total dissolved solids (TDS), pH, conductivity, and chloride. This initial set of tests can be performed by the Oklahoma State Environmental Laboratory, OSU Agronomic Services Laboratory (no coliform test), or a private laboratory for a fee.

You may choose to obtain a broad scan of your water quality for a number of contaminants. The Oklahoma State Environmental Laboratory and various private labs can provide you the costs of analyzing for certain metals, inorganic chemicals, volatile organic chemicals, herbicides/pesticides, and coliform bacteria.

The results may not include contaminants that could be near your farm or ranch—the most commonly used pesticides in your area, for example. Test for contaminants that are most likely at your farm or ranch. Test for lead if you have lead pipes or soldered copper joints. Test for volatile organic chemicals (VOCs) if there has been a spill of petroleum (oil or gasoline) or solvent nearby. For further advice about deciding which tests are appropriate, contact your county health department or sanitarian.

The expense of testing for pesticides may be justified if:

* A pesticide spill has occurred near the well.
* Unwanted backflow of water into the well has occurred.
* Your well is shallow and is located near an area of heavy pesticide use.

Bacteria and nitrates are two important contamination indicators. At excessive levels, they can cause health problems themselves and also may suggest problems with the well's location or construction. Hardness and pH indicate how corrosive the water may be to your plumbing system. A high chloride level also may indicate other problems. In Oklahoma, most chloride comes from human activities (such as oil and gas production) and natural salt deposits.

You should test your water more frequently if:

* There are unexplained illnesses in the family.
* There are pregnancies in the family.
* There are noticeable changes in livestock or poultry performance.
* Your neighbors find a particular contaminant in their water.
* You note a change in water taste, odor, color, or clarity.
* You have a spill or unwanted backflow of chemicals or petroleum products near your well.
* You apply chemicals, manure, etc. to your fields within 100 feet of your well.
* Your livestock operation inspectors require it.

Follow the lab's instructions for water sampling to assure accuracy of the results. Use only the container provided, and return samples promptly. Bacteria sample bottles are sterile and must be returned within specified time limits. Because many materials, including bacteria and nitrate-nitrogen, are naturally present in minor amounts in ground water or can vary seasonally, you may want to contact a specialist for help in interpreting test results.

Keep in mind that activities off your farm can affect your ground water. Chemical spills, changes in land use, and the presence of landfills can increase the chance of pollutants getting into your water. If your water has a high nitrate or bacteria level, you may want to talk with a specialist about the need for additional testing. It is also important to record test results and to note changes in water quality over time. In addition to water analysis test results, you should write down details about the well's construction, and dates and results of maintenance intervals for the well and pump.

4. Unused or Abandoned Wells

Many farms and ranches have unused wells. Old home sites or shallow wells once pumped by windmills are common in Oklahoma. If not properly filled and sealed, unused wells can provide a direct path for surface water carrying pollutants to reach ground water, or allow contaminant movement from one aquifer to another. In addition to being a threat to ground water, open wells pose safety hazards for small children and animals.

Understanding Drinking Water Standards and Guidelines

The U.S. Environmental Protection Agency (EPA) was directed by the Safe Drinking Water Act amendments to set water quality standards for contaminants in public water supplies. These standards apply to public water supply systems only. However, they may offer guidance as to how you can best protect and maintain your private water well. Standards for some of the contaminants have been set, others have not yet been proposed, and still others are in various stages of development. Remember that states have the option to set standards that are stricter than those set by the EPA.

There are guidelines and two types of standards. Primary standards are health-based and are enforceable. Secondary standards are aesthetic-based and are non-enforceable. The Health Advisory Level (HAL) for public water supplies is a guideline and is also health-based, but it is non-enforceable. Standards and guidelines are described below.

MCL **Maximum Contaminant Level**
Primary standard; related to health effects; legally enforceable; the maximum level of a contaminant allowed in a public water system.

MCLG **Maximum Contaminant Level Goal**
Primary standard; related to suspected health effects; non-enforceable. The MCLG is set at zero for substances that are known human carcinogens, since there is no known safe level for this type of substance.

SMCL **Secondary Maximum Contaminant Level**
Secondary standard; non-health effects, such as taste, odor, appearance etc.; non-enforceable health goals.

HAL **Health Advisory Level**
Guideline; related to suspected health effects; non-enforceable.

ppm **Parts Per Million**
A unit of measure for concentration, equivalent to one milligram per liter (1 mg/L).

ppb **Parts Per Billion**
A unit of measure for concentration, equivalent to 0.001 mg/L; also equal to one microgram per liter (1 μg/L).

