Disinfecting Drinking Water After a Flood

Water Quality Association
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The Water Quality Association, based in Lisle, Illinois, is a not-for-profit international trade organization representing the residential, commercial, and industrial water treatment industry. WQA is a resource and information source, a voice for the industry, an educator of professionals, a laboratory for product testing, and a communicator with the public. For more information visit www.WQA.org or call us at 630-505-0160.

The Water Quality Association provides technical information as a service to its members, policymakers and the general public. WQA’s intent is to promote discussion on key water quality related issues through reliable, verifiable facts and data.

Boil Water Alert Public Health Concerns

It is recommended to follow the boil water alert and take drinking water treatment systems (i.e. water softeners; reverse osmosis) offline. Disinfect the water treatment system separately following manufacturer’s instructions or the cleaning and sanitizing guidelines below. Wait until the public water system has lifted the boil water alert and has said the water is safe to drink before reconnecting the water treatment system.

What is a Boil Water Alert?

There are 153,530 public water systems (PWSs) in the U.S. supplying drinking water to customers every day. A boil water alert is issued by a PWS when there is a known or suspected microbial contaminant in the drinking water distribution system. A boil water alert may be issued in response to a known event or as a precautionary measure to protect the public in case microbial contaminants are present. The microbes could be viral, bacterial, or protozoan, any of which can cause severe health issues. The alert will instruct residents to boil all water used for drinking, cooking, food preparation, brushing teeth, and making ice. Bathing and showering is typically fine as long as no water is accidentally ingested. The most sensitive populations to microbial contaminants include children, the elderly, and those with compromised immune systems.

How does a Boil Water Alert differ from a Do Not Drink or Do Not Use notice?

A Do Not Drink or Do Not Use notice may indicate chemical contamination and advises consumers to find alternative drinking water sources because boiling will not make the water safe for these specific contaminants. This type of notice advises residents to avoid contact with the water.

For more information on a boil water alert notice, consult the municipality, water district, or regulatory agency that has oversight for the water system. Knowing the specific circumstances of the boil water alert will help you determine your next actions.

For more information on disinfection contact a water treatment provider in your area and certified water treatment professionals who have completed WQA’s professional certification program. Visit WQA’s website for a searchable database: http://www.wqa.org/find-providers or Texas WQA at: https://twqa.org/
Sanitizing Water-Using Appliances in Water Emergencies and Well Disinfection Procedures

Disasters, such as floods and earthquakes can gravely compromise public water systems. The conventional and highly appropriate response of municipalities, health departments, and other regulatory agencies in times of water emergencies is to notify all consumers to boil all water used for drinking or culinary purposes until bacteriological samples demonstrate that the water is safe, and/or until appropriate corrective actions have been completed.

Water treatment professionals, dealers, and most importantly, individual customers must be aware that many home water treatment equipment products (including reverse osmosis systems) do not provide total protection against all types of disease-causing microorganisms that may be present in contaminated drinking water. In many cases, products will be labeled with a statement such as: "Do not use with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system." Recommendations made in all cases should follow the manufacturer’s instructions, if available.

Each manufacturer's equipment is different, and appropriate cleaning and sanitizing procedures may also differ accordingly. Following evidence of serious potential disease-causing contamination or in flood or other disaster stricken areas and after the discontinuance of a Boil Water Alert (BWA) has been issued and the water supply has been declared safe to use and drink, several sanitization steps should be taken to ensure that water treatment equipment is ready to use again. Similarly, residents who get water from a well must be concerned about contamination of their water supply and should follow basic procedures to clean and sanitize their well and water treatment equipment before use, whenever a water test indicates that well contamination has occurred.

Recommended Cleaning and Sanitizing Guidelines for Water Using Appliances Following Discontinuance of a Boil Water Advisory

* Courtesy of EcoWater Systems, Inc., St. Paul, Minnesota

Before Beginning the Sanitizing Process
With lower risk BWA situations where no actual microorganism contamination or waterborne illnesses have occurred, routine equipment sanitation will suffice following a BWA. In judging the significance or degree of actual water safety impairment that may have occurred during a BWA, the water assessment may be discussed with state or local health/environmental protection agency officials. Where health-related contamination or illnesses have been confirmed, the first step toward equipment sanitization is to determine that the BWA has been lifted and that the water supply is again safe to use and drink. This information is available by contacting your municipal water supplier or the applicable regulatory agency.

