How Well Do You Know Your Water Well?

Groundwater and Water Wells in Southwest Colorado

Prepared by:
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In cooperation with the following agencies:
Southern Ute Indian Tribe
La Plata County
San Juan Basin Health Department
Colorado Oil & Gas Conservation Commission
Colorado Division of Water Resources

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San Juan Basin Health Department
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Colorado Oil & Gas Conservation Commission
970-259-4587
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Colorado Division of Water Resources
970-247-1845
http://water.state.co.us/

Colorado Department of Public Health & Environment
303-692-3320
http://www.cdphe.state.co.us/environ.asp

US Bureau of Land Management
970-247-4082
http://www.co.blm.gov/sjra/index.html

US EPA Safe Drinking Water Hotline
800-426-4791

Information considered accurate as of June 2001

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Introduction

Due to the rural nature of much of southwest Colorado, individual domestic water wells are a way of life for many of us. This informative booklet has been prepared as a reference guide for water well owners throughout the region. In it you will find basic information concerning the groundwater supplied to you from your private water well. It includes information concerning:

- the occurrence of groundwater and different types of aquifers;
- how aquifer replenishment and the use of groundwater affect the amount and quality of water available to you;
- water well permitting and water testing;
- contamination sources and protecting your well;
- typical components of a water well and distribution system;
- water quality standards and interpretation of test results;
- information concerning well maintenance and disinfection.

Also included are some handy tools such as a water well troubleshooting guide, a water treatment decision guide, and links to helpful Internet web sites that deal with local water issues.

Finally, the guide also contains contact information for various government agencies that can help answer questions this document cannot cover. People at these agencies have a great deal of very specific information about water and wells. They can also help you investigate and resolve problems or concerns that you may have about your water well.

We hope that you will keep this guide handy and use it to help answer basic questions about groundwater and your water well for years to come.

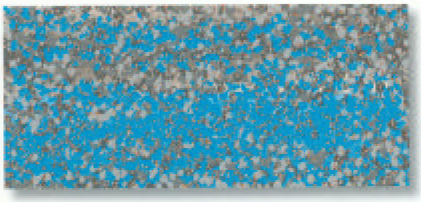
Aquifers and Water Use Basics

Aquifers are underground layers of porous and permeable sediment or rock. Water naturally collects in the small spaces among this sediment or rock and moves very slowly through these interconnected "pore spaces." Groundwater can also accumulate and move through small, interconnected fractures found in some rocks like sandstone or granite. There is generally no such thing as "underground rivers or lakes" except in rare and special geologic conditions involving rocks known as limestone.

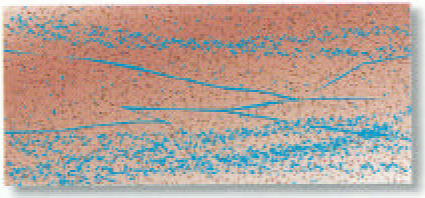
The water in aquifers is replenished through a process called "recharge." Rain, snowmelt and even irrigation water all soak into the ground and slowly move and accumulate to saturate pore spaces. Rivers, streams and irrigation ditches also provide recharge into aquifers. When drought occurs, or irrigation water is removed, recharge is diminished. Shallow river valley aquifers can be recharged quickly, but it may take many years for recharge water to reach deep bedrock aquifers.

Pumping groundwater from a well always causes a decline in groundwater levels at or near the well. This decline in groundwater level near the well also always causes, a diversion of groundwater from its natural, possibly distant area of discharge. Pumping of a single well typically has a local effect on the groundwater-flow system. Pumping of many wells (sometimes hundreds or thousands of wells) in large areas can have regionally significant effects on groundwater systems. Too much groundwater pumping can exceed the recharge rate and groundwater levels in a given area will decline. This is called "Groundwater Mining."

The figures below give an idea of how groundwater is found in different types of rock. Sand and gravel can hold significant amounts of water because pore spaces are large and well connected. Sandstone has smaller pores that are less well connected so it often yields less water. Shale has very small, interconnected pores and normally yields very little water. Coal can yield large amounts of water but will also often contain methane gas. The thin coal seams found in shallow aquifers are not the same coal seams where natural gas production occurs. The natural gas industry removes methane from the thick coal seams that are several thousand feet deep, much deeper than shallow aquifers. Crystalline rock has no pores and water must be drawn from interconnected fractures that naturally occur within the rock.

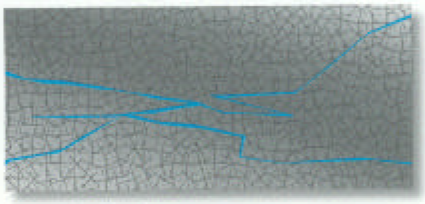


Sand and Gravel



Sandstone

Shale and Coal



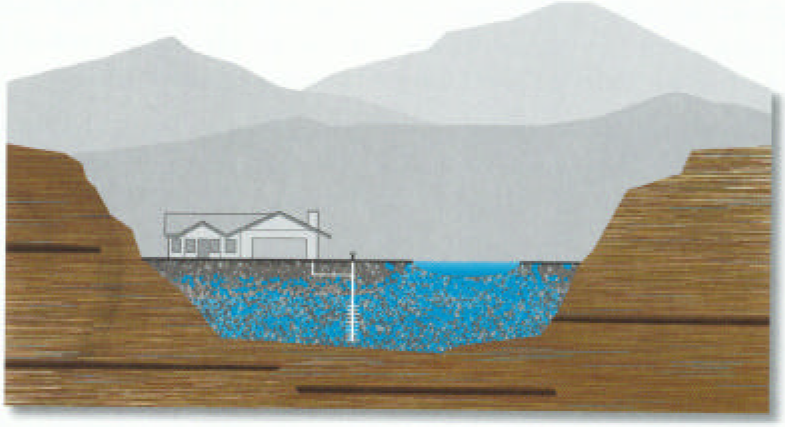
Crystalline Rock

Aquifers and Water Use Basics

Southwest Colorado water wells typically tap into four different kinds of aquifers.

River Valley Aquifer

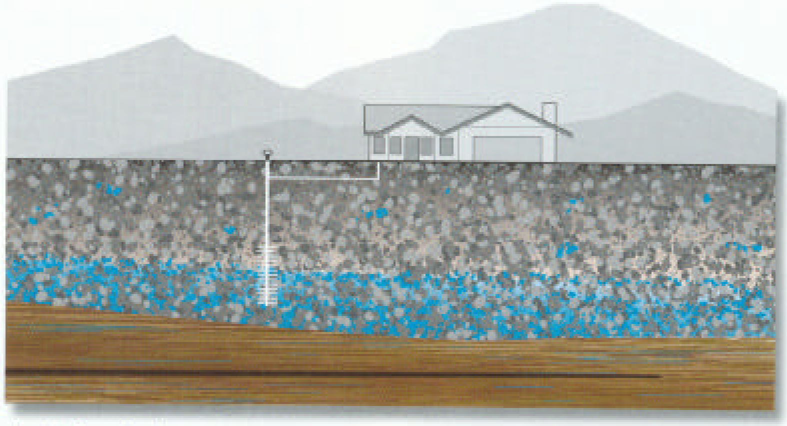
River valley aquifers are found in shallow loose sediments like gravel and sand next to rivers and streams. They are usually found within the immediate proximity of a river or stream valley. These aquifers are recharged by the river flow and usually have good water quality and sustained yield because of the regular recharge from the river. However, the groundwater is often close to the ground surface and is therefore very susceptible to pollution from adverse surface conditions.



River Valley Aquifer

Florida Mesa Aquifer

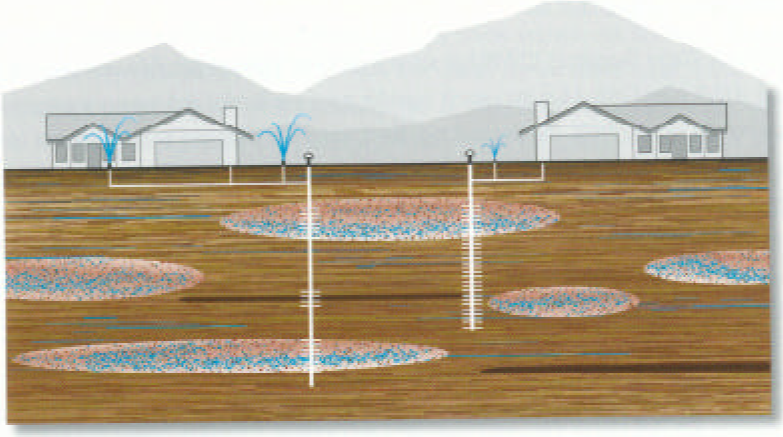
The Florida mesa aquifer is found in southeast La Plata County. This aquifer consists of a thick gravel deposit situated over a large area. Much of La Plata County's densely populated suburban area is situated over the Florida Mesa Aquifer. Recharge to this aquifer is primarily from irrigation water used on farms and ranches in the area. This aquifer typically has good water quality and yield. However, as more water wells are drilled and fewer farms are irrigated, the aquifer is at risk of becoming depleted in certain areas.



