The American Well Owner

★ INFORMATION AND ADVICE ABOUT GROUND WATER, WELLS AND WATER SYSTEMS ★

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Independent Authority on Ground Water

Flooding and Water Wells

Message From The Publisher

Salty Water

With the US population increasing at 6,000 a day, the pressure on water resources is of growing concern. Over 50% of US drinking water comes from underground sources with approximately 110 million people supplied by utility wells and 40 million supplied from private wells.

Many of the major aquifers used by utilities are "maxed-out" or close to capacity. There is increasing attention being paid to desalination. While the oceans offer a limitless supply of potential water, engineers are also paying attention to the desalination of "brackish" ground water which has a lower salt concentration, and costs less than desalting seawater.

Worldwide there are more than 7,500 desalination plants. The world's largest plant in Saudi Arabia produces 128 million gallons a day. In the US, California and Florida already have desalination plants in operation. As desalting technology becomes more cost-effective, the environmental issues of energy use and brine disposal will become important aspects of water policy debate to be balanced against supply alternatives such as diverting rivers and building dams.

The water use by individual home and farm wells is spread over thousands of square miles of suburban and rural land whereas ground water use by many utility supplies is much more concentrated. As water planners in areas with rapidly growing populations grapple with water source issues, the use of individual home wells becomes more significant for national water supply. Every self-supplied home reduces the regional demand for water supply infrastructure. Most of the ground water supplied to homes is from small aquifer systems that could not feasibly be used as a utility supply source.

Technology is available for individual homes to "desalinate" but fortunately there are still vast amounts of unused fresh ground water in rural areas. We just have to make sure that it stays protected and that development does not exceed sustainability.

Andrew Stone

American Ground Water Trust

Through the fury of hurricanes Katrina and Rita, the Gulf Coast suffered one of the worst natural disasters ever recorded in the United States. During most natural disasters such as these, potable water is an essential resource that may be compromised. Reestablishing water supplies is an important first step in restoring stability to an impacted region. In some instances residential wells may be brought back on line quickly to fill the need for water. Aquifers are usually the safest water source because they are naturally protected from the effects of flooding. However, the water from a flooded well should not be used for drinking until it has been tested and, if necessary, disinfected to destroy bacterial contaminants. Testing should continue for several weeks after the event because some effects may not be felt immediately.

Water Quality ▶ There are several water quality aspects to consider. If the actual well has been covered by flood water, and the casing sticking out of the ground has been submerged, even for a short time, then it is likely that some surface water has entered the well.

1. High flood waters may result in the recharge to aquifers of water contaminated from broken fuel lines, damaged storage tanks, flooding or sewage treatment facilities, etc.
2. Excessive recharge from rainfall associated with flooding may raise water levels in aquifers and put ground water in contact with contaminants in the soil. This occurs when rising water table levels reach the leach fields of septic systems.
3. If the flooding is from a tidal surge in a coastal area, then there could be a temporary increase in sodium and chloride levels in wells.

Well Equipment ▶ Virtually all home wells use electric power to drive their well pump. The pumps are usually submersible (down in the well) or jet pumps (pump is at the surface). There are several aspects to consider with regard to starting up a pump after a flood or because of a regional power failure:
1. If the electrical controls (circuit board) for the pump have been flooded they should be disconnected, cleaned, dried and checked out by a qualified electrician before operating the pump.
2. Submersible pumps in wells with a properly fitted well cap and screened vent should not have been affected by debris and will likely have received only small amounts of sediment from the flood waters. However, above surface pump and motors that have been flooded should be disconnected, cleaned and dried then checked before restarting.
3. Regional power failures are an unfortunate feature of natural disasters. Back-up generators are often used by homeowners in such emergencies. However, there are some important safety rules that should be followed before hooking up to a generator. Go to http://www.agwt.org/info/pdfs/generators.pdf for basic information about generator use.

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To avoid potential short circuits and electrical problems the well pump should be disconnected from its electrical power source prior to connecting to a generator. Unless a generator input connection has been previously installed, the work will require a qualified electrician especially if the pump is a three-phase unit. The generator should be set up to run outside to prevent exhaust fumes (carbon monoxide) accumulating and creating deadly low oxygen conditions.