Homeowners with their own private well system need to "shock chlorinate" their well. Shock treating a well involves using a household bleach* solution to flush out the entire system. Water should be checked after each treatment by a qualified laboratory to ensure that it is safe to drink. Specific instructions for shocking wells are described in in the section well disinfection below, or may be obtained from your local department of health or a pump installer.
Basic Preparation

- Drain all water from water using appliances such as water heaters and cartridge filters (be sure that the power or gas to the water heater is turned off). Refer to the article sections below for basic preparations for water softeners, backwashing filters, and reverse osmosis (RO) units. For ice makers, discard all ice and beverages made with the questionable water; remove any water treatment device and flush the service line with disinfected water for two minutes, place the new water treatment unit in line, run two additional ice making cycles, discard all this ice and clean the ice reservoir.
- Remove all debris, mud, silt, etc. from inside and outside of the appliance, and clean exterior and interior surfaces with a disinfecting cleaner such as Lysol. Be certain the cleaner to be used is recommended by the equipment manufacturer as being compatible with this product.
- If the appliance has been partially or fully submerged in water, make sure electrical components are completely dry.
- You are now ready to begin the sanitizing procedure. Please follow the steps outlined below and as previously described in this text for each water-using appliance.
- Handle all disinfectants with care; refer to the label on the bleach bottle for safe handling, and use disinfectant chemicals certified to NSF/ANSI Standard 60. Do not use scented or unscented bleach.

Procedure for Water Softeners

- Flush and backwash the softener repeatedly with potable water until the water runs clear. In extreme cases, the resin may have to be removed and either cleaned or replaced. The interior of the mineral (resin) tank should then be cleaned and disinfected before replacing the resin.
- Remove the salt tank and brine well covers. Note the level of water existing in the brine tank and brine well. Remove the salt, and discard all the wet salt and existing water from the brine tank.
- Clean the brine tank with disinfectant.
- Replace the dry salt and/or add new salt to the brine tank.
- Add chlorinated water (i.e., water with three teaspoons [0.5 ounce] of household bleach mixed per gallon of water) to the previous level of water existing in the brine tank.
- Pour about 1-3 ounces of 5.25% household bleach per cubic foot of resin directly into the softener brine well.
- Replace the covers.
- Initiate an immediate regeneration cycle. The bleach is drawn into and through the resin bed and other internal passages of the softener to sanitize it.

Note: On a twin system you must sanitize twice (once for each tank)
Procedure for Carbon Filters/Water Refiners

- With carbon filters and other water filters, remove and discard the old filter cartridge, wash the sump and head with household detergent and bleach and insert a new cartridge filter.
- For a whole-house carbon tank filter or a water softener which contains carbon, empty the entire mineral bed. Thoroughly clean the empty unit inside and out with a household bleach and water solution. Rebed the unit using new carbon or resin/carbon mix.

Procedure for Reverse Osmosis (RO) Systems

- If in doubt about the significance or degree of water contamination, discontinue using the RO system product water, and test the product water coming from the RO system for microbiological contamination. If the RO product water is microbiologically contaminated, then proceed to the following steps. If the product water is not contaminated, you may go to the alternate procedure below.
- Turn off the water supply to the RO unit, and open the RO faucet to relieve pressure and drain the RO storage tank. Close the shutoff to the RO storage tank.
- Remove and discard the prefILTER and postfilter (refer to owner’s manual).
- Remove the RO membrane and either replace it with a new membrane or disinfect the membrane in accordance with the manufacturer’s instructions.
- Fill the RO housing (single tank models) or prefILTER sump (dual sump models) with water to about 1" from the top. Add 1 ounce (two tablespoons) of common 5.25% household bleach to the RO housing and the prefILTER sump and mix in RO Tank & Assembly water.
- Reassemble the RO without the RO membrane and filter cartridge elements in place.
- Reopen the water supply to the RO and the tank shutoff valve. Open the RO faucet and allow water to run until you can smell the bleach.
- Close the RO faucet, and wait until the storage tank fills.
- Let the entire system stand in contact with the chlorine/water solution for 20-30 minutes.
- Open the RO faucet again, and leave it open until the water has circulated through the system and all bleach odor is gone. Let the RO storage tank drain completely.
- Turn off the water supply to the RO. Close the RO faucet after the water flow stops.
- Install a new or disinfected RO membrane, prefILTER, and postfilter.
- Open the water supply to the RO.
- Discard the first tankful of water following membrane replacement.
Alternate RO Disinfection Procedure

If the test of the RO product water shows no sign of microbiological contamination, a preventative cleaning and sanitization of the entire RO system's housings, tubing, storage tank, and in-place membrane element may be accomplished with a moderate application of chlorine bleach to reduce any future colonization and growths of microorganisms in the system.