Florida Mesa Aquifer

Bedrock Shale and Sandstone Aquifer

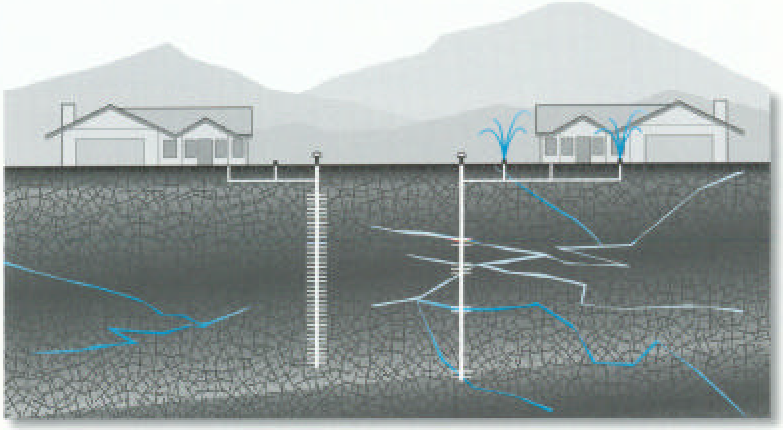
Bedrock shale and sandstone aquifers are often tapped in southwest Colorado. The most commonly drilled bedrock aquifers in La Plata County are the Animas and Nacimiento Formations in the southeast part of the county. However, many other bedrock formations are also drilled in other parts of the region. Most of these aquifers are mixed beds of sandstone and shale. More groundwater is generally found in sandstone than in shale. The yield and quality of water removed from bedrock aquifers can vary widely. And because recharge into bedrock aquifers is usually very slow, bedrock aquifers can easily suffer from the effects of overuse or groundwater mining.



Bedrock Shale and Sandstone Aquifer

Crystalline Fractured Aquifer

Crystalline fractured aquifers are most commonly found in northern La Plata County in granite and volcanic rocks. While these types of rocks have little or no pore spaces, groundwater is accumulated and transported in interconnected fractures within the rock. Wells that are drilled into a network of fractures can yield water. However, a nearby well that does not intercept fractures may yield no water at all.



Crystalline Fractured Aquifer

Water Well Permitting, Construction and Recordkeeping

In the early stage of planning a new or replacement water well there are several steps, including selecting a licensed drilling and pump contractor, selecting a well location that avoids contamination hazards, and obtaining a well permit. The Colorado Division of Water Resources requires that every new or replacement well be permitted before it is drilled, and that water wells must be drilled and constructed pursuant to Colorado Water Well Construction Rules (2 CCR 402-2).

In general, the well permit application asks for ownership and proposed well location information, proposed construction details, water use and septic system information and the well driller's license number. Well permit applications can be obtained on the Internet at:
http://water.state.co.us/default.htm

The Division of Water Resources (DWR) has several different types of possible well permits that can be issued. DWR form GWS-44 is the permit used for most residential and livestock water wells. Based on certain local criteria, the Division may limit water to indoor use only for parcels of less than 35 acres, and to outdoor use of no more than 1 irrigated acre for parcels larger than 35 acres. In water critical areas (where water rights are over appropriated) the Division may deny a new well permit altogether unless a landowner obtains appropriate replacement water rights. There are several areas in southwest Colorado that are designated as water critical areas. Persons interested in purchasing undeveloped land should always contact DWR before purchasing the property to determine if a well permit can be issued for that particular parcel.

Another early step developing a water well is planning for your water analysis and treatment. In Colorado, private well owners are responsible for the quality and quantity of their water supply. They are also responsible for determining what treatment equipment may be necessary for their well water. Before drilling your well, you should contact a qualified analytical laboratory to discuss the appropriate testing to be performed on your well water. You can obtain a list of qualified laboratories by contacting the Health Department. Also, you should obtain the necessary bottles and instruction on how to collect and preserve your water sample. Then, after the well is drilled and fully developed, you will be ready to collect your water sample and deliver it to the laboratory. Based on the analytical results, you can select appropriate treatment equipment (see Water Treatment Decision Guide on page 16-17).

As part of the well drilling process, the driller must record certain data that will be reported to DWR. This includes a record of the geologic formations encountered (the well log), an as-built well construction record and diagram, and an accurate well yield test. It is very important that the driller collects and records this information accurately. You may wish to ask the driller to collect and save samples of all the different soil and rock formations that were penetrated so they can be examined later by a geologist. You should also ask the driller to provide you with copies of all the diagrams and reports that must be submitted to DWR. Keep these records in a safe place. You will need to refer to these documents in the future when performing well maintenance or while evaluating well problems. If you have an existing well with no records, DWR can provide you with copies of the reports that were submitted by the driller when the well was drilled.

Man-Made Pollutants

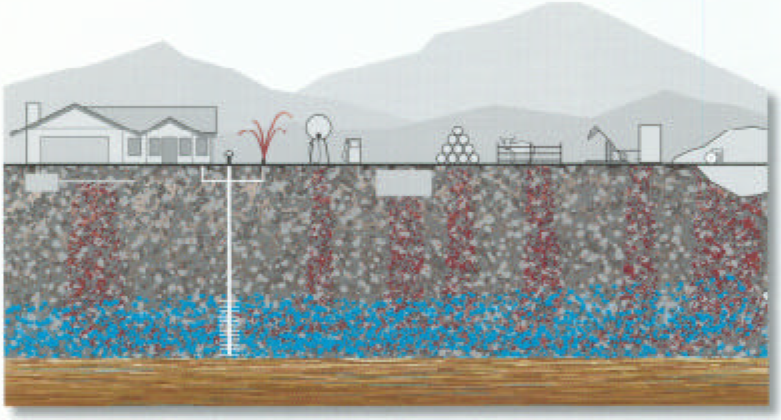
Groundwater pollution occurs when man-made products such as gasoline, oil, road salts and chemicals get into the groundwater and cause it to become unsafe or unfit for human use. Some of the most common sources of these pollutants are leaking fuel storage tanks, septic systems, inappropriate chemical storage sites, landfills, and the widespread use of road salts and chemicals.

A domestic well can easily be polluted if it is not properly constructed or if unsafe materials are released into the well. Toxic materials spilled or dumped near a well can leach into the aquifer and pollute the groundwater. Drinking water drawn from such a well is very dangerous.

Individual septic systems, or those not connected to a city sewer system, can also be a serious pollution source. Septic systems are designed to slowly drain away human waste underground at a harmless rate. An improperly designed, located, constructed, or maintained septic system can leak bacteria, viruses, or household chemicals into groundwater causing serious problems. A permit from San Juan Basin Health Department is required to install, alter or repair a septic system in southwest Colorado, and the property owner is responsible for proper installation and maintenance of the system and for the abatement of any nuisance arising from its failure.

Landfills are another possible source of pollution. When properly constructed, contemporary landfills have a protective bottom layer to prevent pollutants from getting into our groundwater. But, if this protective layer fails, pollutants from the landfill can make their way down into the groundwater.

Finally, chemicals including fertilizers, insecticides and pesticides are washed into the ground by irrigation and precipitation and eventually end up in the groundwater if they are improperly applied.



Sources of Man-Made Pollutants

Natural Contaminants

Contamination of groundwater is not always a result of the introduction of pollutants by human activities. Possible natural contaminants include trace elements such as arsenic and selenium, dissolved gases like methane and radon, and high concentrations of commonly occurring dissolved salts.