What to do after the flood ▶ Once you are ready to start the pump, the well purging, water testing and, the disinfection process can begin.

Purging ▶ Flooded wells should be pumped to get rid of water that may have entered during flooding. This will allow the subsequent chlorine disinfection process to work more quickly and effectively. The purged water is best run out via a garden hose. Pumping for at least an hour, or longer if the water is not yet running clear, should remove most of the water that might have entered the well. Water samples should be taken at the start and end of the purge process and tested for bacteria. If you suspect that oil or gasoline may have entered your well these "products" may be floating on the top of the well water and a contractor may be needed to remove them by a process known as bailing.

Testing ▶ Homeowners can disinfect wells to remove bacteria (the most common problem for flooded wells) but it is essential to have a more comprehensive laboratory test to ensure that the overall well quality has returned to normal.

Bacteria test kits are available in most hardware stores. Typical home bacteria tests take 24 hours to produce a result. By taking a sample during the well purging and after the disinfection phases, (in sterile bottles labeled with date and time), improvements in quality can be measured. Testing for most other contaminants is not really feasible for homeowners. A post-disinfection water sample should be sent to a certified laboratory for testing before using well water for drinking. As an additional safety precaution, iodine tablets approved for drinking water disinfection could also be used for a few weeks after a flood to further ensure the quality of water from the purged and disinfected well. Iodine tablets are available at most outdoor hiking, hunting or recreation stores (or their on-line outlets). Visit http://www.agwt.org/watertest.htm for basic information about water testing.

Disinfection ▶ Based on the concept of "better safe than sorry" the disinfection process is recommended for any well that has been impacted by flooding. The most user-friendly way to disinfect a well is to use chlorine based laundry bleach. The amount to use will depend on the volume of water in the well. Based on well depth and diameter, the water volume can be calculated using the following conversion factors:

4-inch diameter well = 0.65 gallons per foot
6-inch diameter well = 1.47 gallons per foot
8-inch diameter well = 2.61 gallons per foot

For every 50 gallons of water in the well one quart of laundry bleach will be needed (1 gallon of bleach will disinfect 200 gallons of well water at a chlorine concentration of about 200 to 300 ppm (parts per million) depending on bleach strength, aquifer characteristics and well construction). Bleach strength deteriorates in its container over time, so use bleach that is as fresh as possible. Do not use excessive amounts; more is not better.).

The chlorine bleach should be combined with water (chlorine-water mixture) prior to adding it to the well. Preparing a water/bleach mixture helps the liquid pour down the well. Go to http://www.agwt.org/bacteria_info.htm for a detailed description of the well disinfection process.

Emergency preparedness ▶

1. Make sure your well has a properly fitted well cap (Visit www.watersystemscouncil.org for well cap performance standards.)
2. If the top of your well casing is below the local historical or 100-year flood level, have a contractor raise the level by adding a couple of feet of casing
3. Have all your well information (depth/diameter), water test results, equipment specifications, etc. stored in one place
4. Raise the well circuit board above flood level
5. Have a professional electrician install a "plug-in" connection for a generator
6. Keep a supply of bacteria test-kits and iodine tablets on-hand
7. Ensure that you have two or three days supply of drinking water in bottles or containers

You may contact the American Ground Water Trust by e-mail at Trustinfo@agwt.org with questions about wells and ground water. Visit www.privatewell.com for additional information.

Corrosive Water

Corrosion is a chemical action that results in the gradual deterioration of metals by oxidation or chemical reaction on their surfaces. Corrosive water from a well can cause problems by dissolving metals and other substances. Corrosive water may have a metallic or bitter taste. The taste comes from metals leached from the aquifer rocks tapped by the well or from metals in the pipes in the home. Bluish-green staining on the plumbing fixtures from dissolved copper is a sign of corrosive water. Corrosive water may cause leaks in the plumbing system.