- Turn off the water supply to the RO unit, and open the RO faucet to relieve pressure and drain the RO storage tank. Close the shutoff to the RO storage tank.
- Remove and discard the pre-and postfilters and remove the RO membrane element.
- Clean and disinfect the filter sumps, the filter heads, and the RO membrane housing and end caps.
- Fill the first prefILTER sump with water to within about one or two inches from the top and add one ounce (2 tablespoon or 6 teaspoon) of 5.25% household bleach; carefully reassemble this first prefILTER sump with the chlorine/water mixture but without its filter cartridge element in place.
- Reassemble all remaining housings without their membrane element and filter cartridge elements in place.
- Open the water supply to RO, and open the shut off to the RO storage tank.
- Open the RO faucet, and allow water to run until you can begin to smell the chlorine bleach.
- Close the RO faucet, and allow the storage tank to fill and then remain full for 25-30 minutes.
- Open the RO faucet again, and leave it open until all the bleach odor is gone. Let the RO storage tank drain completely.
- Turn off the water supply to the RO. Close the RO faucet after all pressure has been relieved and the water flow stops.
- Install all new pre- and postfilter elements, using careful aseptic techniques so as not to again contaminate the RO system.
- Reinstall the RO membrane element in its housing, also fill the membrane element housing with water and one milliliter (20 drops) of 5.25% household bleach solution, and reassemble this membrane element, chlorinated water, and housing unit.*
- Immediately reopen the water supply to the RO system and open the RO faucet. Let water drip from the RO faucet until the odor of chlorine has dissipated.
- Finally, close the RO faucet, let the storage tank completely refill, and discard the first tankful of water following the completion of this procedure.

* CAUTION: High levels of chlorine over an extended period of time will degrade polyamide RO membranes, although significant degradations should not occur in these specified few minutes of chlorine contact time. After completion of Step 12 above, immediately go to Step 13 and complete the procedure.
Procedure for Water Heaters
For municipal water users:

- When the softener regeneration cycle is completed, refill the water heater by turning on a hot water faucet nearest the hot water heater. Leave the faucet open until water flows smoothly without air bursts. Turn off the faucet.
- This will flush out the water heater. The heater and softener are now clean and ready to use again.

For well water users:

- Prior to shock chlorinating your well, disconnect the water heater’s power source following the manufacturer’s instructions. Drain the water heater.
- Then reopen the valve to the water heater and a hot water faucet while shocking the system so the chlorinated water runs through the heater and rids it of contaminated water.

Procedure for Well Disinfection
Harmful bacteria and viruses can contaminate the water from newly constructed wells if care has not been taken to disinfect the well and pumping equipment thoroughly. It is also possible that bacteria and other organisms may be introduced into a well or plumbing system when repair or maintenance occurs. Wells and plumbing systems should always be disinfected following new construction or repair. Also, wells and plumbing systems should always be disinfected if the well or pump room has flooded.

Note that a number of states and local regulatory bodies only allow licensed well drillers and pump installers to perform well disinfection. Check local regulations before beginning any work.

Well caps and seals are integral to the sanitary safety and integrity of drinking water wells. They are often regulated by the state and local codes. Be certain to comply with all applicable codes and well driller/pump installer licensing laws, whenever opening a well. In wells equipped with a removable plug or an air vent in the sanitary well seal, the chlorine solution may be introduced by removing the plug or air vent. Do not attempt to remove the sanitary well seal without the help of a qualified pump installer. Also do not loosen the bolts that compress the seal. Shallow well jet pumps must be disconnected in order to disinfect the well [National Groundwater Association].

Step 1: Remove debris from the well

- Debris removal by way of pump and surge is an important first step before chlorine is introduced to the system. If debris and sludge are not removed, it poses a risk for developing disinfection by-products and makes the chlorine less effective in the disinfection process.
- Flush and pump until clean, clear water is coming through.
- Recirculate clean water, re-flush when necessary and recirculate again [National Groundwater Association]

Step 2: Gather necessary information about the well.

- Start by gathering the following specifications of the well: including depth, static water level, and volume of water in the well [National Groundwater Association].
• Check the pH level of the well water before introducing chlorine. When pH is below 5.0 free chlorine gas will release which is dangerous to inhale. If the pH is below 7.5, some hypochlorous acid will be present and introduction of the disinfectant should proceed.