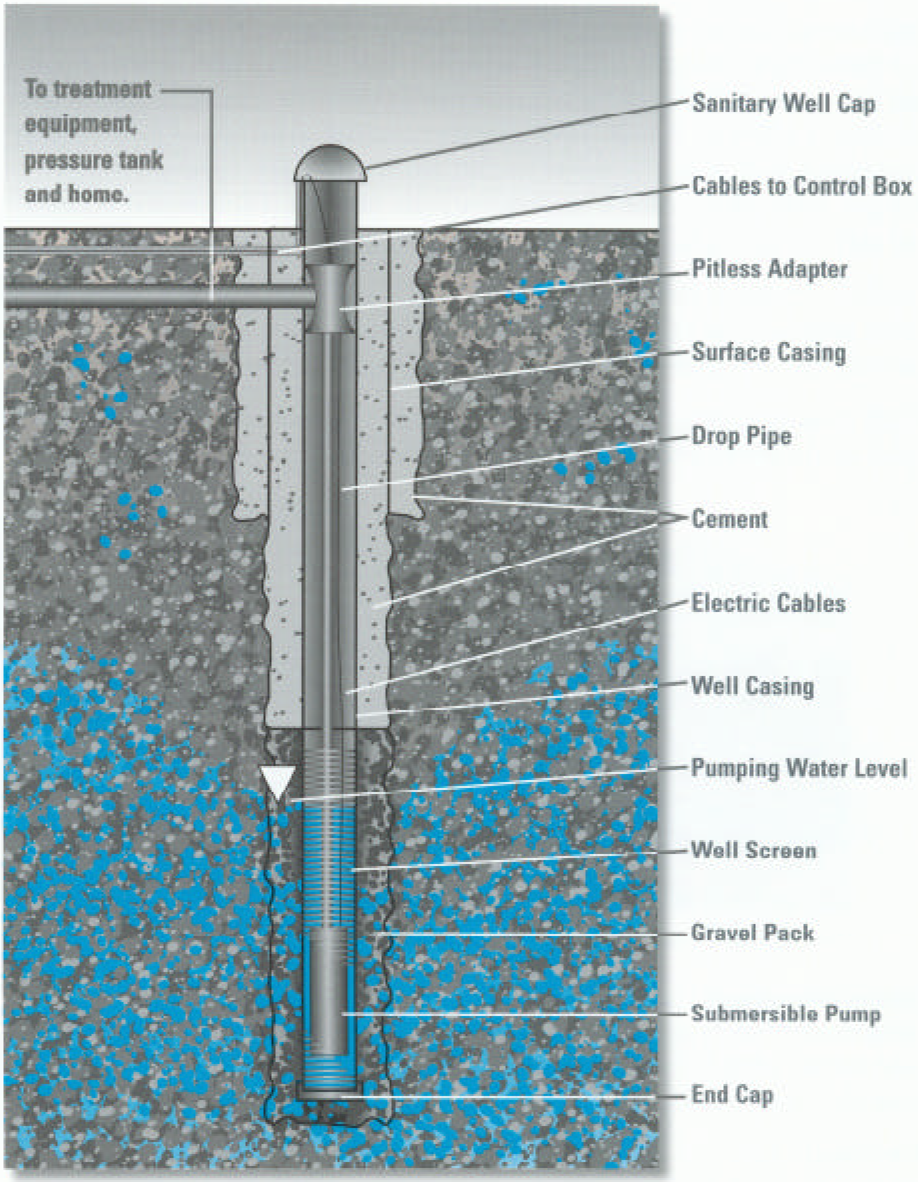
In southwest Colorado, many groundwaters naturally contain arsenic, chloride, dissolved salts, fluoride, iron, magnesium, manganese, nitrates, selenium and sulfate in concentrations exceeding recommended or mandatory standards for drinking water established by the Colorado Department of Public Health & Environment, the EPA and the U.S. Public Health Service.

Anatomy of a Water Well

Components of a Typical Water Well

This schematic diagram represents a typical water well as constructed in a water table type aquifer. While most wells are much deeper than illustrated here, all of the individual components that make up a water well are shown and labeled. The following list of water well terms helps explain the well components and other useful terms.

Knowing about the different components of a water well, and their function, will allow you to more effectively discuss your well with your well driller or pump installer.



Typical Water Well Construction

Anatomy of a Water Well

Typical Water System Terminology

Aquifer – A water bearing layer of sediment or rock with interconnected pore spaces or fractures that accumulate water.

Borehole – The cylindrical hole drilled into the aquifer.

Casing – Steel or PVC tubing placed in the borehole to keep the borehole open and to allow a void to store water and install a pump.

Casing Stickup – The amount of casing that projects up above the ground surface. This should be at least 1 foot.

Cement – Placed between the wall of the borehole and the casing to prevent surface contamination from reaching the aquifer.

Control Box – Electrical switch box that turns the well pump on and off.

Drop Pipe – Pipe placed in the casing to connect the pump to the surface.

Electrical Cable – Wiring from the pump control box to the pump that supplies power for the pump and sends command signals.

End Cap – Cap placed on the bottom of the casing to prevent sediment from flowing into the casing.

Gravel Pack – Gravel or sand placed between the borehole wall and the well screen to keep the borehole open and filter water before it enters the well.

Groundwater – Water stored beneath the surface of the earth that is transmitted through small, interconnected pores and fractures between sediment and rock.

Pitless Adapter – A device placed in the well casing that allows water to be diverted from the drop pipe to piping on the exterior of the well below the frost line.

Pressure Tank – A water holding tank equipped with an air bladder that regulates water pressure into the home and demand to the pump.

Pumping Water Level – The depth below the surface of the groundwater level in the well when the pump is operating. This is always deeper than the static water level.

Sanitary Well Seal – A sealed cap on the top of the well casing that prevents surface contaminants from entering the inside of the well.

Submersible Pump – The most common type of water well pump includes the pump and pump motor placed at the bottom of the drop pipe below the pumping water level.

Static Water Level – The depth below the surface of groundwater when the pump is not operating.

Surface Casing – Steel casing at least 25 feet deep that is the first casing installed in a well that prevents surface contaminants from entering the well.

Treatment Equipment – Can include a variety of equipment designed to remove various water contaminants and purify groundwater before use.

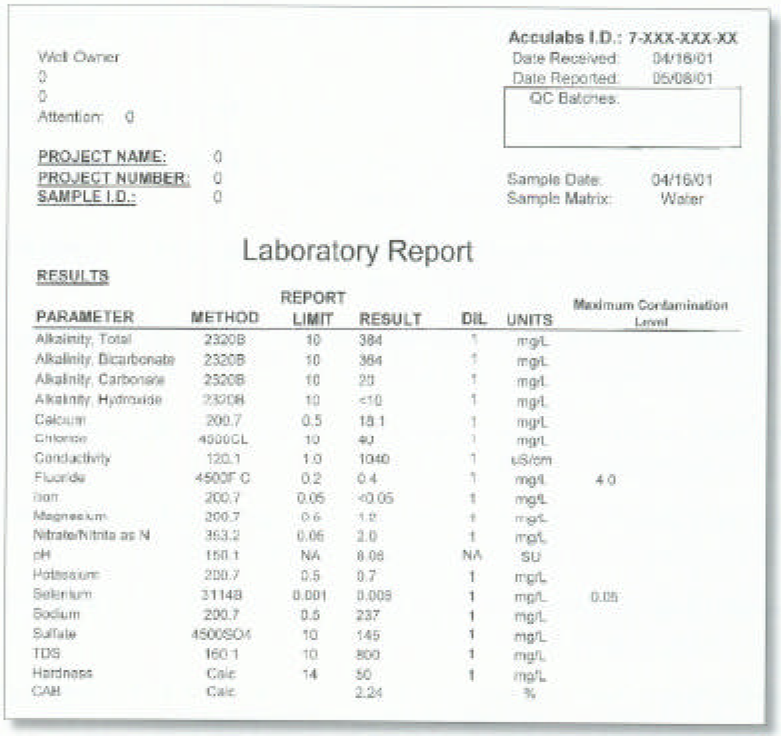
Well Screen – Steel or PVC perforated pipe that water flows through to enter the well and pump.

Water Quality Standards and Interpretation

Interpreting Your Water Test Report

Obtaining a water analysis from a testing laboratory is a necessary first step toward solving household water quality problems. Before seeking a water test, you may have had concerns about the safety of the water used in your household. Or you may have noticed objectionable symptoms when using the water for drinking, cooking, or other household purposes. Perhaps you have routinely monitored your household water quality through periodic testing and have noticed differing results between tests for one or more indicators. To positively identify the source of contamination problems, as well as to determine the type of corrective action to take, a properly interpreted water analysis report is essential.

Besides providing a laboratory report of the analysis for given pollutants or contaminants, most water testing laboratories provide little additional explanation of test results beyond the units used or possibly a footnote in the event that a problem contaminant is identified. The information provided below, along with the Water Testing Glossary on page 21, will help you understand a water analysis report for some common household water contaminants.



Acculabs I.D.: 7-XXX-XXX-XX
Date Received: 04/16/01
Date Reported: 05/08/01
QC Batches:

Well Owner
0
0
Attention: 0

PROJECT NAME: 0
PROJECT NUMBER: 0
SAMPLE I.D.: 0

Sample Date: 04/16/01
Sample Matrix: Water

Laboratory Report

RESULTS

PARAMETER	METHOD	REPORT LIMIT	RESULT	DIL	UNITS	Maximum Contamination Level
Alkalinity, Total	2320B	10	384	1	mg/L	
Alkalinity, Bicarbonate	2320B	10	384	1	mg/L	
Alkalinity, Carbonate	2320B	10	20	1	mg/L	
Alkalinity, Hydroxide	2320B	10	<10	1	mg/L	
Calcium	200.7	0.5	18.1	1	mg/L	
Chloride	4500CL	10	40	1	mg/L	
Conductivity	120.1	1.0	1040	1	uS/cm	
Fluoride	4500F C	0.2	0.4	1	mg/L	4.0
Iron	200.7	0.05	<0.05	1	mg/L	
Magnesium	200.7	0.6	1.2	1	mg/L	
Nitrate/Nitrite as N	353.2	0.06	2.0	1	mg/L	
pH	150.1	NA	8.08	NA	SU	
Potassium	200.7	0.5	0.7	1	mg/L	
Selenium	3114B	0.001	0.009	1	mg/L	0.05
Sodium	200.7	0.5	237	1	mg/L	
Sulfate	4500SO4	10	145	1	mg/L	
TDS	160.1	10	800	1	mg/L	
Hardness	Calc	14	50	1	mg/L	
CAB	Calc		2.24		%	

What Do the Numbers Mean?