Pipes sticking out of the ground around the farm or ranch, in an area where a farm or ranch used to be, or under an old windmill are the most obvious places for finding unused wells. Unused well locations may not be obvious. A depression in the ground may indicate an old well. Also, wells were often drilled in basements of houses, under front steps, or near old cisterns.

Abandoning a Well

While you can fill and seal your own abandoned well, hiring a licensed, registered well driller is recommended. Effective well plugging calls for experience with well construction materials and methods, as well as a working knowledge of the geology of the well site. A license is not required, but the minimum well-code standards should be met when you abandon and fill a well.

Special equipment may be needed to remove old pumps and piping and to properly install sealing material inside the well. Use of inappropriate materials and methods can lead to well settling, collapse, and continued ground water contamination. If plugging materials are improperly installed in a well, correcting defective work is nearly impossible.

State well standards (Oklahoma Administrative Code 785:35-11-1) recommends that you report plugging of your well. These standards also explain well-closing criteria.

Procedure for Closing a Well

* Remove pump, piping, and any other obstructions from the well.
* Chlorinate the well.
* Seal the entire length of the well with fill material to prevent surface water from entering the ground water and to prevent contaminant movement from one aquifer to another. The goal of proper sealing is to restore as closely as possible the geologic conditions that existed before the well was constructed. For specific criteria, consult the OWRB rules and regulations.

Proper well closing takes time and money. Costs will vary with the well depth, diameter, and geology of the area. Spending a few hundred dollars plugging an unused well near your home may prevent contamination of your drinking water. Contact the OWRB for additional information and well closure report forms.

Contacts and References

Who to Call About...

Certified Well Water Testing Laboratories—A list of laboratories is available from the Oklahoma Department of Environmental Quality by calling 1-800-522-0206 or 405-271-4468.

Private Well Testing—For a test kit, call your county health department.

Cost to Have Your Well Tested—To find out the cost of analysis, call the State Environmental Laboratory at 405-271-5240.

Interpreting Well Water Test Results—Contact your county Extension agent, DEQ laboratory, or county health department environmental specialist for an interpretation of test results.

Drinking Water Quality Standards—Call the U.S. Environmental Protection Agency's Safe Drinking Water Hotline at 1-800-426-4791 from 8:00 a.m. to 4:30 p.m., CST.

Approved Water Treatment Devices—A list is available from Oklahoma Cooperative Extension, Oklahoma State University, Stillwater Oklahoma, phone: 405-744-5653.

Requirements for Installation of Treatment Devices—Before installing treatment devices on water supplies contaminated with nitrates, heavy metals, VOCs, pesticides, microorganisms, and other health-related contaminants in excess of enforcement standards, contact the Department of Environmental Quality at 1-800-522-0206 or 405-271-4468.

Locating Possible Sources of Contamination—Qualified plumbers, well drillers, OWRB district office water supply specialists (listed above), or county sanitarians can locate contamination sources and recommend improvements.

Well Construction or Inspection—Your OWRB district office or registered well drillers or pump installers can offer assistance.

A Copy of Your Well Construction Report—If a report was filed with the state, contact the Oklahoma Water Resources Board at 405-231-2500.

Well Abandonment—Contact your district OWRB Water Management Division at 405-231-2500.

What to Read About...

Ground Water, Ground Water Flow. Oklahoma State Department of Health Bulletin, No. 0589.

Oklahoma Ground-Water Resources. U.S. Geological Survey, paper No. 2300.

Oklahoma Ground-Water Quality. U.S. Geological Survey, paper No. 2325.

Ground Water: A Resource for the Future. Oklahoma Cooperative Extension Service, Division of Agricultural Sciences and Natural Resources, Oklahoma State University.

Private Water Systems Handbook. 1979. Fourth Edition. 72 pages. MWPS-14. Includes information on wells, ponds, springs, and other water supply systems; pumps, piping, and water treatment. (Recommendations may not meet Oklahoma codes.) Available from Oklahoma Cooperative Extension Plan Service, Oklahoma State University, phone: 405-744-5425.

*Partial funding for the cost of printing the Farm*A*Syst publications was provided by a grant from the Environmental Protection Agency, Region 6.*

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Charles B. Browning, Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Dean of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of $273.70 for 1,000 copies. #1155 0195 MSC