The most common cause of corrosion is low pH (acid) water. The US EPA recommends that drinking water have a pH between 6.5 and 8.5. [pH 7.0 is neutral] Low pH water can dissolve metal from the copper and lead in home plumbing systems. Lead was often used in pipe-joining solder in homes built before 1987 (Lead in solder used for home plumbing has been illegal since 1987). Low pH water may also have a low dissolved mineral concentration commonly described as low hardness or "soft" water. Some dissolved solids in water are necessary to control the corrosivity and create the "taste" of the water (perhaps 50 to 150 milligrams per liter [mg/L] depending on what elements are dissolved). The EPA recommends that the Total Dissolved Solids (TDS) should be less than 500 mg/L. Dissolved solids in water commonly include bicarbonate, chloride, sulfate, phosphate, nitrate, calcium, magnesium and sodium.

Corrosive Water Clues

- Bluish-green staining on sink, toilet, bathtub surfaces and plumbing fixtures.
- Metallic or bitter taste to water when first drawn in the morning after setting idle all night.
- Pinhole leaks in plumbing system.

When problems due to corrosive water conditions are present, there are several options to fix the situation. These options should be considered on a case by case basis to assess the advantages of each approach:

1. Replace the plumbing in the home ▶ Replacing the metal piping may be appropriate, especially if the length of piping is relatively short. The entire length of pipe for a drinking water line should be replaced otherwise some corrosion will continue to occur in the remaining metal pipes. Plastic piping may be used as an alternative to copper piping, however, not all-plastic piping is designed for household plumbing use. Plastic piping certified by the National Sanitation Foundation for drinking water plumbing systems will have "NSF" and "Drinking Water" printed on the side of the pipe.

2. Treat the water to reduce the level of corrosivity ▶ Low pH is the most common cause for corrosive water. It may be treated with relatively simple neutralizing beds of calcium carbonate (limestone and marble) or other alkaline material (magnesium oxide) in a tank that can treat all the water entering the home (a "Point of Entry" or POE system). The system adds calcium to the water to raise the pH to the pH 7 neutral point. The process will increase the "hardness" level of the water and neutralization above pH 7 is not recommended.

Causes of Corrosive Water

- Low pH (acid water)
- Low dissolved mineral content
- High dissolved oxygen content

3. Treat the water to reduce the products of the corrosivity (dissolved metals) ▶ Reducing corrosivity is the preferred solution, but installing equipment to remove the dissolved metals is an option. Water softeners can reduce iron levels, in some cases up to levels of 25mg/L. Two common iron treatment methods are catalytic oxidizing filters and oxidation-filtration systems. If iron bacteria are present then chlorination or ozonation may also be required. Lead and copper levels can be reduced or removed by catalytic activated carbon filters, reverse osmosis systems, activated alumina adsorption or by distillation.

Some electricians use plumbing pipes as a route for "earthing" a home's electrical system. In some cases, especially if there is an appliance with an electrical earth leak, this may increase pipe corrosion. Don't disconnect the earth wires yourself, but have a qualified electrician reroute the electrical earthing system so it bypasses the home's plumbing.

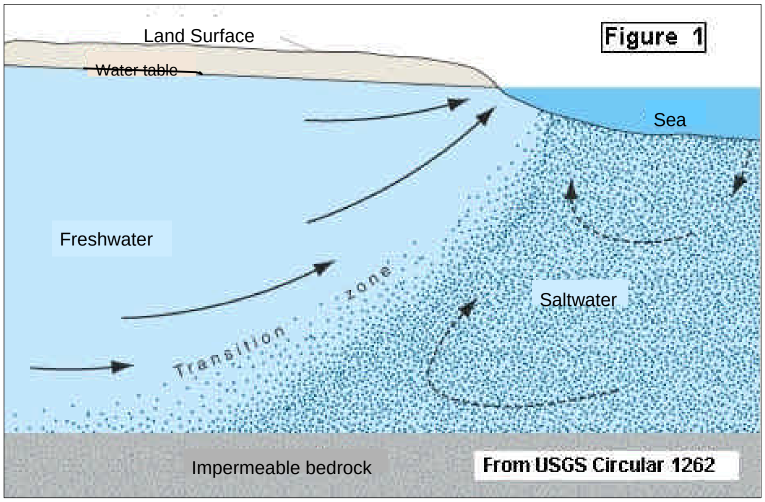
Although the corrosivity of water may not be severe enough to cause the plumbing to fail or affect cooking utensils, the levels of dissolved metals such as copper and lead may be elevated above EPA drinking water Maximum Contaminant Levels (0.015 mg/L for lead and 1.3 mg/L for copper). These metals leach out of the plumbing in proportion to the length of time that corrosive water is in contact with the pipes, so the highest concentrations of lead or copper will occur in the first use of water after the water has been idle in the pipes overnight. To test that the water has naturally low values for these metals, a second sample should be tested after the water has run for 3 to 5 minutes. If this second sample is free of detectable lead and copper, the water may be used for drinking provided the plumbing lines are flushed. To conserve water, a pitcher of the "metal-free" water may be collected for use during the rest of the day.