Once a water testing laboratory has completed the analysis of your water, you will receive a report. It will contain a list of possible contaminants and physical characteristics for which your water was tested, and the measured concentration of each. The concentration is the amount (weight) of a given substance in a specific amount (volume) of water. The most common concentration unit used is milligrams per liter (mg/L) which, is approximately equal to one part per million (ppm), or one part contaminant to one million parts water.

Water Quality Standards and Interpretation

How Much is Too Much?

"Pure" water does not actually exist in nature and all natural water contains some contaminants. In most cases, the levels of these contaminants are either beneficial, or minimal and of little consequence. However, when certain contaminant levels in household water are excessive, they may affect household activities and/or be detrimental to your health. Evaluating what levels of contaminants are acceptable and understanding the nature of problems caused by these contaminants are the basic considerations in interpreting a household water analysis report.

Acceptable limits for evaluating the suitability and safety of your well water are established for many contaminants. Some established standards are set by nuisance considerations (taste, odor, staining, etc.) while many are based on health implications and are legally enforceable on public water systems. These acceptable limits for public water systems should be used as guidelines for your own water supply when evaluating your well water test results.

Whether you have the results of tests that you specifically requested, or you simply instructed the laboratory to conduct general or routine household water quality tests, you can use the following tables as a general guideline for the most common household water quality contaminants. These are divided into three categories: general indicators, nuisance impurities, and health contaminants. (Note: Some contaminants are evaluated on the basis of both nuisance and health criteria.)

General Indicators

General water quality indicators are parameters used to indicate the possible presence of harmful contaminants. Testing for general indicators may eliminate the need for costly tests for specific contaminants. Generally, if an indicator is excessive, the water supply may contain other contaminants as well, and further testing is recommended.

For example, you are probably familiar with harmless coliform bacteria, which are present in the air, soil, vegetation, and all warm-blooded animals. However, a positive total coliform bacteria test result may be followed by tests for fecal coliform or E. coli bacteria which, if present, would confirm that sewage or animal waste is contaminating the water.

Total dissolved solids (TDS) and pH are considered general water quality indicators, and may vary over time depending on well recharge characteristics. The tests listed in Table 1, along with a test for nitrate (see Table 4), provide a good routine analysis (as often as once a year) for most rural water supplies, unless there is a reason to suspect other contaminants.

Table 1: General Water Quality Indicators

Indicator	Acceptable Limit	Indication
Bacteria	----	Possible bacterial or viral contamination from human sewage or animal waste.
pH Value	6.5 to 8.5	An important overall measure of water quality, pH can alter corrosivity and solubility of contaminants. Low pH will cause pitting of pipes and fixtures and/or metallic taste. This may indicate that metals are being dissolved. At a high pH, the water will have a slippery feel or soda taste.
Total Dissolved Solids (TDS)	500 mg/L	Dissolved minerals, like iron or manganese. High TDS also may indicate hardness (scaly deposits) and cause staining, or a salty, bitter taste.

Water Quality Standards and Interpretation

Nuisance Impurities

Nuisance Impurities are another category of contaminants. While these have no adverse health effects at low levels, they often make water unsuitable for many household purposes. Nuisance impurities may include iron, bacteria, chloride, and hardness. Table 2 lists some typical nuisance impurities you may see on your water analysis report. Acceptable limits for nuisance impurities come from the EPA Secondary Drinking Water Standards.

Table 2: Common Nuisance Impurities and Their Effects

Contaminant	Acceptable Limit	Effects
Chlorides	250 mg/L	Salty or brackish taste; corrosive; blackens and pits stainless steel
Copper (Cu)	1.0 mg/L	Blue-green stains on plumbing fixtures; bitter, metallic taste
Iron (Fe)	0.3 mg/L	Metallic taste; discolored beverages; yellowish stains on laundry; reddish brown stains on fixtures
Manganese (Mn)	0.05 mg/L	Black specks on fixtures; bitter taste
Sulfates (SO_4)	250 mg/L	Bitter, medicinal taste; corrosive
Iron Bacteria	----	Orange- to brown-colored slime in water

Hardness is one contaminant you will also commonly see on the report. Hard water causes white, scaly deposits on plumbing fixtures and cooking appliances and decreased cleaning action of soaps and detergents. Hardness is the sum of the calcium and magnesium levels found in your water. Hard water can also cause buildup in hot water heaters and reduce their effective lifetime. Table 3 will help you interpret your water hardness parameters.

Hardness may be expressed in either milligrams per liter (mg/L) or grains per gallon (gpg). A gpg is used exclusively as a hardness unit and equals approximately 17 mg/L or ppm. Those water supplies falling in the hard-to-very hard categories may need to be softened. However, as with all water treatment, you should carefully consider the advantages and disadvantages of softening before making a decision on how to proceed.

Advantages of softening your water include increased effectiveness of detergents and soaps, increased life of hot water heater elements, and the reduction of scaly deposits on plumbing fixtures, etc. The disadvantages of softening your water included increased levels of sodium in softened water, and increased potential for pipe corrosion, to note just a few. Since the level of sodium can affect your health, consult your health professional about any impacts that softening your water may have on your health.

Table 3: Hardness Classifications (Concentration of Hardness)

In Grains per Gallon (gpg)	In Milligrams per Liter (mg/L)	Relative Hardness Level
Below 3.5	Below 60	Soft
3.5 to 7.0	60 to 120	Moderately Hard
7.0 to 10.5	120 to 180	Hard
10.5 and above	180 and above	Very Hard

Health Contaminants

The parameters outlined in Table 4 are some common contaminants that have known health effects. The table lists acceptable limits, potential health effects, and possible sources of the contaminant. In public water systems, these contaminants are regulated under the EPA Primary Drinking Water Standards. Except for nitrates, tests for these contaminants in private water wells are usually done only when a specific contamination is suspected.

Table 4: Standards, Sources, and Potential Health Effects of Common Regulated Contaminants

Contaminant	Acceptable Limit	Sources	Potential Health Effects at High Concentration
Fecal Coliform Bacteria	zero	Human sewage and animal wastes leaking into well or groundwater source.	Gastrointestinal distress, shock. Infants, elderly and the sick are especially susceptible.
Fluoride	4.0 mg/L	In southwest Colorado, fluoride is naturally leached from bedrock.	Mottling of teeth and bones. If less than 0.7 mg/L contact your doctor or dentist for recommendations about the need for additional fluoride for small children and the elderly.
Selenium	0.05 mg/L	In southwest Colorado, selenium is naturally leached from bedrock.	Dangerous to humans and animals alike. Horses are especially susceptible exhibiting hoof damage, hair loss, still born foals, weight loss, and even death with long term exposure. Humans and other animals share many of the same symptoms.
Lead	0.015 ppm	Used in batteries; may be leached from brass faucets, lead caulking, lead pipes and lead soldered joints.	Nervous disorders and mental impairment especially in fetuses, infants, and young children. Also, kidney damage; blood disorders and hypertension; low birth weights.
Arsenic	0.05 mg/L*	In southwest Colorado, arsenic is naturally leached from bedrock.	Dangerous to humans and animals alike. May cause skin damage, circulatory system problems and an increased risk of cancer.
Nitrates	10 mg/L nitrate-N	By-product of agricultural fertilization; human and animal waste leaching to groundwater.	Blue baby disease in infants (birth - 6 months); low health threat to children and adults.
Radon	30 pCi/L	Naturally-occurring radioactive gas formed from uranium decay, can seep into a well water from surrounding rocks and be released in the air as it leaves the faucet.	Breathing gas increases chances of lung cancer; may increase risk of stomach, colon, and bladder cancers.

* EPA is considering lowering the limit in 2001.

Water Quality Standards and Interpretation

Methane in Groundwater

Methane is a colorless, odorless and tasteless gas, which is produced by biological decay of organic materials or by high temperatures acting on organic materials. These materials include coals, organic rich shales, landfill materials, compost piles and other accumulations of organic materials both above and underground. Methane is also produced in the digestive system of humans and animals, and has no known direct health effect. The specific source of methane found in groundwater in southwest Colorado, can generally be determined by detailed laboratory analysis.