Step 3: Bypass water treatment equipment; drain water heater.
• Place any water treatment equipment in to the bypass mode. Failure to do so could result in a breakdown of the treatment media and materials.
• Turn off and drain the water heater

Step 4: Mix the Chlorine Solution
• A concentrated solution of chlorine in water is the simplest product for disinfecting wells. A solution of chlorinated water may be prepared by dissolving calcium hypochlorite, or by diluting sodium hypochlorite bleach, in water, according to the ratios in Table 1. This should provide a solution of about 50 parts per million (ppm) or milligrams per liter (mg/L) of chlorine.
• Calcium hypochlorite is a white, granular material containing approximately 70% chlorine by weight and is available in both powder and tablet form. This material is relatively stable and will maintain 90% of its strength over several months if stored in a cool, dry location.
• Sodium hypochlorite is available only in liquid form. Common laundry bleach, available from most grocery stores, usually contains 5.25% chlorine. Sodium hypochlorite solutions are caustic and must be handled carefully. They are also somewhat unstable and should not be depended upon to remain at full strength after storage for more than 60 days.
• It is important that calcium hypochlorite or sodium hypochlorite not contain other chemicals or additives, such as stabilizers, perfumes, or algicides.

Table 1.
In the case of large diameter dug wells, a greater quantity of chlorine solution may be required to accomplish the disinfection. As a general rule, one gallon of laundry bleach will be necessary for 1000 gallons of water to achieve a chlorine concentration of 50 parts per million.

Approximately 10 ounces of granular calcium hypochlorite dissolved in one gallon of water would be equivalent to one gallon of common household laundry bleach. Flooded wells, wells with sediment, iron or iron bacteria may require higher than normal chlorine concentrations or may require more than one disinfection.

To achieve a chlorine concentration of 200 parts per million for well repair, or shock chlorination to reduce iron bacteria, multiply the quantities in the table by four.

Step 5: Open the Well

- CAUTION — Well caps and seals are integral to the sanitary safety and integrity of drinking water wells. They are often regulated by the state and local codes. Be certain to comply with all applicable codes and well driller/pump installer licensing laws, whenever opening a well. If you are unsure of any of the following steps, seek the assistance of a qualified or licensed well driller or pump installer.
- A well with a submersible pump can usually be disinfected by removal of the well cap.
- In wells equipped with a removable plug or an air vent in the sanitary well seal, the chlorine solution may be introduced by removing the plug or air vent. Do not attempt to remove the sanitary well seal without the help of a qualified pump installer. Also, do not loosen the bolts that compress the seal. (See Figure 1.)
- Wells equipped with a packer jet pump can be thoroughly disinfected only through removal of the pipe and jet unit from the well.
- Shallow well jet pumps must be disconnected in order to disinfect the well.

Figure 1.
Step 6: Add the Chlorine Solution

- As you are adding the chlorine solution, take safety precautions to protect yourself from splashing and fumes. Protect your eyes with goggles. Wear protective gloves and clothing.
- Pour the chlorine solution into the well. Avoid pouring the chlorine solution on the pump wire connections.
- Where the well is relatively deep, the disinfectant may be dispersed to the bottom by alternately starting and stopping the pump several times. If possible, place a garden hose in the top of the well, turn on the faucet, and circulate the chlorine solution for 15 minutes or until a strong chlorine smell is detected.
- Allow the chlorine solution to remain in the well for at least two hours.
- Recap the well.

![Well Disinfection](image)

Step 7: Disinfect the Plumbing System

- Water should be pumped from the well into the pressure tank and plumbing system. All water faucets should be turned on in the house and all outside fixtures including yard hydrants, watering troughs, and any supply lines to barns or other buildings until the odor of chlorine is evident, at which time the faucets should be turned off.
- The chlorine should be left in the well and plumbing system for a minimum of 4-6 hours for concentration of 50 ppm chlorine. Two hours should be adequate contact time for 100 ppm concentration of chlorine.

Step 8: Remove the Chlorinated Water

- After the chlorine has been left in the well and plumbing system for a minimum of two hours, the chlorinated water can be discharged. Large amounts of chlorinated water should not be discharged into the septic tank or onto lawns or gardens. If possible, discharge as much of the water as possible through an outside faucet with a hose attachment. The small amount of
chlorinated water which remains in the household plumbing can be discharged into the septic system.

**Step 9: Reattach the Hot Water Heater and Water Softeners**
Backwash softeners, flush the water heater, and replace all filters.

**Step 10: Retest the Water System**
For wells and plumbing systems that have bacterial contamination or have been flooded, resample the water, and have it tested after all chlorine has been removed. Disinfection will need to be repeated if bacteria are present in the water sample. Until a safe test result is obtained, use an alternate known safe source of water or boil all water used for drinking, food preparation, or ice making for at least five minutes. *Note: If several disinfection attempts were necessary before a safe sample was obtained, it is advisable to resample several times at weekly intervals to assure that the water remains safe.*