The flushing method to obtain drinking water is not an ideal permanent solution, especially if young children are in the home. Relatively inexpensive Point-of-Use (POU) treatment systems can be installed to remove the metals at specific taps around the house. POU systems are an option when only a small amount of water is needed for cooking or drinking. Reverse osmosis and activated alumina adsorption systems are examples of POE methods that are effective for lead and copper removal.

For more information visit: http://www.agwt.org/waterconditioning.htm

Ground Water at the Coast

Ground water is always on the move in response to the force of gravity. Most ground water eventually finds its way to streams and rivers and then to the oceans. For areas adjacent to oceans, ground water may flow seawards and eventually discharge directly into the ocean. At some point, the fresh seaward flowing ground water meets the saline ground water that is usually found in the rocks beneath the ocean. The zone where fresh and salty ground water meet is called the "saline/fresh water interface." Where there is a strong flow of fresh ground water, the position of the interface may be some distance off shore. There are many reports from divers about freshwater springs occurring on the ocean floor. However, if there is considerable pumping of freshwater from coastal aquifers then the interface may occur inland. The movement of salty ground water inland because of on shore pumping is called saline or salt water intrusion.

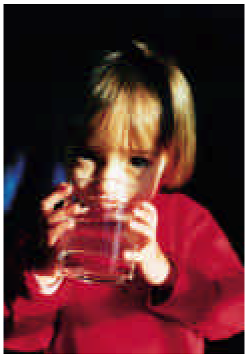


Fresh water has a density of 1.0, and salt water has a density of about 1.025. In theory, fresh ground water should float on salty ground water. However, because of the dynamics of flow, the interface between salt and fresh usually occurs at an angle, as shown in the USGS diagram. (Fig. 1). The salt/fresh boundary is a transition zone of mixing and not a sharp divide.

In the coastal aquifer cross-section (Fig. 1), the salt water zone forms a wedge shape under the fresh water.
As the layer of fresh ground water above sea level in coastal aquifers increases in thickness, because of recharge from precipitation, it displaces ("pushes out") salt water. Based on density differences, for every one foot of freshwater in the aquifer above sea level, the position of the salt water interface should be 40 feet below sea level. This relationship between salt and fresh water in coastal aquifers is called the Ghyben-Herzberg relationship by hydrologists, and is named for the two Europeans who first described it in the late 19th century.

Pumping coastal-area wells can move the salt water interface landward and/or upwards toward the well by reducing the volume of freshwater "pushing" the salt water toward the sea. Coastal aquifers worldwide have been impacted by pumping and land use changes. For example, the position of the interface in coastal aquifers in southern California and Florida is closely monitored so that freshwater pumping can be stopped if the interface moves too far inland.

For more information on saltwater intrusion go to: USGS: http://pubs.usgs.gov/circ/2003/circ1262/#boxf



AMERICAN GROUND WATER TRUST
16 Centre Street, Concord, New Hampshire 03301
☏ (603) 228-5444 ✯ 🖷 (603) 228-6557
TrustInfo@agwt.org ✯ www.agwt.org

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