Methane in water wells becomes a problem when it is allowed to build up in confined spaces. High concentrations of methane can displace oxygen, or in the presence of a spark, can explode. Extensive testing for methane in water wells in southwest Colorado has been conducted during the past ten years. As a result of this testing, many believe that methane concentrations below 1 mg/L are considered harmless. Methane levels up to 7 mg/L usually are not a concern but should be monitored for changes. Between 7 mg/L and 13 mg/L additional monitoring and treatment should be considered. Also, care should be taken to ventilate confined spaces where well water is used. When methane levels are 13 mg/L or above, treatment is a must. These treatments include some form of aeration to remove methane from well water, and ventilation to allow the methane to safely dissipate outdoors rather than accumulate within your home, well house or other confined space. When you find methane in your well water, additional regular testing and monitoring should be performed since methane levels can fluctuate over time.

Where Can I Get Additional Information?

Further assistance with interpretation of your household water quality test report is available. If you have any problems understanding the way the information is presented on the report, you should contact the testing laboratory directly for explanation. To assist you in evaluating the significance of your results, and any actions you should take to solve identified problems, or for further information on contaminants not discussed in this publication, contact your local Health Department or environmental professional. If you wish to obtain more background information about the occurrence of contaminants and their effects on household water quality, particularly as it pertains to established drinking water standards, call the EPA **Safe Drinking Water Hotline at (800) 426-4791**. Or you can explore sites on the Internet starting with one or more of the web sites listed on the inside back cover of this booklet.

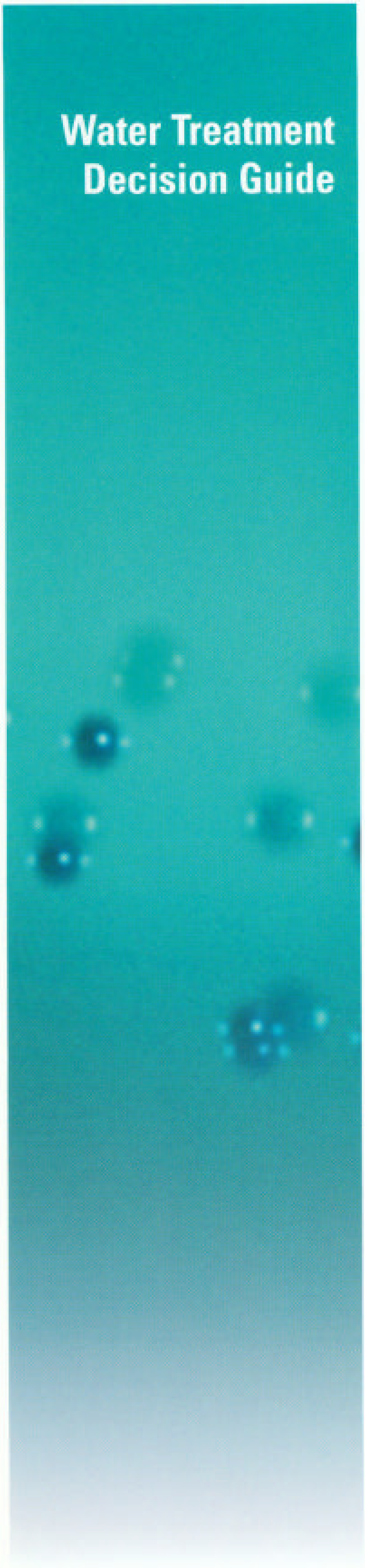
Water Quality Standards and Interpretation

Where Can I Get Additional Help For Water Treatment?

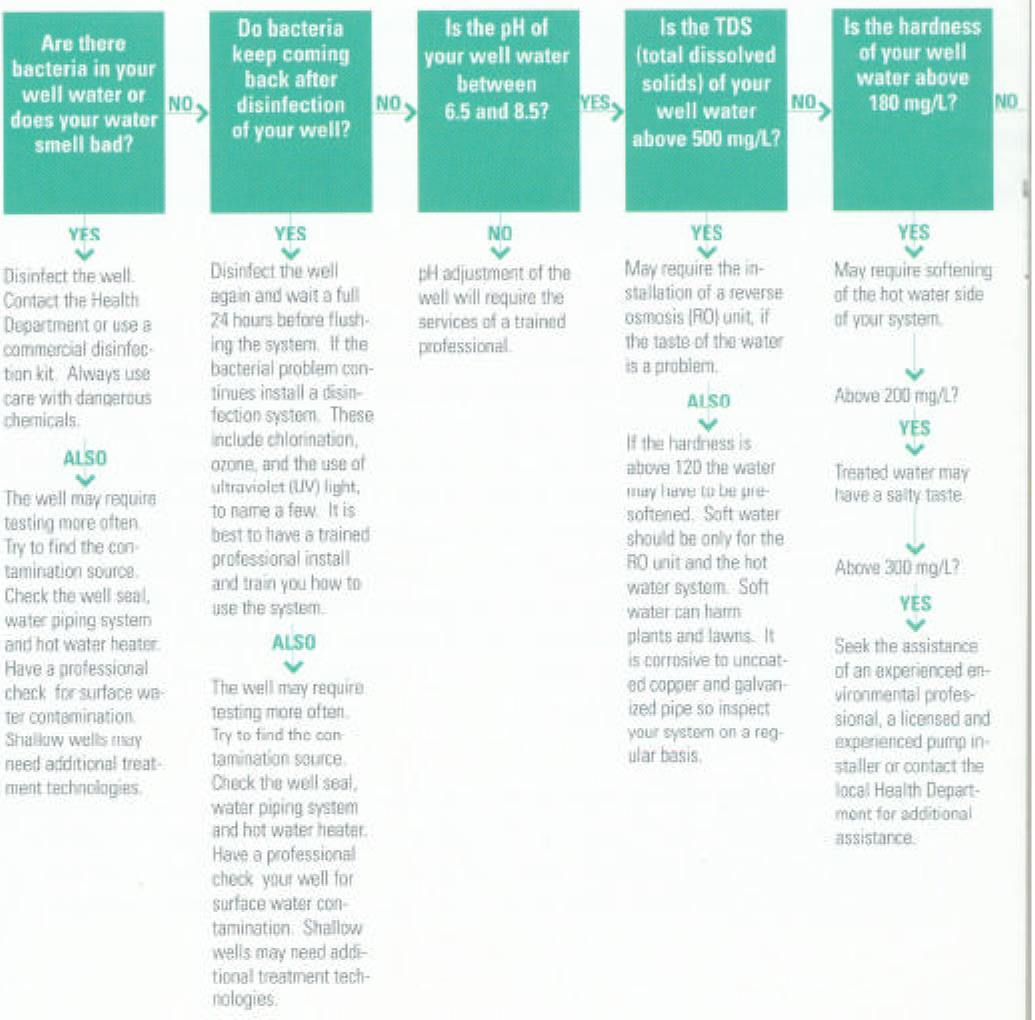
Sources for water treatment assistance can be found in most Yellow Pages under the headings of "Water Purify & Filter Equipment" or "Water Treatment Equipment, Service and Supplies." Additional assistance can be found by talking to the local Health Department, and in some cases the laboratory that analyzed your water. Care should be taken when a professional offers to test your water or to perform in home water quality tests. Many of these in-home tests are difficult to perform and can provide misleading information. Whenever possible use an independent testing laboratory that is certified.

As with the use of any technical service, care should be taken to assure yourself that the professional you have chosen has specific experience in the treatment of your water's problems. Ask for references, certifications, training credentials and the names of others who have used their services. Check with the Better Business Bureau for consumer complaints. Ask how long the professional has been performing his services. Don't be shy. Obtain recommendations and quotations from more than one professional. Verify the terms of warranty claims on both equipment and installation. Ask to see the technical information on your proposed system before signing any contract. If you have any doubts about the contract drawn up by the professional, seek legal assistance BEFORE signing. Look up web sites on the specific types of equipment that your professional recommends. Talk to your friends. Ask questions, and if you don't get satisfactory answers, don't buy until your questions are answered. If you can't afford the entire system initially ask for a recommendation on a basic system to treat the major problem(s) to start with, and make sure that it will be compatible with any upgrades in the future.

Remember that you are the owner of a small domestic water treatment system, and just like the big systems in town, yours too will need to be maintained on a regular basis. Make sure that you are provided with the technical manuals for your system and ask your professional to set up a regular maintenance schedule for you to follow, including follow-up and annual visits by your professional.



Water Treatment Decision Guide



Are there bacteria in your well water or does your water smell bad?

YES

Disinfect the well. Contact the Health Department or use a commercial disinfection kit. Always use care with dangerous chemicals.

ALSO

The well may require testing more often. Try to find the contamination source. Check the well seal, water piping system and hot water heater. Have a professional check for surface water contamination. Shallow wells may need additional treatment technologies.

NO

Do bacteria keep coming back after disinfection of your well?

YES

Disinfect the well again and wait a full 24 hours before flushing the system. If the bacterial problem continues install a disinfection system. These include chlorination, ozone, and the use of ultraviolet (UV) light, to name a few. It is best to have a trained professional install and train you how to use the system.

ALSO

The well may require testing more often. Try to find the contamination source. Check the well seal, water piping system and hot water heater. Have a professional check your well for surface water contamination. Shallow wells may need additional treatment technologies.

NO

Is the pH of your well water between 6.5 and 8.5?

NO

pH adjustment of the well will require the services of a trained professional.

YES

Is the TDS (total dissolved solids) of your well water above 500 mg/L?

YES

May require the installation of a reverse osmosis (RO) unit, if the taste of the water is a problem.

ALSO

If the hardness is above 120 the water may have to be presoftened. Soft water should be only for the RO unit and the hot water system. Soft water can harm plants and lawns. It is corrosive to uncoated copper and galvanized pipe so inspect your system on a regular basis.

NO

Is the hardness of your well water above 180 mg/L?

YES

May require softening of the hot water side of your system.

Above 200 mg/L?

YES

Treated water may have a salty taste.

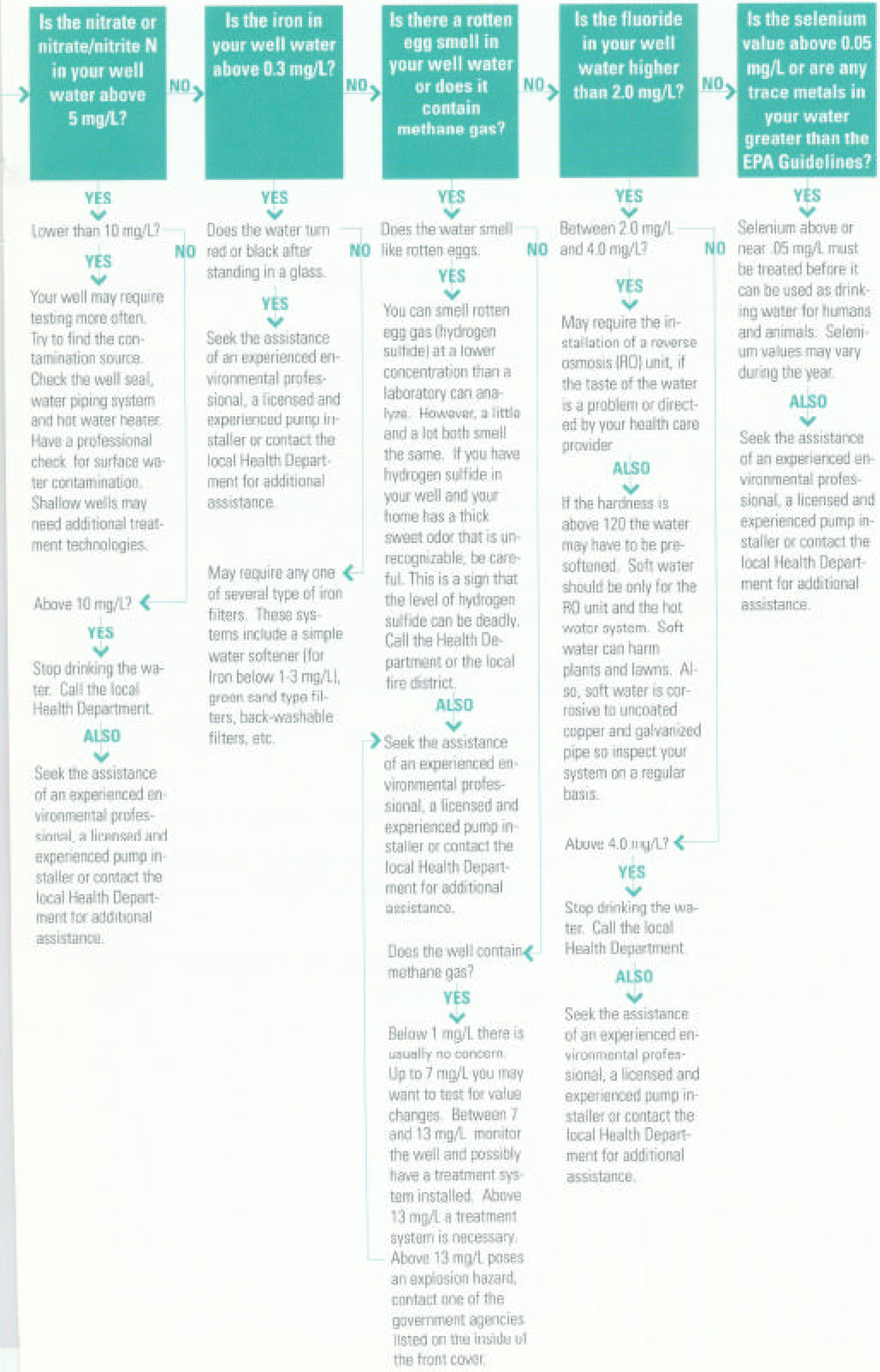
Above 300 mg/L?

YES

Seek the assistance of an experienced environmental professional, a licensed and experienced pump installer or contact the local Health Department for additional assistance.

NO

Water Treatment Decision Guide



Is the nitrate or nitrate/nitrite N in your well water above 5 mg/L? NO

YES

Lower than 10 mg/L? NO

YES

Your well may require testing more often. Try to find the contamination source. Check the well seal, water piping system and hot water heater. Have a professional check for surface water contamination. Shallow wells may need additional treatment technologies.

Above 10 mg/L?

YES

Stop drinking the water. Call the local Health Department.

ALSO

Seek the assistance of an experienced environmental professional, a licensed and experienced pump installer or contact the local Health Department for additional assistance.

Is the iron in your well water above 0.3 mg/L? NO

YES

Does the water turn red or black after standing in a glass. NO

YES

Seek the assistance of an experienced environmental professional, a licensed and experienced pump installer or contact the local Health Department for additional assistance.

May require any one of several type of iron filters. These systems include a simple water softener (for Iron below 1-3 mg/L), green sand type filters, back-washable filters, etc.

Is there a rotten egg smell in your well water or does it contain methane gas? NO

YES

Does the water smell like rotten eggs. NO

YES

You can smell rotten egg gas (hydrogen sulfide) at a lower concentration than a laboratory can analyze. However, a little and a lot both smell the same. If you have hydrogen sulfide in your well and your home has a thick sweet odor that is unrecognizable, be careful. This is a sign that the level of hydrogen sulfide can be deadly. Call the Health Department or the local fire district.

ALSO

Seek the assistance of an experienced environmental professional, a licensed and experienced pump installer or contact the local Health Department for additional assistance.

Does the well contain methane gas?

YES

Below 1 mg/L there is usually no concern. Up to 7 mg/L you may want to test for value changes. Between 7 and 13 mg/L monitor the well and possibly have a treatment system installed. Above 13 mg/L a treatment system is necessary. Above 13 mg/L poses an explosion hazard, contact one of the government agencies listed on the inside of the front cover.

Is the fluoride in your well water higher than 2.0 mg/L? NO

YES

Between 2.0 mg/L and 4.0 mg/L? NO

YES

May require the installation of a reverse osmosis (RO) unit, if the taste of the water is a problem or directed by your health care provider

ALSO

If the hardness is above 120 the water may have to be presoftened. Soft water should be only for the RO unit and the hot water system. Soft water can harm plants and lawns. Also, soft water is corrosive to uncoated copper and galvanized pipe so inspect your system on a regular basis.

Above 4.0 mg/L?

YES

Stop drinking the water. Call the local Health Department.

ALSO

Seek the assistance of an experienced environmental professional, a licensed and experienced pump installer or contact the local Health Department for additional assistance.

Is the selenium value above 0.05 mg/L or are any trace metals in your water greater than the EPA Guidelines?

YES

Selenium above or near .05 mg/L must be treated before it can be used as drinking water for humans and animals. Selenium values may vary during the year.

ALSO

Seek the assistance of an experienced environmental professional, a licensed and experienced pump installer or contact the local Health Department for additional assistance.

Water Well Maintenance

Properly constructed private water supply systems require routine maintenance. These simple steps will help protect your system and investment.

- Always use licensed water well drillers and pump installers when a well is constructed, a pump is installed, or the system is serviced.
- An annual well maintenance check, including a water chemistry and bacterial test, is recommended. Any source of drinking water should be checked any time there is a change in taste, odor or appearance, or anytime a water supply system is serviced.
- Keep hazardous chemicals, such as paint, fertilizer, pesticides, and motor oil far away from your well and pump house.
- Periodically check the well cover or well cap on top of the well casing to ensure it is in good repair.
- Always maintain proper separation between your well and buildings, waste systems, chemical storage facilities and livestock corrals.
- Do not allow back-siphonage. For example, when mixing pesticides, fertilizers or other chemicals, never put the hose into the chemical tank or container.
- When landscaping, keep the top of your well at least one foot above the ground. Slope the ground away from your well for proper drainage.
- Take care in working or mowing around your well. A damaged casing could jeopardize the sanitary protection of your well. Do not pile snow, leaves, or other materials around your well.
- Keep your well records in a safe place. These include the construction report, as well as annual water well system maintenance and water testing results.
- Be aware of changes in your well, the area around your well, or the water it provides.
- A licensed water well contractor can periodically measure the water level in your well and its production rate. He can also clean your well screen if there are indications of it becoming plugged by mineralization or bacteria.
- When your well has come to the end of its serviceable life (usually more than 20 years), have your licensed well driller properly plug and abandon your well.

Chlorination Techniques

The following basic technique has been recommended by the Health Department for the disinfection of domestic drinking water wells that have been determined to have bacterial contamination. Before disinfection, inspect your water system (or have it inspected by a professional) to determine and correct any damage, faults or design problems that may exist. These problems may contribute to the bacterial contamination found in your well. Inspect all areas and surfaces that may be a source of dust or other contamination in and around the system. After every possible contamination source has been eliminated, the water supply should be disinfected as outlined below:

1. Wearing rubber gloves and eye protection, add 1/2 cup of a 5% chlorine household bleach to 4 1/2 gallons of water. DO NOT USE any of the newer concentrated products, dry bleach or any of the "Fresh Scent", "Lemon Scent" or similar forms of bleach. Mix well and pour this solution into the well between the well casing and the pump drop line. If you should splash this solution on your person or clothing, immediately rinse thoroughly with water. Wait about 15 minutes before completing the system wide disinfection noted in step 2 below.
2. After adding the bleach and waiting as noted in step 1 above, continue as follows: Wearing eye protection, open a faucet on the system and run the water until you can smell the chlorine bleach odor. Turn off the faucet. Now do the same for ALL faucets on the system. Allow the bleach to remain in the entire system for 24 hours (at least overnight). During this wait period do not use the water for any purpose. This is to allow the disinfectant to kill all the bacteria within the system. After waiting 24 hours (or overnight), flush out the chlorine bleach from the system by running as much of the water on the ground as possible. DO NOT run the water into your septic system as the chlorine bleach may disrupt the operation of the system.
3. If your well does not respond to two or three treatments as described above contact a licensed pump installer.

Wells with excessive bacterial contamination or wells that contain slime bacteria may require more than one treatment or the installation of a permanent disinfection system. Two days after the system is flushed obtain a sterile sample bottle from San Juan Basin Health Department and collect a sample of water. Take this sample as directed from a clean water tap that does not have an aeration head (a possible source of contamination) and take it back to the Health Department as soon as possible (within 6 hours) for bacterial analysis.

If you use a commercially available disinfection kit follow the manufactures directions. If your system contains a cistern contact the Health Department or a licensed pump installer before proceeding.

Troubleshooting Guide

Q – Why does water not come from my well anymore?

A – There may be several reasons why water is not delivered from a well. First check your breaker box to see if the breaker is tripped. You should call a licensed pump installer to check the pump and pump control equipment, which may have failed. The pump installer can also check the water level in the well. Overuse of the aquifer may have dropped the groundwater level below the depth of your well.

Q – Why does my well seem to pump less water than it used to?

A – Over time minerals or bacteria can constrict your water well screen or your water system pump or piping. Overuse or seasonal lack of recharge of the aquifer can also cause the groundwater level to drop and thus decrease the amount of water that can enter the well. A licensed well driller or pump installer can clean your well screen and check your pump, piping and water level. They can also measure the yield of your well and compare it to the yield when the well was originally drilled.

Q – Why does my pump seem to run every time I turn on the tap?

A – The pressure in your water system is regulated by a pressure tank so that the pump does not have to be run every time there is demand for water. The tank has an air bladder in it that can rupture. Have a licensed pump installer check the pressure tank.

Q – Why does my water leave stains on fixtures and clothes?

A – Your water likely has lots of dissolved minerals in it. Have the water tested by a laboratory to determine its chemical composition. You can then use the Water Treatment Decision Guide in this booklet, or call a licensed pump installer to help you decide what treatment equipment may be appropriate for your well and water.

Q – Why is there a lot of sediment in my water?

A – Your well may have been improperly developed to remove excess drilling fluids and sediment when it was drilled. Or your well casing or well seals may have failed. Have a licensed well driller inspect the well and determine the source of the sediment.

Q – Why does my water smell like sulfur or have sewer like smell.

A – Your well probably has bacteria in it. Have the water tested for bacteria immediately. The local Health Department or a licensed pump installer can help disinfect the well and find the source of the bacteria.

Q – Why does my water smell or taste like chemicals?

A – Your well may be polluted with chemicals. Stop using the water immediately. Call the Health Department to help you find out where the source of the chemical contamination may be and what to analyze your water for. Have the water tested by a laboratory for likely chemical pollutants.

Q – Why does my water fizz?

A – Your well water has gas dissolved in it. This gas may be harmless air or carbon dioxide. It may also be methane. Have the water tested by a laboratory to determine what the gas is and whether or not a treatment system is necessary.

Water Testing Glossary

Acidic – descriptive term used in reference to water having a pH of less than 7; pertains to the corrosiveness of water.

Acute Health Effects (acute toxicity) – Any poisonous effect with a sudden and/or severe onset produced within a short period of time after using contaminated water, resulting in mild to severe biological harm or illness. Acute symptoms include, but are not limited to, upset stomach, loose stool, bowel upset, and gastrointestinal difficulties. If symptoms occur as a result of drinking contaminated water, medical attention should be sought promptly.

Aesthetic Characteristics – The nonhealth-related characteristics of water that make it desirable for human use. Generally taste, color, odor, and turbidity are considered to be aesthetic characteristics.

Alkaline – A water sample having a pH greater than 7 is alkaline (non-acidic).

Certified Testing Laboratory – A lab listed by the Colorado Department of Public Health & Environment as qualified to test drinking water. Information about local state-approved labs is available at the Health Department.

Chronic Health Effects – Chronic means long-term. Chronic health effects occur and persist as a result of repeated or long term use of contaminated water. Often, it takes many years of exposure for chronic health effects to occur. Chronic health effects include irreversible damage to internal organs, and changes to our gene structure, which can result in cancer, birth defects, disabilities, and other problems.

Coliform Bacteria – A type of bacteria that is found in the intestinal tract of all animals, including humans. These bacteria are used as an indicator of well cleanliness. If the coliform test is unacceptable, it is an indicator that your well is polluted and that additional tests or treatments are advisable. If the disinfection of your well does not remove the coliform bacteria seek the assistance of your local Health Department. Unacceptable coliform tests are usually seen on your report as: TNTC (too numerous to count) and confluent growth.

Concentration – The amount of a given substance (weight) in a specific amount of water (volume) and is expressed as mg/L or ppm.

Contaminants – Naturally occurring substances when present in high enough levels make water unfit for drinking and/or other household uses.

Corrosive Water – Water that is acidic and "soft" may be corrosive and may deteriorate plumbing and leach toxic metals such as lead and copper from pipes.

Corrosivity Index – One of the methods for assessing the scale dissolving (corrosive) or scale forming potential of water. A positive number indicates a tendency to deposit calcium carbonate. If the result is negative, it is an indication that the water will dissolve calcium carbonate and enhance corrosion.

Detection Limit – The minimum concentration of a substance that may be measured and reported in the given testing method. Many lab reports will state what the detection limit is for each contaminant.

Water Testing Glossary

Disinfection – The destruction of all pathogenic organisms, with chlorine, ozone, ultraviolet "UV" light or heating.

EPA – The abbreviation for the Environmental Protection Agency, properly called, "the United States Environmental Protection Agency." This agency has the responsibility of developing and enforcing Primary Drinking Water Standards. The EPA also develops, but does not enforce, Secondary Drinking Water Standards.

Grains per Gallon (gpg) – Apothecaries' weight of a chemical substance in one gallon of water used in the water-conditioning trade to indicate hardness of water. One gpg equals approximately 17 mg/L hardness.

Hardness – A water quality problem in much of southwest Colorado. Hardness is a relative term. It describes the content of the dissolved minerals, calcium and magnesium, and is reported as grains per gallon. Water with less than 3.5 grains per gallon is considered "soft"; while hard water above 7 grains per gallon may affect the appearance of plumbing fixtures, the lifespan of water heaters, and the effectiveness of detergents.

Health Risk – The risk or likelihood that a chemical will adversely affect a person's health. Estimating health risks is a complex and inexact science.

Heavy Metals – Elements with higher molecular weights, which are generally toxic in low concentrations to plant and animal life. Examples include mercury, chromium, cadmium, arsenic, selenium, and lead.

Hydrogen Sulfide – A hazardous, poison gas that smells like rotten eggs when it escapes from water. It is sometimes produced by bacteria in well water. It can be found in local water wells at concentrations that are a nuisance but are not poisonous.

Iron Bacteria – Microorganisms that feed on iron in the water. They may appear as a slimy rust-colored coating on the interior surface of a toilet flush tank or as a glob of gelatinous material in the water.

Maximum Contaminant Level (MCL) – The maximum level of a contaminant permitted in public water supplies. Maximum contaminant levels are specified in the Primary Drinking Water Standards set by EPA for contaminants that affect the safety of public drinking water.

Milligrams per Liter (mg/L) – Metric weight of a substance in a liter of water. 1 mg/ L = 1 ounce per 7,500 gallons. (1 mg/L = approximately 1 ppm in water).

Nitrate – A salt form of the chemical, nitrogen. The presence of nitrates in a water supply generally indicates pollution by human or animal waste, and/or commercial fertilizer.

Nuisance Contaminants – Contaminants that affect aesthetic or functional aspects of water quality and have little or no impact on health. They are managed by setting Secondary Maximum Contaminant Level Standards.

Organic Chemicals – Those chemicals that contain carbon. Today, many organic chemicals may pollute water supplies. These can include trihalomethanes, pesticides, and volatile organic chemicals such as gasoline.

Water Testing Glossary

Parts per Million (ppm) – Concentration of a substance on a weight basis in water. 1 ppm = 1 pound of a contaminant per million pounds of water (1 ppm in water = approximately 1 mg/L).

Pathogens – Live organisms that contaminate water such as bacteria, viruses, and parasites.

pH – A factor used to measure the acidity and alkalinity of water. Values for pH fall on a scale ranging from 0 to 14. Water that has a pH of 7 is neutral; water that is acid has a pH lower than 7 and water that is alkaline has a pH greater than 7. The secondary standard for drinking water is a pH between 6.5 and 8.5.

Pollutants – Man-made substances introduced to the environment that at high enough levels can make water unfit for human consumption or use.

Potable Water – Water fit for drinking.

Primary Drinking Water Standards – The Primary Drinking Water Standards are published, monitored, and enforced by the EPA. Primary standards regulate contaminants which pose serious health risks to the water user. The primary standards are only enforceable in public water systems and should be used as a guide for your personal drinking water well.

Private Water Systems – Any systems which do not meet the definition of public water systems, for example, a private individual water source, such as a residential water well. Private water systems are not regulated by the Colorado Department of Public Health & Environment or EPA.

Public Water System – In Colorado, a public water system is one that serves at least 15 connections (for example households) or at least 25 individuals. Colorado Department of Public Health & Environment and EPA regulations apply to public water systems.

Pure – Without contaminants or pollutants.

Radon – A tasteless, odorless, colorless radioactive gas formed from decay of uranium in rocks that has been found dissolved in some groundwater supplies. Activities that release radon as vapor from water include showering, bathing, and cooking. High concentrations of radon are known to be carcinogenic and are linked with increased risk of lung and other cancers.

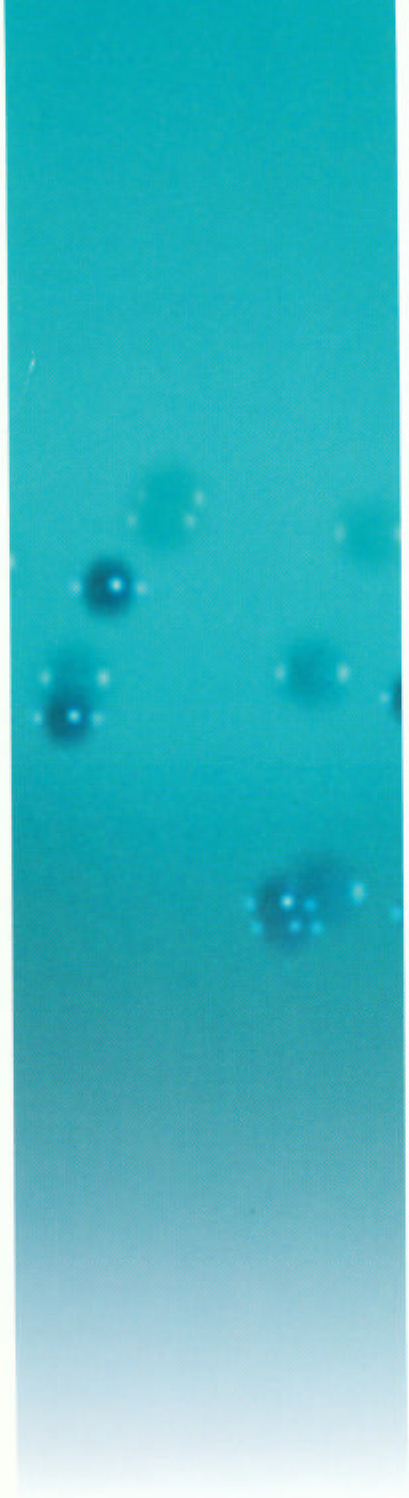
Safe – The level of a contaminant or pollutant is low enough that no health problems will occur.

Scale – Mineral deposits which build up on the inside of water pipes and water-using appliances, like coffee pots. It is primarily made of calcium carbonate and usually associated with hard water.

Secondary Drinking Water Standards – The Secondary Drinking Water Standards are published by the EPA. Secondary Standards set desirable/ acceptable levels for nuisance contaminants, which affect taste, odor, color, and other aesthetic and functional qualities of the water supply. These secondary standards are not enforced by law, but rather are guidelines for municipal water treatment plants and state governments.

Total Dissolved Solids (TDS) – A good general indicator of water quality, which measures the total amount of dissolved minerals, metals, and salts. Water with more than 500 milligrams per liter TDS is of marginal quality and may contain undesirable amounts of calcium, magnesium, sulfates, chlorides, or other salts.

Water Testing Glossary



Toxic Metals – Arsenic, Barium, Chromium, Mercury, Selenium, Lead, and other toxic metals are regulated by EPA Primary Drinking Water Standards. Toxic metals may be naturally occurring in rock and soil, or may pollute water as a result of runoff or leaching from industrial or agricultural sites or hazardous waste disposal.

Toxicity – The toxicity (poisonous effect) of a water contaminant depends on the concentration of the contaminant in the water and the period of time the contaminated water is consumed. Any chemical can be toxic, if you swallow enough of it. Also, people react differently to different toxic substances; some people may be harmed more than others. Pregnant and nursing women, the elderly, infants, ill or malnourished people, and people taking medication may be especially vulnerable to certain contaminants.

Turbidity – A cloudy condition in water due to suspended silt or organic matter.

Volatile Organic Chemicals (VOCs) – Synthetic compounds which evaporate readily and are difficult and expensive to detect. Primary Drinking Water Standards set limits for several volatile organic chemicals, including the solvents such as trichloroethylene and carbon tetrachloride, and the gasoline component, benzene. Tests for synthetic organic chemicals are not routine and tend to be fairly expensive because of the difficult and precise laboratory work involved.

Water Quality – Determined by these characteristics: safety, taste, color, smell, corrosivity, staining, and hardness.

Text for Water Quality Standards and Interpretation, and Water Testing Glossary are freely adapted from publications provided by the Pennsylvania Cooperative Extension, Oregon Cooperative Extension, Virginia Cooperative Extension and the Colorado Department of Public Health & Environment.

Additional Notes:

Helpful Water Web Sites

US Environmental Protection Agency

http://www.epa.gov
http://www.epa.gov/ogwdw/standards.html
http://www.epa.gov/safewater/ (stuff for kids to do)
www.epa.gov/safewater/dwinfo/co.htm

EPA Regulations (a summary)

http://www.epa.gov/safewater/source/therule.html

US Geological Survey

http://water.usgs.gov/
http://water.usgs.gov/ogv

Radon

http://www.epa.gov/iaq/radon/

American Petroleum Institute

http://www.api.org/edu/

Center for Drinking Water Optimization

http://www.cowo.org

Wilkes University Center for Environmental Quality

http://wilkesl.wilkes.edu/~eqc/helpguide.htm

University of Minnesota Extension Service - Water Resource Center

http://www.extension.umn.edu/water

The Groundwater Foundation

http://www.groundwater.org/GWBasics/whatisgw.htm

The Water Information Program - Southwestern Colorado

http://www.waterinfo.org/

National Groundwater Association

http://www.ngwa.org/public/public.html
http://www.wellowner.org/

Water Quality Association

http://www.wqa.org

US Water News Online

http://www.uswaternews.com